Big Valley Groundwater Basin Advisory Committee (BVAC)

Unapproved Meeting Minutes

BVAC Members:

Lassen County BVAC – Aaron Albaugh, Board Representative; Gary Bridges, Alt. Board Representative; Kevin Mitchell, Public Representative; Duane Conner, Public Representative
Modoc County BVAC – Geri Byrne, Board Representative; Ned Coe, Alt. Board Representative; Jimmy Nunn, Public Representative; John Ohm, Public Representative

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Wednesday, October 6, 2021 | 2:00 PM | Veterans Memorial Hall
657-575 Bridge Street
Bieber, CA 96009

BVAC Convene in Special Session.

Present: Committee Members: Byrne, Albaugh, Mitchell, Conner, Ohm, and Nunn.
Absent: Committee Members: None

Also in attendance: BVAC Secretary Maurice Anderson
BVAC Staff Tiffany Martinez
BVAC Staff Gaylon Norwood
BVAC Recorder Brooke Suarez
Alt. Board Representative Gary Bridges

BVAC Chairman Byrne called the meeting to order at 2:21 p.m. She read the public comment rules for the meeting.

Flag Salute: Chairman Byrne requested Representative Mitchell lead the Pledge of Allegiance.

General Update by Secretary: Secretary Anderson just had a general comment that hopefully the BVAC, even though they disapprove of having to go through this process, comes to a consensus on the GSP and provides it to both the counties' Boards of Supervisors.

Matters Initiated by Committee Members: Vice-Chairman Albaugh gave kudos to staff for the work they have put into the GSP. He also told GEI representative D. Fairman that GEI's quality of work and content is disappointing. He recommended that GEI refund monies back to all parties involved.

Representative Ohm stated that he had ties to other counties and was concerned that the fees for implementing the plan in those counties are going back to the land owners. He knew of a particular instance of a Glenn County 6,000 acre land owner who is paying $12,000 per year towards the implementation fees. Ohm feels this needs to be addressed now.

Correspondence (unrelated to a specific agenda item): None

Approval of Minutes (September 9, 2021) –

> **A motion was made by Vice-Chairman Albaugh to approve BVAC meeting minutes from September 9, 2021 with changes. The motion was seconded by Representative Ohm. The motion was carried by the following vote:**
>
> **Aye:** 6 – Byrne, Albaugh, Mitchell, Conner, Ohm, and Nunn.

Laura Snell facilitated the meeting.

SUBJECT #1:
Introduction of the Revised Draft Groundwater Sustainability Plan (GSP – *all chapters)*

ACTION REQUESTED:

1. Receive reports from the pertinent ad hoc committees, BVAC Secretary, Staff, and/or Consultant.
2. Receive public comment.
3. Adopt a resolution recommending that the Big Valley Groundwater Sustainability Agencies (GSAs) each conduct a public hearing to consider adoption of a Groundwater Sustainability Plan for the Big Valley Groundwater Basin.

Tiffany Martinez went over the schedule for the final steps of the GSP. She stated DWR has two years to review the GSP. If DWR disapproves the GSP with deficiencies, the GSAs have 180 days to address those deficiencies. She also reviewed the changes to Chapters 1 and 2. She reported on the September 21st ad hoc committee's changes.

Committee comment: Committee members had many verbiage and grammar changes. Vice-Chairman Albaugh pointed out where DWR had made assumptions instead of using science. Chairman Byrne pointed out that the percentage of the basin in each county was not consistent where it was listed.

D. Fairman presented changes to Chapters 3 through 6. He had a handout of those changes (Exhibit A).

Committee comment: Committee members had many verbiage changes. Vice-Chairman Albaugh told GEI to be consistent with reference to the 144 acres. The words “is”, “about” and “approximately” were used prior to the same referenced 144 acres in different places. Also get rid of the word “managed” in regard to the wetlands. Vice-Chairman Albaugh told GEI they need to be consistent with the footnotes as well. He also stated that D. Fairman should contact Brian Hutchinson regarding the correct wording for line 640 and then send it to Representatives Ohm and Nunn to proof.

Motion to Recess:

> **A motion was made by Vice-Chairman Albaugh to take a brief break period. The motion was seconded by Representative Ohm. The motion was carried by the following vote:**
>
> **Aye:** 6 – Byrne, Albaugh, Mitchell, Conner, Ohm, and Nunn.

Break: 3:48 pm to 4:04 pm.

Representative Nunn left the meeting during the break.

G. Norwood presented changes to Chapters 7 through 12. He noted that text was added to summarize Lassen County’s requests to the governor to extend the GSP deadline. He handed out the Executive Summary and a cover page sample for the GSP, exhibits B and C. Exhibit D, which listed some public comment, was handed out also.

Committee comment: Committee members had many verbiage changes. Vice-Chairman Albaugh wanted to be sure that staff included GSP changes in the Executive Summary as needed. Discussion was held on the choice of the photo for the cover. Staff will choose a new picture to put on the cover in consultation with the chair and vice chair.

Public comment: None

Online comment: Julie suggested legal references be added for lines 369-370. She also questioned the areas with no color in Figure 5-17 as she did not see anything in the legend. Ian Espinoza gave the definition for a perennial stream and that a perennial stream would not preclude it from being considered interconnected. Doreen Smith Power found fault in the way public comments were being handled and not being taken into consideration.

Further discussion was held regarding the resolution as well as the time line of the GSP going forward. D. Fairman said there will be organizations that will wait until the last minute to provide public comment. T. Martinez stated for the record that various groups have been asked to respond to the GSP and they said that they will wait for the 30-day comment period to respond.

Matters Initiated by the General Public (regarding subjects not on the agenda)**:** None

Establish next meeting date: Special Meeting October 20, 2021 at 5:00 pm in Adin.

Adjournment: There being no further business, Chairman Byrne adjourned the meeting at 6:08 pm.

RESOLUTION NO. ________

RESOLUTION OF THE BIG VALLEY GROUNDWATER BASIN ADVISORY COMMITTEE MAKING RECOMMENDATION TO THE LASSEN AND MODOC COUNTY GROUNDWATER SUSTAINABILITY AGENCIES REGARDING A GROUNDWATER SUSTAINABILITY PLAN.

WHEREAS, in September 2014, the Governor signed into law a legislative package (three bills), collectively known as the Sustainable Groundwater Management Act (SGMA), which requires local agencies with land use and/or water management or water supply authority to do certain things to reach sustainability of medium and high priority groundwater basins as designated by the State of California Department of Water Resources (DWR). SGMA became effective on January 1, 2015; and

WHEREAS, the Big Valley Groundwater Basin (BVGB) has been erroneously designated a medium priority basin by the DWR; and

WHEREAS, the Lassen and Modoc County Board of Supervisors adopted resolutions (17-013 and 2017-09 respectively) declaring themselves to be the Groundwater Sustainability Agency (GSA) for the portion of the BVGB within their respective jurisdictions; and

WHEREAS, GSAs are required to develop Groundwater Sustainability Plans (GSP) for all medium and high priority basins, and said GSP for the BVGB is to be submitted to the DWR by January 31, 2022; and

WHEREAS, the Big Valley Groundwater Basin Advisory Committee (BVAC) was formed through a memorandum of understanding (MOU) to advise both the Lassen and Modoc County GSAs on the preparation of a GSP for the basin; and

WHEREAS, the BVAC has held approximately fifteen public meetings to review and propose draft text for a GSP and to receive and consider public comment from local stakeholders; and

WHEREAS, a revised draft GSP has been assembled with BVAC guidance.

NOW, THEREFORE, BE IT RESOLVED AS FOLLOWS:

1. The BVAC hereby recommends that the GSAs receive the Draft Groundwater Sustainability Plan, including incorporation of all edits and corrections identified at the October 20, 2021, meeting of the BVAC.

2. The BVAC hereby recommends that the GSAs (or GSA staff) initiate a 30-day public comment period for the Draft Groundwater Sustainability Plan.

3. The BVAC hereby recommends that each GSA conduct at least one public hearing to consider adoption of said Groundwater Sustainability Plan, as is required by the Sustainable Groundwater Management Act.

4. The BVAC hereby recommends that the GSAs provide direction to staff, consultants or others to make any edits or corrections the GSAs may identify and adopt and submit the final Groundwater Sustainability Plan to the Department of Water Resources by January 31, 2022.

PASSED AND ADOPTED at a regular meeting of the Big Valley Groundwater Basin Advisory Committee, on the 20th day of October 2021, by the following vote:

AYES: ______________________________

NOES: ______________________________

ABSTAIN: ______________________________

ABSENT: ______________________________

____
Chairman
Big Valley Groundwater Basin Advisory Committee

ATTEST:

____
Maurice L. Anderson, Secretary
Big Valley Groundwater Basin Advisory Committee

Big Valley Groundwater Sustainability Plan

Public Review Draft
October 2021

No. 5-004 Big Valley Groundwater Basin

Prepared by:

Big Valley Groundwater Sustainability Plan

Revised Draft October 18, 2021

Prepared by:

Lassen County Groundwater Sustainability Agency	Modoc County Groundwater Sustainability Agency

Board Members

Lassen County	Modoc County
Aaron Albaugh, Chair	Ned Coe, Chair
Chris Gallagher, Vice-Chair	Geri Byrne, Vice-Chair
Gary Bridges	Kathie Rhoads
Jeff Hemphill	Elizabeth Cavasso
Tom Hammond	Vacant

County Staff

Department of Planning and Building Services
- Maurice Anderson, Director
- Gaylon Norwood, Assistant Director
- Nancy McAllister, Associate Planner
- Brooke Suarez, Fiscal Officer
- Dana Hopkins, Administrative Assistant

Tiffany Martinez, Assistant County Administrative Officer

Big Valley Groundwater Basin Advisory Committee

Lassen County	Modoc County
Aaron Albaugh, Board Representative, Vice-Chair	Geri Byrne, Board Representative, Chair
Gary Bridges, Alt. Board Representative	Ned Coe, Alt. Board Representative
Kevin Mitchell, Public Representative	Jimmy Nunn, Public Representative
Duane Conner, Public Representative	John Ohm, Public Representative

Technical Team

Laura K. Snell, University of California Cooperative Extension, Modoc County
David F. Lile, University of California Cooperative Extension, Lassen County
Claire K. Bjork, University of California Cooperative Extension, Modoc County
David Fairman, GEI Consultants
Rodney Fricke, GEI Consultants
Chris Petersen, GEI Consultants

Other Acknowledgements

Stacey Hafen, Executive Director North Cal-Neva Resource Conservation and Development Council
Jason Housel, Lassen County Information Technology

The Basin Setting (Chapters 4-6) was developed under the direction of Professional Geologists:

{STAMP}	{STAMP}
David Fairman Professional Geologist 9025	Rodney Fricke Professional Geologist 4089

Cover photo credits: Pivot: Laura Snell, Deer in Alfalfa: Kim Steed Photography

<< Insert GSA Resolutions Adopting the Plan Here >>

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Acronyms and Abbreviations

ACWA	Ash Creek Wildlife Area
AF	acre-feet
AFY	acre-feet per year
AgMAR	Agriculture Managed Aquifer Recharge
ASR	Aquifer Storage and Recovery
Basin	Big Valley Groundwater Basin
Basin Plan	Water Quality Control Plan
bgs	below ground surface
BIA	U.S. Bureau of Indian Affairs
Big Valley	Big Valley Groundwater Basin
BLM	U.S. Bureau of Land Management
BMO	Basin Management Objective
BMP	Best Management Practices
BVGB	Big Valley Groundwater Basin
BVAC	Big Valley Groundwater Basin Advisory Committee
BVWUA	Big Valley Water Users Association
C&E	communication and engagement
CAL FIRE	California Department of Forestry and Fire Protection
CASGEM	California Statewide Groundwater Elevation Monitoring
CDEC	California Data Exchange Center
CDFA	California Dept of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFCC	California Financing Coordinating Committee
CGPS	continuous global positioning system
CIMIS	California Irrigation Management Information System
CRP	conservation reserve program
CWA	Clean Water Act
CWC	California Water Code

DDW	State Water Resources Control Board's Division of Drinking Water
District	Lassen-Modoc County Flood Control and Water Conservation District
DMS	Data Management System
DOI	Department of the Interior
DTW	depth to water
DWR	California Department of Water Resources
EC	electrical conductivity
EQIP	Environmental Quality Incentives Program
ET	evapotranspiration
ETo	reference evapotranspiration
°F	degrees Fahrenheit
Forest Service	U.S. Forest Service
ft/yr	foot or feet per year
GAMA	Groundwater Ambient Monitoring and Assessment Program
GAMA GIS	GAMA Groundwater Information System
GDE	groundwater dependent ecosystem
General Order	Statewide ASR General Order
GIS	geographic information system
GP	General Plan
gpm	gallons per minute
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	hydrogeologic conceptual model
HSG	Hydrologic Soils Group
IC	institutional controls
ILRP	Irrigated Lands Regulatory Program
IM	Interim Milestone
in/hr	inches per hour
InSAR	Interferometric Synthetic Aperture Radar, a technology used to detect subsidence
IRWMP	Upper Pit Integrated Regional Water Management Plan
IWFM	Integrated Water Flow Model

LCGMP	Lassen County Groundwater Management Plan
LCWD #1	Lassen County Waterworks District #1
LNAPL	Light non-aqueous phase liquid (found in petroleum hydrocarbons)
LUST	Leaking underground storage tank
M	million
MCL	Maximum Contaminant Level
Mn	manganese
MO	Measurable Objective
MOU	Memorandum of Understanding
msl	mean sea level
MT	Minimum Threshold
MTBE	Methyl tert-butyl ether
NCCAG	Natural Communities Commonly Associated with Groundwater
North Cal-Neva	North Cal-Neva Resource Conservation and Development Council
NCWA	Northern California Water Association
NECWA	Northeastern California Water Association
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NR	Natural Resources
NRCS	Natural Resources Conservation Service
NSP	Nonpoint Source Program
OS	Open Space
OWTS	Onsite Water Treatment System
PFAS	per/polyfluoroalkyl substances
PG&E	Pacific Gas and Electric
Plan	Groundwater Sustainability Plan
Reclamation	United States Bureau of Reclamation
RWMG	Regional Water Management Group
RWQCB	Regional Water Quality Control Board
RWQCB-R5	Regional Water Quality Control Board Region 5

SAGBI	Soil Agricultural Groundwater Banking Index
SB	Senate Bill
SC	specific conductance
SGMA	Sustainable Groundwater Management Act of 2014
SMC	Sustainable Management Criteria
SRI	Sacramento River Index of water year types
SSURGO	Soil Survey Geographic Database
State Water Board	California State Water Resources Control Board
SVE	Surprise Valley Electric
SVWQC	Sacramento Valley Water Quality Coalition
SWEEP	State Water Efficiency and Enhancement Program
SY	specific yield
TBA	tert-Butyl alcohol
TDS	total dissolved solids
TMDL	Total Maximum Daily Load Program
TNC	The Nature Conservancy
UCCE	University of California Cooperative Extension
U.S.	United States
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	United States Geologic Survey
UST	Underground Storage Tank
WAA	Water Availability Analysis
WCR	well completion report
WDR	Waste Discharge Requirement
WRP	wetland reserve project
WY	Water Year (October 1 – September 30)

Executive Summary

ES.1. Introduction & Plan Area (Chapters 1 – 3)

The Big Valley Groundwater Basin (BVGB, Basin, or Big Valley) lies on the border of Modoc and Lassen counties in one of the most remote and untouched areas of California. The sparsely populated Big Valley has a rich biodiversity of wildlife and native species who live, feed and raise young on the irrigated lands throughout the Basin. The snow-fed high desert streams entering the Basin have seasonal hydrographs with natural periods of reduced flows or complete cessation of flows late in the summer season. The Pit River is the largest stream and is so named because of the practice, employed by the Achumawi and other Native American bands that are now part of the Pit River Tribe, of digging pits in the river channel when it went dry to expose water and trap game that came to water at the river. Farming and ranching in Big Valley date back to the late 19th and early 20th centuries when families immigrated to Big Valley and made use of the existing water resources. A large amount of the land in the Basin is still owned and farmed by the families that homesteaded here.

Historically, agriculture was complemented by a robust timber industry as a key component of the economy for Big Valley which supported four lumber mills. Due to regulations and policies imposed by state and federal governments, the timber industry has been diminished over time and subsequently caused a great economic hardship to the Big Valley communities. Stakeholders realize that the Sustainable Groundwater Management Act of 2014 (SGMA) will unfortunately cause a similar decline to agriculture. The change in land management has transformed once thriving communities in the Basin to "disadvantaged" and "severely disadvantaged" communities. Viable agriculture is of paramount importance to the residents of Big Valley because it supports the local economy and unique character of the community. As required by SGMA, stakeholders have developed a sustainability goal:

> The sustainability goal for the Big Valley Groundwater Basin is to maintain a locally governed, economically feasible, sustainable groundwater basin and surrounding watershed for existing and future legal beneficial uses with a concentration on agriculture. Sustainable management will be conducted in context with the unique culture of the basin, character of the community, quality of life of the Big Valley residents and the vested right of agricultural pursuits through the continued use of groundwater and surface water.

Lassen and Modoc counties are fulfilling their unfunded, mandated roles as Groundwater Sustainability Agencies (GSAs) to develop this Groundwater Sustainability Plan (GSP) after exhausting its administrative challenges to the California Department of Water Resources' (DWR's) determination that Big Valley qualifies as a medium-priority basin. Both counties are disadvantaged, have declining populations and have no ability to cover the costs of GSP development and implementation.

The Basin, shown on **Figure ES-1**, encompasses an area of about 144 square miles (92,057 acres) with Modoc County representing 28 percent and Lassen County comprising 72 percent of the Basin by area. The Basin includes the towns of Adin and Lookout in Modoc County and the towns of Bieber and

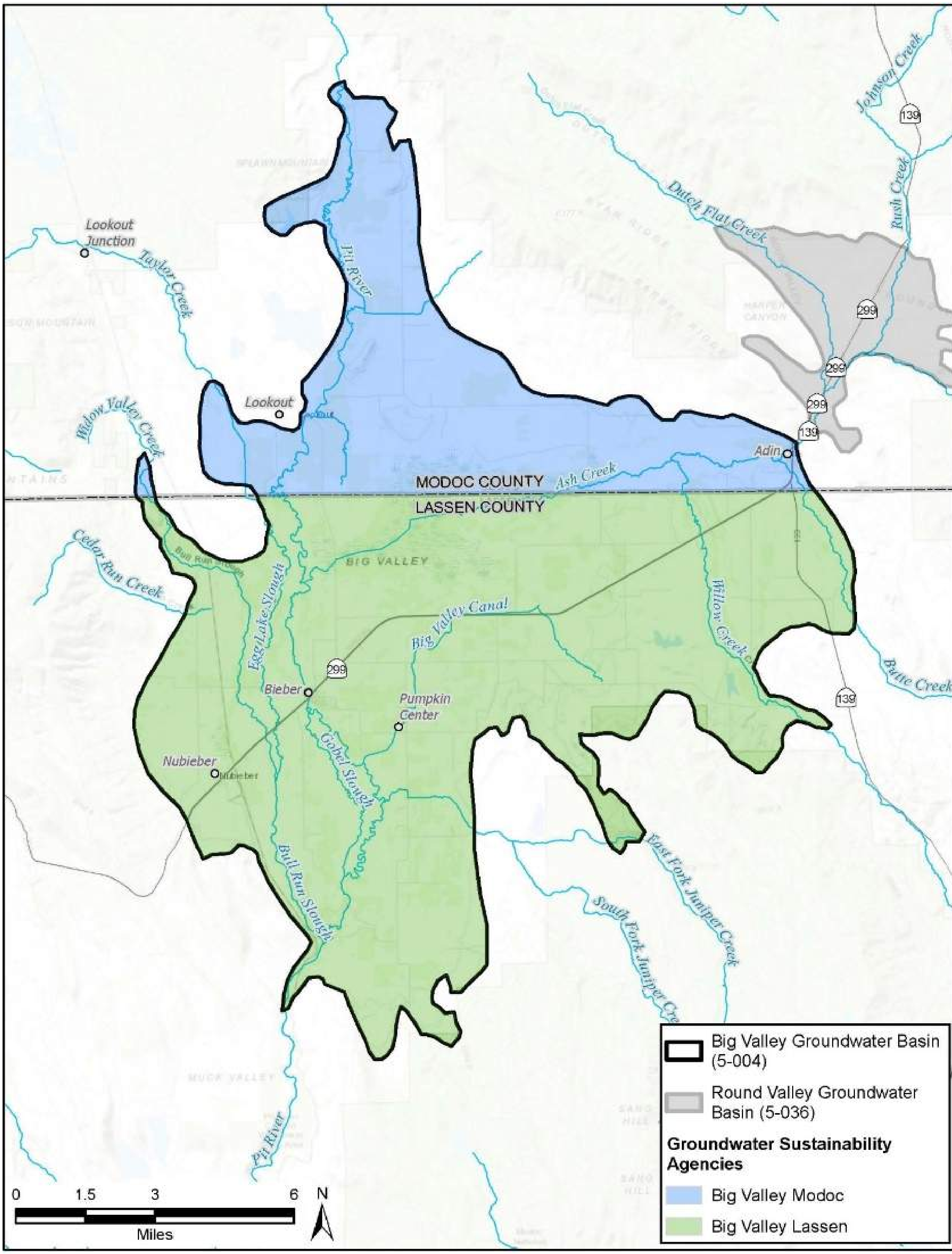

Figure ES-1 Groundwater Sustainability Agencies in Big Valley Groundwater Basin.
Source: DWR 2018d

Nubieber in Lassen County. The Ash Creek State Wildlife Area straddles both counties occupying 22.5 square miles in the center of the Basin in the marshy/swampy areas along Ash Creek. Land use in the BVGB is detailed in **Table ES-1**.

Table ES-1 2016 Land Use Summary by Water Use Sector

Water Use Sector	Acres	Percent of Total
Community[a]	250	<1%
Industrial	196	<1%
Agricultural	22,246	24%
State Wildlife Area[b]	14,583	16%
Managed Recharge	-	0%
Native Vegetation and Rural Domestic[c]	54,782	60%
Total	**92,057**	**100%**

Notes:
[a] Includes the use in the communities of Bieber, Nubieber and Adin
[b] Made up of a combination of wetlands and non-irrigated upland areas
[c] Includes the large areas of land in the Valley which have domestic wells interspersed
Source: See Chapter 6 – Water Budget for explanation of approach

ES.2. Basin Setting (Chapters 4 – 6)

Hydrogeologic Setting

The topography of BVGB is relatively flat in the central area with increasing elevations along the perimeter, particularly in the eastern portions where Willow and Ash creeks enter the Basin. This low relief in the Basin results in a meandering river morphology and widespread flooding during large storm events. The Basin is underlain by a thick sequence of sediment derived from the surrounding mountains of volcanic rocks and is interbedded with lava flows and water-lain tuffs. The volcanic material is variable in composition and is Miocene to Holocene age (23 million to several hundred years ago). The compositions of the lava flows are primarily basalt[1] and basaltic andesite[2], while pyroclastic[3] ash deposits are rhyolitic[4] composition. In general, the Basin boundary drawn by DWR was intended to define the contact between the valley alluvial deposits and the surrounding mountains of volcanic rocks. During development of this GSP, the Basin boundary has been found to be grossly inaccurate in many areas and is not clearly isolated from areas outside the valley floor. The mountains outside of the groundwater Basin capture and accumulate precipitation, which produces runoff that flows into BVGB. Moreover, DWR (1963) suggested that these mountains serve as "upland recharge areas" and provide subsurface recharge to BVGB *via* fractures in the rock and water bearing formations that underlie the volcanics.

[1] Basalt is an extrusive (volcanic) rock with relatively low silica content and high iron and magnesium content.
[2] Andesite is an extrusive rock with intermediate silica content and intermediate iron and magnesium content.
[3] Pyroclastic rocks are formed during volcanic eruptions, typically not from lava flows, but from material (clasts) ejected from the eruption such as ash, blocks, or "bombs."
[4] Rhyolitic rocks are extrusive with relatively high silica content and low iron and magnesium. Rhyolites are the volcanic equivalent of granite.

The Pliocene-Pleistocene age (5.3 million to 12 thousand years ago) Bieber Formation (TQb), shown in **Figure ES-2**, is the main formation of aquifer material defined within the BVGB, and DWR (1963) estimates that it ranges in thickness from a thin veneer to over 1,000 feet. The formation was deposited in a lacustrine (lake) environment and is comprised of unconsolidated to semi-consolidated layers of interbedded clay, silt, sand, gravel and diatomite. The coarse-grained deposits (gravel and sand) are aquifer material[5] and are part of the Big Valley principal aquifer. The "physical bottom" has not been clearly encountered or defined but may extend 4,000 to 7,000 feet or deeper. The "practical bottom" of the aquifer is 1,200 feet because that depth encompasses the known production wells and water quality may be poorer below that depth. As required by SGMA, 1,200 feet is used as the "definable bottom" for this GSP. A single principal aquifer is used for this GSP because distinct, widespread confining beds have not been identified in the subsurface, which, if present, would create multiple aquifers.

The Natural Resources Conservation Service (NRCS) Hydrologic Soils Group (HSG) classifications provide an indication of soil infiltration potential and ability to transmit water under saturated conditions based on hydraulic conductivities of shallow, surficial soils. Characterizing these soils is important because water must first penetrate the shallow subsurface to provide any chance of groundwater recharge. According to the HSG dataset, the Basin is composed of only soils with "slow" or "very slow" infiltration rates. While the soils are not highly permeable, some research has found that water can penetrate through these soils, indicating that managed aquifer recharge projects such as on-farm recharge may be viable.

Groundwater Conditions

Historic groundwater elevations are available from a total of 22 wells in Big Valley that are part of the CASGEM[6] monitoring network, six located in Modoc County and 16 in Lassen County**.** In addition to these 22 wells, five well clusters were constructed in late 2019 and early 2020 to support the GSP. Groundwater level hydrographs from the historic wells show that most areas of the Basin have remained stable, and a few areas have seen some decline averaging 0.53 feet per year of groundwater level decline in the last 38 years.[7]

To determine the annual and seasonal change in groundwater storage, groundwater elevation surfaces[8] were developed for spring and fall for each year between 1983 and 2018. **Figure ES-3** shows this information graphically, along with the annual precipitation. This graph shows that groundwater storage generally declines during dry years and stays stable or increases during normal or wet years. During the period from 1983 to 2000, groundwater levels dipped in the late 1980's and early 1990's, then recovered during the wet period of the late 1990's. After 2000, while most wells are still stable, a few wells have

[5] Meaning the sediments contain porous material with recoverable water.
[6] California Statewide Groundwater Elevation Monitoring Program
[7] Average slope of the trend lines in Appendix 5A.
[8] Groundwater elevation surfaces are developed from the known groundwater elevations at wells throughout the Basin and then estimating/interpolating elevations at intermediate locations *via* a mathematical method known as kriging. The kriging elevation surface is based on a grid covering the entire basin that has interpolated groundwater elevation values for each node of the grid.

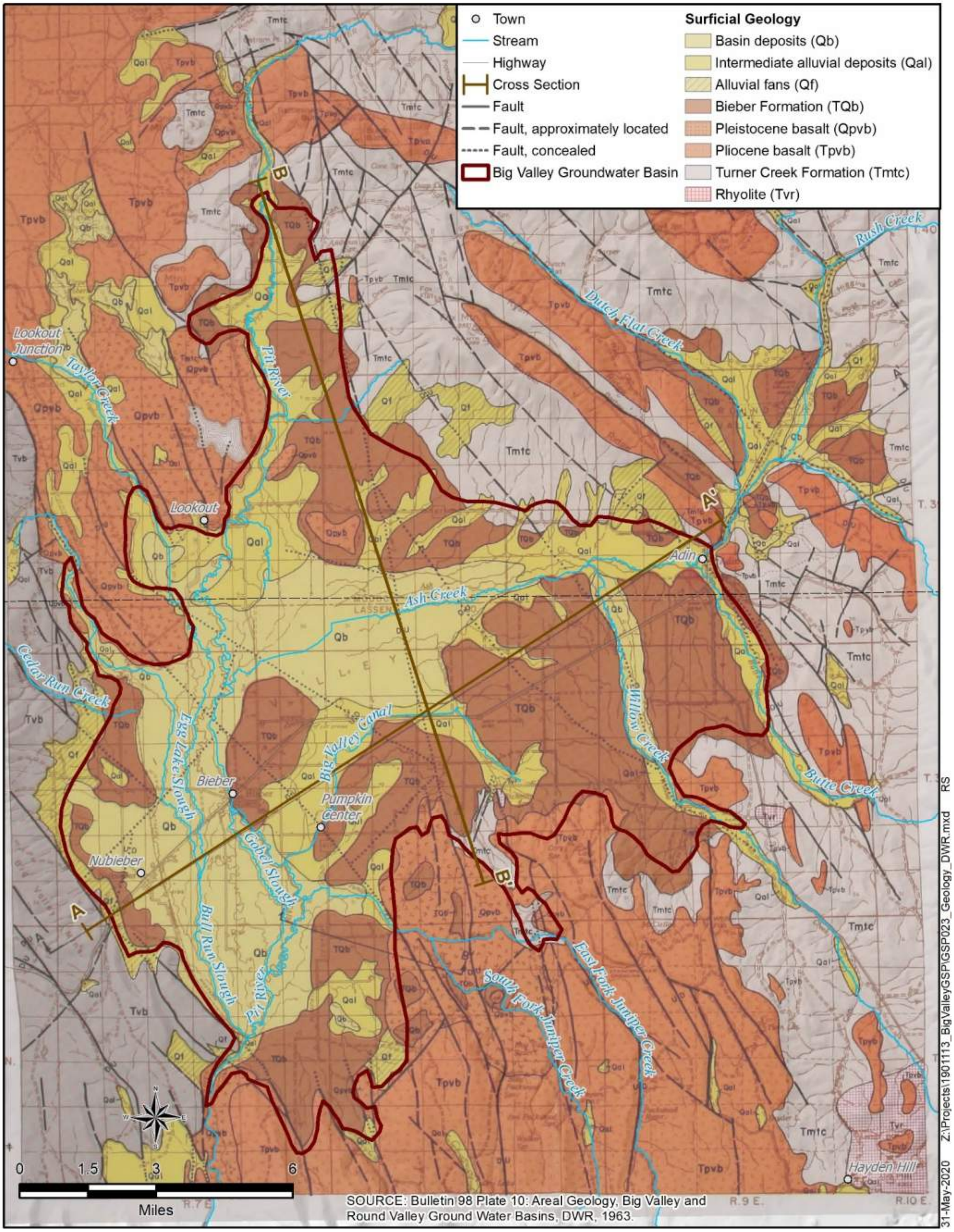

Figure ES-2 DWR 1963 Local Geologic Map.

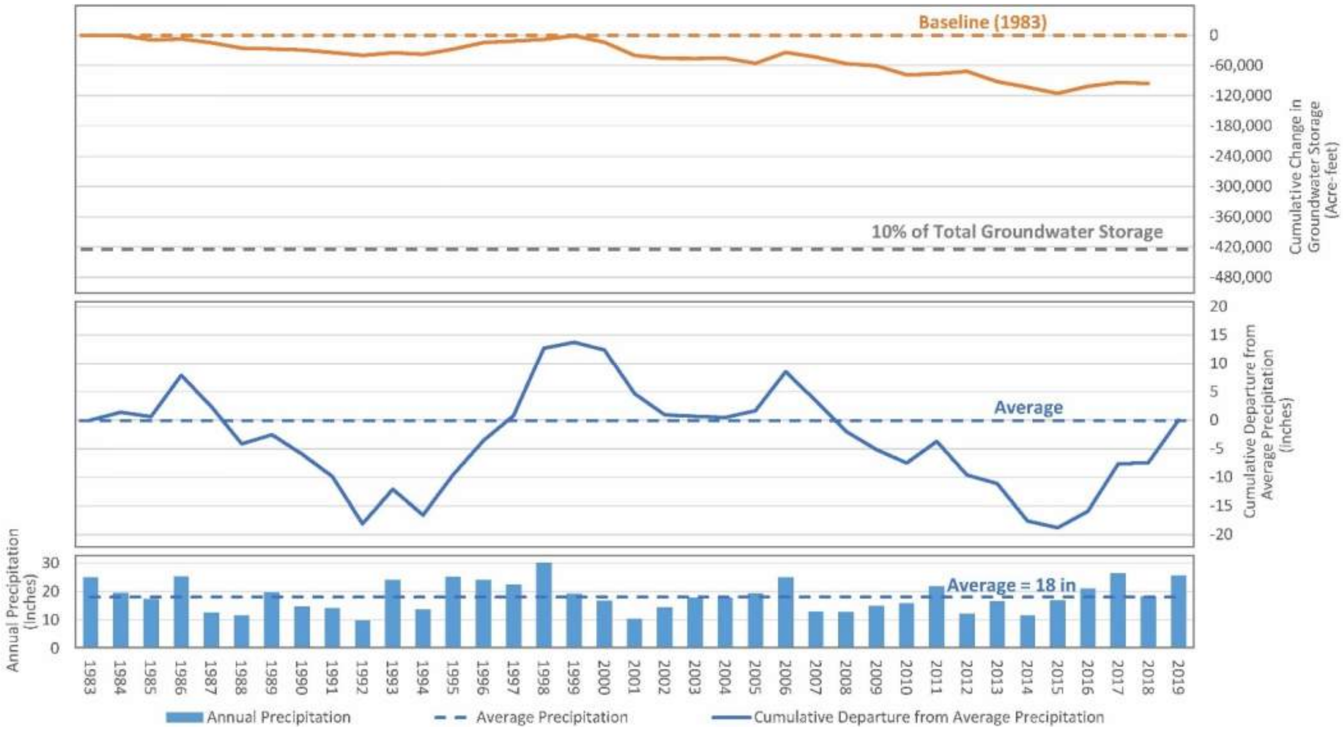

Figure ES-3 Cumulative Change in Groundwater Storage and Precipitation

generally declined resulting in a reduction in overall groundwater storage. The amount of decline represents a reduction in storage of less than 2 percent of groundwater storage.[9]

Groundwater in the BVGB is generally of good to excellent quality. (DWR 1963, United States Bureau of Reclamation [Reclamation] 1979) An analysis of available historic water quality indicates that some naturally occurring constituents associated with volcanic formations and thermal waters are slightly elevated. These elevated concentrations are extremely isolated and primarily not above thresholds that are a risk to human health nor does the water quality affect beneficial uses. There are no contamination plumes or cleanup sites that are likely to affect groundwater quality for beneficial use.

Water Budget

A historic water budget was developed for the 1983-2018 timeframe, shown in **Figure ES-4.** From this water budget analysis, a rough estimate for the sustainable yield is about 39,300 acre-feet per year (AFY) and a rough estimate of average annual overdraft is 5,000 AFY.

[9] Based on assessment in Section 5.2, indicating storage has been reduced by about 96,000 AF since 1983 and using a total storage of about 5.2 million AF (92,057 acre basin area * 1,200 feet to definable bottom * 5% specific yield)

Item	Flow Type	Origin/ Destination	Component	Estimated
		TOTAL BASIN WATER BUDGET		Acre-Feet
(1)	Inflow	Into Basin	Precipitation on Land System	136,800
(14)	Inflow	Into Basin	Precipitation on Reservoirs	500
(13)	Inflow	Into Basin	Stream Inflow	371,100
(27)	Inflow	Into Basin	Subsurface Inflow	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*508,400*
(5)	Outflow	Out of Basin	Evapotranspiration	154,000
(24)	Outflow	Out of Basin	Stream Evaporation	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	700
(19)	Outflow	Out of Basin	Conveyance Evaporation	-
(18)	Outflow	Out of Basin	Stream Outflow	358,500
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*513,600*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(5,000)

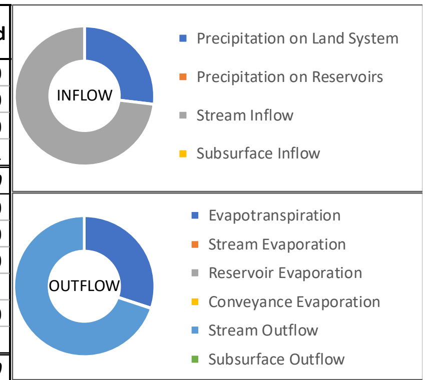

Figure ES-4 Average Total Basin Water Budget 1984-2018

ES.3. Sustainable Management (Chapters 7 – 9)

Sustainable Management Criteria

Sustainable Management Criteria (SMC) define the conditions that constitute sustainable groundwater management. The following is a description of the SMC for each of the six sustainability indicators:

- **Groundwater Levels:** Do not allow groundwater levels to decline to a level where the energy cost to lift groundwater exceeds the economic value of the water for agriculture. A depth of 140 feet below fall 2015 groundwater level for each well in the monitoring network was determined to be the depth at which groundwater pumping becomes uneconomical for agricultural use.
- **Groundwater Storage:** Groundwater levels are used as a proxy for this sustainability indicator because change in storage is directly correlated to changes in groundwater levels.
- **Seawater Intrusion:** This sustainability indicator does not apply to Big Valley
- **Water Quality:** Due to the existence of excellent water quality in the Basin, significant amount of existing water quality monitoring, generally low impact land uses and a robust effort to conduct conservation efforts by agricultural and domestic users, per §354.26(d), SMCs were not established for water quality because undesirable results are not present and not likely to occur. At the 5-year update of this GSP, data from various existing programs will be assessed to determine if degradation trends are occurring in the principal aquifer.
- **Land Subsidence:** Based on evaluation of subsidence data from a continuous GPS station and Interferometric Synthetic Aperture Radar (InSAR) provided by DWR, no significant subsidence has occurred. Therefore, per §354.26(d), SMCs were not established for subsidence because undesirable results are not present and not likely to occur. At the 5-year update of this GSP, subsidence data will be assessed for any trends that can be correlated with groundwater pumping.
- **Interconnected Surface Water:** Data for this sustainability indicator is limited. Currently there is no evidence to suggest that undesirable results have occurred or are likely to occur. At the 5-year update, water level and streamflow data from newly constructed wells and proposed stream

gages will be assessed. Thresholds will be considered if trends indicate that undesirable results have occurred or are likely to occur in the subsequent 5 years.

Monitoring Network

Monitoring networks are developed to promote the collection of data of sufficient quality, frequency and distribution to characterize groundwater and related surface water conditions in the Basin and to evaluate changing conditions that occur as the Plan is implemented. The GSAs developed monitoring networks for the parameters listed below. **Figure ES-5** shows the water level monitoring networks.

- Groundwater levels
- Groundwater storage *via* groundwater levels as proxy
- Shallow groundwater for interconnection of groundwater and surface water
- Groundwater quality
- Land subsidence
- Streamflow and climate
- Land use

Projects and Management Actions

Through an extensive planning and public outreach process, the GSAs have identified an array of projects and management measures that may be implemented to meet sustainability objectives in the BVGB. Some of the projects can be implemented immediately while others will take significantly more time for necessary planning and environmental review, navigation of regulatory processes and implementation. The various projects and estimated timeline can be found in **Table ES-2**.

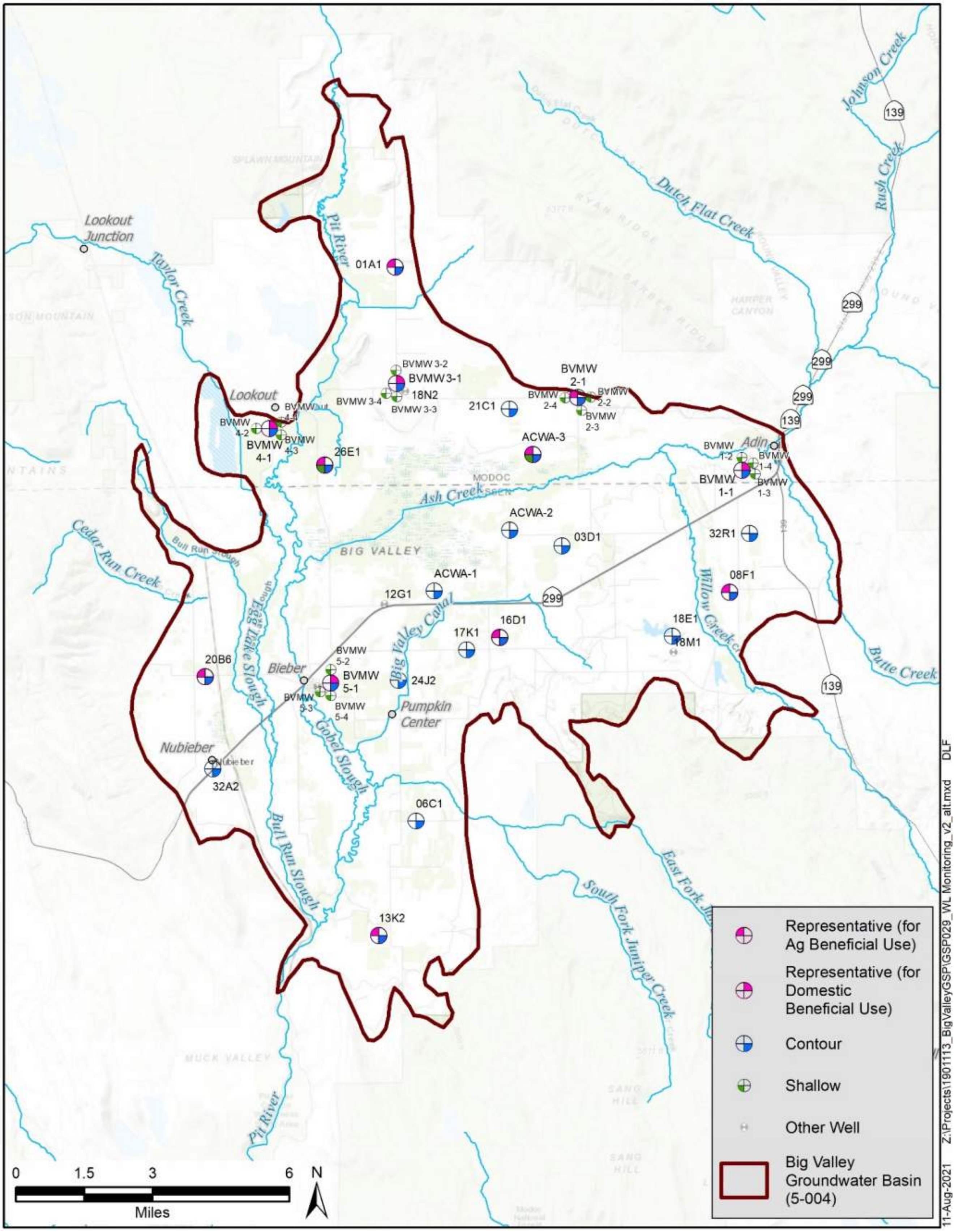

Figure ES-5 Groundwater Level Monitoring Networks

Table ES-2 Projects and Potential Implementation Timeline

No.	Category	Description	Estimated Time for Potential Implementation (years)		
			0-2	2-8	>8
1	9.1 Recharge Projects	AgMAR	X	X	X
2		Drainage and Basin Recharge	X	X	X
3		Ag Injection Wells			X
4	9.2 Research and Data Development	Stream Gages	X		
5		Refined Water Budget	X	X	
6		Agro-Climate Station	X		
7		Voluntary Installation of Well Meters	X	X	
8		Adaptive Management	X	X	X
9		Mapping and Land Use	X	X	
10	9.3 Increased Storage Capacity	Expanding Existing Reservoirs		X	
11		Allan Camp Dam			X
12	9.4 Improved Hydrologic Function	Forest Thinning and Management	X	X	X
13		Juniper Removal	X	X	X
14		Stream and Meadow Restoration	X	X	X
15	9.5 Water Conservation	Irrigation Efficiency	X	X	
16		Landscaping and Domestic Water Conservation	X	X	
17		Conservation Projects	X	X	
18	9.6 Education and Outreach	Public Communication	X		
19		Information and Data Sharing	X	X	
20		Fostering Relationships	X		
21		Compiling Efforts	X	X	
22		Educational Workshops	X		
22		Educational Workshops	X		

Note: AgMAR = Agricultural Managed Aquifer Recharge

ES.4. Plan Implementation (Chapters 10 – 11)

The GSP lays out a roadmap for addressing the activities needed for GSP implementation. Implementing this GSP requires the following activities:

- **GSA Administration and Public Outreach:** The fundamental activities that will need to be performed by the GSAs are public outreach and coordination of GSP activities. Public outreach will entail updates at County Board of Supervisors' meetings and/or public outreach meetings. At a minimum the GSAs will receive and respond to public input on the Plan and inform the public about progress implementing the Plan as required by §354.10(d)(4) of the Regulations. Coordination activities would include ensuring monitoring is performed, annual reports to DWR, 5-year GSP updates and coordinating projects and management actions.
- **Monitoring and Data Management:** Data collection and management will be required for both annual reporting and 5-year updates. Monitoring data that will be collected and stored in the data management system (DMS) for reporting will include water levels, precipitation, evapotranspiration, streamflow, water quality, land use and subsidence.

- **Annual Reporting:** According to §356.2 of the Regulations, the Big Valley GSAs are required to provide an annual report to DWR by April 1 of each year following the adoption of the GSP. The first annual report will be provided to DWR by April 1, 2022 and will include data for the prior Water Year (WY), which will be WY 2021 (October 1, 2020 to September 30, 2021), despite DWR's definition of a WY being inconsistent with what works for Big Valley. The Annual Report will establish the current conditions of groundwater within the BVGB, the status of the GSP implementation and the trend towards maintaining sustainability.
- **Plan Evaluation (5-Year Update)**: Updates and amendments to the GSP can be performed at any time, but at a minimum the GSAs must submit an update and evaluation of the plan every 5 years (§356.4). While much of the content of the GSP will likely remain unchanged for these 5-year updates, the Regulations require that most chapters of the plan be updated and supplemented with any new information obtained in the preceding 5 years.

Cost of Implementation

Cost is a fundamental concern to the GSAs and stakeholders in the BVGB, as the Basin is disadvantaged and there is no revenue generated in the counties to fund the state-mandated requirements of SGMA. Therefore, the GSAs will rely on outside funding to implement this unfunded, mandated Plan.

1. Introduction § 354.2-4

1.1 Introduction

The Big Valley Groundwater Basin (BVGB, Basin, or Big Valley) is located in one of the most remote and untouched areas of California. The sparsely populated Big Valley has a rich biodiversity of wildlife and native species who feed, live and raise young primarily on the irrigated lands throughout the Basin. The Basin has multiple streams which enter from the North, East and West. The Pit River is the only surface water outflow and exits at the southern tip of the Basin. The streams that enter the Basin are some of the most remote, least improved and most pristine surface waters in all of California. The snow-fed high desert streams entering the Basin have seasonal hydrographs with natural periods of reduced flows or complete cessation of flows late in the summer season. The Pit River is the largest stream and is so named because of the practice, employed by the Achumawi and other Native American bands that are now part of the Pit River Tribe, of digging pits in the river channel when it went dry to expose water and trap game that came to water at the river. In addition to the Pit River, the Basin is also fed by Ash Creek year-round, along with Willow Creek and many seasonal streams and springs.

Farming and ranching in Big Valley date back to the late 19th and early 20th centuries when families immigrated to Big Valley and made use of the existing water resources. A large amount of the land in the Basin is still owned and farmed by the families that homesteaded here. The surnames on the tombstones at any of the three cemeteries are the same names that can be overheard during a visit to the Bieber Market or the Adin Supply store, local institutions and gathering places for the residents of this tight-knit community. These stores are remaining evidence of a much more vibrant time in Big Valley.

Following World War II, with the advent and widespread use of vertical turbine pumps, farmers and ranchers began using groundwater to irrigate the land, supplementing their surface water supplies to make a living in Big Valley. The local driller, Conner's Well Drilling, has drilled the majority of wells in Big Valley and the third-generation driller, Duane Conner has been on the advisory committee during the development of this Groundwater Sustainability Plan (GSP or Plan). (Conner 2020-2021)

Historically, agriculture was complemented by a robust timber industry, a key component of the economy for Big Valley, which supported four lumber mills. Due to regulations and policies imposed by state and federal government, the timber industry has been diminished over time which has caused a great economic hardship to the Big Valley communities. Stakeholders realize that the Sustainable Groundwater Management Act of 2014 (SGMA) will unfortunately cause a similar decline to agriculture. The loss of jobs due to the closure of all four lumber mills and the reduction of timber yield tax, which had provided financial support to the small rural schools and roads, is evident in the many vacant buildings which once had thriving businesses. In addition to the loss of jobs, the reduced student enrollment in local schools has caused an economic hardship to the school district which is struggling to remain viable. The change in land management has transformed once thriving communities in the Basin to "disadvantaged" and "severely disadvantaged" communities as defined by the California Department of Water Resources (DWR). The addition of SGMA will increase the severity of the disadvantaged and severely disadvantaged status in the Basin due to increased regulatory costs and potential actions that must be taken to comply with SGMA and is likely to intensify rural decline in this area. With the increased cost of this unfunded mandate for monitoring, annual reports and GSP updates, land values will likely decline and lower the property tax base.

The two counties that overlie the BVGB are fulfilling their unfunded, mandated role as the Groundwater Sustainability Agencies (GSAs) since there are no other viable entities that can serve as GSAs. Both counties have severe financial struggles as their populations and tax base are continually declining. The counties not only lack the tax revenue generated out of Big Valley to implement SGMA, but they have no buffer from revenue generated county-wide to cover such costs. As such, the GSAs are depending almost solely on outside funding sources for development and implementation of this Plan.

With the demise of the timber industry, agriculture has been the only viable industry remaining to support residents living and working in the Basin, with many of the families who ranch and farm today having cultivated the land for over a century. These families are fighting to maintain the viability and productivity of their land so that their children and grandchildren can continue to pursue the rural lifestyle that their forebearers established.

The ranchers and farmers have developed strategies to enhance the land with not only farming and ranching in mind, but also partnerships with state and federal agencies as well as local non-governmental agencies (NGOs). The purpose of these partnerships is to maintain and improve the condition of privately-owned land for the enhancement of plant and animal populations while addressing invasive plant and pest concerns.

The Ash Creek Wildlife Area (ACWA) is an example of a local rancher who provided land for conservation efforts with an understanding that managed lands promote wildlife enhancement for the enjoyment of all. The California Department of Fish and Wildlife (CDFW) has largely left the property unmanaged. (Albaugh 2021) While the ACWA does offer some refuge, most species graze and rear their young on the private lands around the Basin which are actively being cultivated because those lands offer better forage and protection from predators. Below is an account from the former land owner of how the ACWA property has fared since being sold to the government.

> The government bought the ranch as a refuge for birds and wildlife. When I was running cattle on that ranch it was alive with waterfowl. They fed around and amongst the cattle. It was a natural refuge. The cattle kept the feed down so the birds didn't have to worry about predators, and they could feed on the new growth grass. After the government got their hands on it all the fences were removed, at taxpayer expense. In the years since, the meadows have turned into a jungle -- old dead feed and tules. The birds are gone, moved to other ranches where they get protection from skunks and coyotes and other predators that work on waterfowl and wildlife. Under the management of the U.S. Fish and Wildlife the value of the land has been completely destroyed. All those acres of wonderful grass and the irrigation system that for generations have produced food for the people of this country now *produce nothing*. (Stadtler 2007)

Recently the CDFW has attempted to manage the property by constructing a ¾-mile pipeline to replace an unlined portion of the Big Valley canal and convey water to a 65-acre constructed wetland on a corner of the ACWA property. CDFW allows water to continue past ACWA to water rights holders down-canal, then uses any excess to support the wetland. The abandoned portion of the unlined canal travels through a private land-owner's property. Although there are no documented water rights holders on the abandoned portion of the unlined canal, it has dried that portion of the land-owner's property and reduced groundwater recharge there. (CDFW 2021)

Activities such as this from state agencies exacerbates the negative sentiments from local stakeholders toward state government and make them extremely wary of unintended consequences of government programs. This, coupled with the burden imposed on locals through regulations such as SGMA, are some of the fundamental reasons why residents of this area generally consider themselves distinct from the rest of the state. Furthermore, local political leaders have pointed out that the state is behind on tax payments to the disadvantaged counties. (Albaugh 2021)

The BVGB not only differs politically, but also differs physically from California's other groundwater basins because the climate sees extreme cold. On average there are fewer warm temperature days, making the growing season considerably shorter than in other parts of the state. Ground elevations in the Basin range from about 4,100 to over 5,000 feet and along with its northerly latitude in the state, creates conditions where snow can fall in any month of the year. According to the Farmer's Almanac, the average growing season for the Big Valley Basin is about 101 days. The typical crops for the Big Valley Basin are low land use intensity and low value crops such as native pasture, grass hay, alfalfa hay and rangeland.

The vast majority of the farmed land utilizes low impact farming, employing no-till methods to grow nitrogen-fixing crops which require little to no fertilizer or pesticide application. While this climate and range of viable crops is a challenge to farmers and ranchers, it helps maintain the pristine nature of surface water and groundwater. As an example of how local landowners have been good stewards of their water resources, they have participated in the Natural Resources Conservation Service's (NRCS's) Environmental Quality Incentives Program (EQIP), drilling wells away from streams to encourage watering of cattle outside of riparian corridors. Now these additional wells have increased the inventory of wells in the Basin, one of the criteria used by DWR to categorize Big Valley as medium priority and subject to the SGMA unfunded mandate of developing a GSP. (Albaugh 2020-2021)

The GSAs are also aware of poor stewardship, such as illegal water uses (i.e., unlicensed marijuana growers). These operations may utilize groundwater, are known to have illegal diversions of surface water and have a negative impact on water quality. However, the counties have not received the state and federal support needed to identify, eliminate and prosecute these operations.

The Big Valley Basin has a population of 1,046 residents and a projected slow growth of 1,086 by 2030. (DWR 2021a). The largest town (unincorporated community) within the Basin is Adin, California which had a population of 272 residents according to the 2010 Census. (USCB 2021). Located in Modoc County, Adin had a 2.43 percent decline in population from 2017 to 2018. Both Modoc and Lassen are experiencing a decline in population county-wide. (USCB 2021)

As detailed in this GSP, there are three major beneficial uses of groundwater: agriculture, community/domestic and environmental. However, the importance of agriculture to Big Valley cannot be overstated, as it is the economic base upon which community/domestic users rely and provides the habitat for many species important to healthy wildlife and biodiversity. Both groundwater and surface water are important to maintaining this ecosystem. There are efforts being made to diversify the economic base of the community. While economic diversity of Big Valley is not the purview of this GSP, it is acknowledged that at present and for the foreseeable future, the Big Valley communities rely almost solely on farming and ranching to support their residents. The financial and regulatory impact of implementing SGMA will affect this disadvantaged community. Therefore, minimizing the GSP's impact to agriculture while complying with SGMA and working to enhance water supply in Big Valley is the thrust of this GSP.

1.2 Sustainability Goal

The GSAs are developing this GSP to comply with SGMA unfunded mandates, maintain local control and preclude intervention by the State Water Resources Control Board (State Water Board), and prove that the Basin is sustainable and should be ranked as low priority. Satisfying the requirements of SGMA generally requires four activities:

1. Formation of at least one GSA to fully cover the basin. Multiple GSAs are acceptable and Big Valley has two GSAs
2. Development of this GSP that fully covers the basin
3. Implementation of this GSP and management to achieve quantifiable objectives
4. Regular reporting to DWR

Two GSAs were established in the Basin; County of Modoc GSA and County of Lassen GSA; each covering the portion of the Basin in their respective jurisdictions. This document is a single GSP, developed jointly by both GSAs for the entire Basin. This GSP describes the BVGB, develops quantifiable management criteria that accounts for the interests of the Basin's legal beneficial groundwater uses and users, and identifies projects and management actions to ensure and maintain sustainability.

The Lassen and Modoc GSAs developed a Memorandum of Understanding (MOU) which details the coordination between the two GSAs. The MOU states a Big Valley Advisory Committee (BVAC) is to be established to provide local input and direction on the development of a GSP. The counties solicited applicants to be members of the BVAC through public noticing protocols. Big Valley landowners and residents submitted applications to the County Boards of Supervisors, who then appointed the members of the BVAC. The BVAC is comprised of one county board member from each county, one alternate board member from each county and two public applicants from each county. The BVAC and county staff have dedicated countless hours to reviewing the data and content of the GSP, largely uncompensated. After careful consideration of the available data and community input from the BVAC and interested parties, the GSAs have developed the following sustainability goal:

> The sustainability goal for the Big Valley Groundwater Basin is to maintain a locally governed, economically feasible, sustainable groundwater basin and surrounding watershed for existing and future legal beneficial uses with a concentration on agriculture. Sustainable management will be conducted in context with the unique culture of the basin, character of the community, quality of life of the Big Valley residents and the vested right of agricultural pursuits through the continued use of groundwater and surface water.

The BVGB sustainability goal will be culminated through DWR's better understanding of the surface water and groundwater conditions over time and the implementation of projects and management actions described in this GSP. Several areas of identified data gaps have been established and while an estimated future water budget has been completed, its accuracy is uncertain since many assumptions had to be made due to the lack of available data. The monitoring network established under this Plan includes new and existing monitoring wells, inflow/outflow measurement of surface water, groundwater quality and land subsidence.

The implementation of projects such as winter recharge studies currently in progress will help establish the feasibility of immediate actions the GSAs can take to improve Basin conditions. A detailed off-season water availability analysis has not been conducted on the Upper Pit River watershed and this has been identified as a data gap within the Basin. The GSAs are working to locate funds to conduct an off-season and storage capacity water accounting which will provide the amount of available surface water for potential winter recharge in the Basin. Additional research will be conducted on the available use of non-active surface water rights for storage. An additional stream gage is being installed where the Pit River enters the Basin and will provide a more accurate accounting of the amount of surface water entering the Big Valley Basin from the Pit River. While better accounting is needed, it should be noted that SGMA and this GSP will not affect existing water rights in the Basin.

The understanding that has been gained by the GSAs is that with proper management and coordination with and support from federal landowner partners, the Big Valley Basin, which is not currently at risk of overdraft, will remain sustainable for the benefit of all interested parties and should be re-ranked as low priority.

1.3 Background of Basin Prioritization

The Big Valley GSAs are being forced to develop this GSP after exhausting its challenges to the California Department of Water Resources' (DWR's) determination that Big Valley qualifies as a medium-priority basin. DWR first prioritized the state's basins in 2014, at which time Big Valley was the lowest-ranked medium priority basin that had to develop a GSP. In 2019, DWR changed their prioritization process and criteria and issued draft and final prioritizations. In the end, Big Valley is still the lowest-ranked medium priority basin.

From the draft to final re-prioritization, the Big Valley GSAs recognize the scoring revisions made by DWR for Component 8.b, "Other Information Deemed Relevant by the Department." However, the GSAs continue to firmly believe that the all-or-nothing scoring for Component 7.a, regarding documented declining groundwater levels, is inconsistent with the premise of SGMA: that prioritization levels recognize different levels of impact and conditions across the basins of the state. DWR's adherence to treating all declines the same, assigning a fixed 7.5 points for any amount of documented groundwater level decline, renders meaningless the degrees of groundwater decline and penalizes those basins experiencing minor levels of decline, including Big Valley which has only experienced approximately 0.53 feet per year of groundwater level decline on average in the last 38 years.

Additionally, the GSAs recognize the adjustments made to Component 7.d, overall total water quality degradation. Noting that degradation implies a lowering from human-caused conditions, the Big Valley GSAs urge DWR to further refine the groundwater quality scoring process for Secondary Maximum Contamination Levels (MCLs) - which are not tied to public health concerns, but rather aesthetic issues such as taste and odor. Secondary MCLs which are due to naturally occurring minerals should not be factored into the scoring process. Here, the water quality conditions reflect the natural baseline and are not indicative of human-caused degradation and cannot be substantially improved through better groundwater management.

The inaccurate Basin boundary was drawn with a 63-year old regional scale map (CGS 1958), and subsequent geologic maps with more precision and detail are available. Additionally, the "upland" areas outside the Basin boundary are postulated to be recharge areas interconnected to the Basin, which is contrary to DWR's definition of a lateral basin boundary as being, "…features that significantly impede groundwater flow" (DWR 2016c). The GSAs submitted a request to DWR for basin boundary modification, to integrate planning at the watershed level and leverage a wider array of multi-benefit water management options and strategies within the Basin and larger watershed. DWR's denial of the boundary modification request greatly hampers jurisdictional opportunities to protect groundwater recharge areas in higher elevations. The final boundary significantly curtails management options to increase supply through upland recharge, requiring that groundwater levels be addressed primarily through demand restrictions. *See* **Appendix 1A** for communications with DWR regarding Basin prioritization ranking and boundary modification. The GSAs may consider future submittal of a Basin boundary modification request to DWR.

Development of this GSP by the GSAs, in partnership with the BVAC and members of the community, does not constitute agreement with DWR's classification as a medium-priority basin – nor does it preclude the possibility of other actions by the GSAs or by individuals within the Basin seeking regulatory relief.

1.3.1 Timeline

In September 2014, the state of California enacted SGMA. This law requires medium- and high-priority groundwater basins in California to take actions to ensure they are managed sustainably. DWR is tasked with prioritizing all 515 defined groundwater basins in the state as high, medium, low and very low priority. Prioritization establishes which basins need to go through the process of developing a GSP. When SGMA was passed, basins had already been prioritized under the California Statewide Groundwater Elevation Monitoring (CASGEM) program, and that existing ranking process was used as the initial priority baseline for SGMA.

DWR was required to develop its rankings for SGMA based on the first seven criteria listed in **Table 1-1**. For the final SGMA scoring process (DWR, 2019), groundwater basins with a score of 14 or greater (up to a score of 21) were ranked as medium priority basins. Big Valley scored 13.5 and DWR chose to round the score up to put it in the medium priority category as the lowest ranked Basin in the state required to develop a GSP. Lassen County reviewed the 2014 ranking process and criteria that were used and found erroneous data. The county made a request to DWR for the raw data that was used, which were eventually provided, and verified the error that would have put the BVGB into the low priority category. However, because the comment period for these rankings had already expired in 2014 (prior to the passage of SGMA), DWR would not revise their ranking. County staff were mis-led because when the rankings were first publicized, SGMA had not yet existed, and county staff were told that being ranked as a medium priority basin was insignificant and would actually be a benefit to the counties.

Table 1-1 Big Valley Groundwater Basin Prioritization

Criteria	2014	2018	2019	Comments
2010 Population	1	1	1	
Population Growth	0	0	0	
Public Supply Wells	1	1	1	
Total # of Wells	1.5	2	2	Existing information inaccurate, and includes all types of wells, including newly constructed stockwatering wells under EQIP
Irrigated Acreage	4	3	3	
Groundwater Reliance	3	3.5	3.5	
Impacts	3	3	2	Declining water levels, water quality
Other Information	0	7	2	Streamflow, habitat and “other information determined to be relevant”
Total Score	**13.5**	**20.5**	**14.5**	**Medium priority each year**

Source: DWR 2019

Once SGMA was passed and the onerous repercussions of being ranked as medium priority were better understood (and the counties identified erroneous data), DWR did not offer any recourse, simply saying the Big Valley Basin would remain ranked as medium priority and that the basins would soon be re-prioritized anyway.

In 2016, Lassen County submitted a request for a basin boundary modification as allowed under SGMA. The request was to extend the boundaries of the BVGB to the boundary of the watershed. The purpose of the proposed modification was to enhance management by including the volcanic areas surrounding the valley sediments, including federally managed timberlands and rangelands, that have an impact on groundwater recharge. The modification was proposed on a scientific basis but was denied by DWR because the request, “…did not include sufficient detail and/or required components necessary and evidence was not provided to substantiate the connection [of volcanic rock] to the porous permeable alluvial basin, nor were conditions presented that could potentially support radial groundwater flow as observed in alluvial basins.” DWR therefore justifies denial based on inadequate scientific evidence, yet as stated above they used inaccurate, unscientific information to rank the Basin as medium priority in the first place.

In 2018, DWR released an updated draft basin prioritization based on the eight components shown in **Table 1-1** using slightly different data and methodology than previously used. For this prioritization, Big Valley's score increased from 13.5 to 20.5, primarily because of an addition of 5 ranking points awarded under the category of "other information determined to be relevant" by DWR. DWR's justification for the five points was poorly substantiated as "Headwaters for Pit River/Central Valley Project – Lake Shasta." Lassen and Modoc counties sent a joint comment letter questioning DWR's justification and inconsistent assessment of these five points as well as their methodology for awarding the same number of points for water level and water quality impacts to basins throughout the state regardless of the severity of the impacts.

In 2019, DWR released their final prioritization with the BVGB score reduced to 14.5, but still ranked as medium priority and subject to the development of a GSP. DWR's documentation of the 2019 prioritization can be viewed on their website (DWR 2019).

Meanwhile, throughout this time, Lassen and Modoc counties began moving forward to comply with SGMA unfunded mandates through a public process that established them as the GSAs in 2017. The establishing resolutions forming the GSAs adopted findings that it was in the public interest of both counties to maintain local control by declaring themselves the GSA for the respective portion of the Basin. The Water Resources Control Board would become the regulating agency if the counties did not agree to be the GSAs since there were no other local agencies in a position or qualified to assume GSA responsibility. The counties obtained state grant funding to develop the GSP in 2018 and began the GSP development process and associated public outreach in 2019.

1.4 Description of Big Valley Groundwater Basin

The BVGB is identified by DWR in Bulletin 118 as Basin No. 5-004 (DWR, 2016a). The inaccurate Basin boundary was drawn by DWR using a 1:250,000 scale geologic map produced by the California Geological Survey (CGS 1958) along the boundary between formations labeled as volcanic and those labeled as alluvial. The Basin boundary was not drawn with as much precision as subsequent geologic maps, and because of this the "uplands" areas outside the Basin boundary are postulated to be recharge areas interconnected to the Basin. The 63-year old map being used to define the Basin boundary is inadequate and contrary to DWR's definition of a lateral basin boundary as being "features that significantly impede groundwater flow" (DWR 2016c).

The Basin is one of many small, isolated basins in the northeastern region of California, an area with widespread volcanic formations, many of which produce large quantities of groundwater and are not included within the defined groundwater basin due to their classification as "volcanic" rather than "alluvial".

The boundary between Lassen and Modoc counties runs west-east across the Basin. Each county formed a GSA for its respective portion of the Basin and the counties are working together to manage the Basin under a single GSP. The Basin, shown on **Figure 1-1**, encompasses an area of about 144 square miles

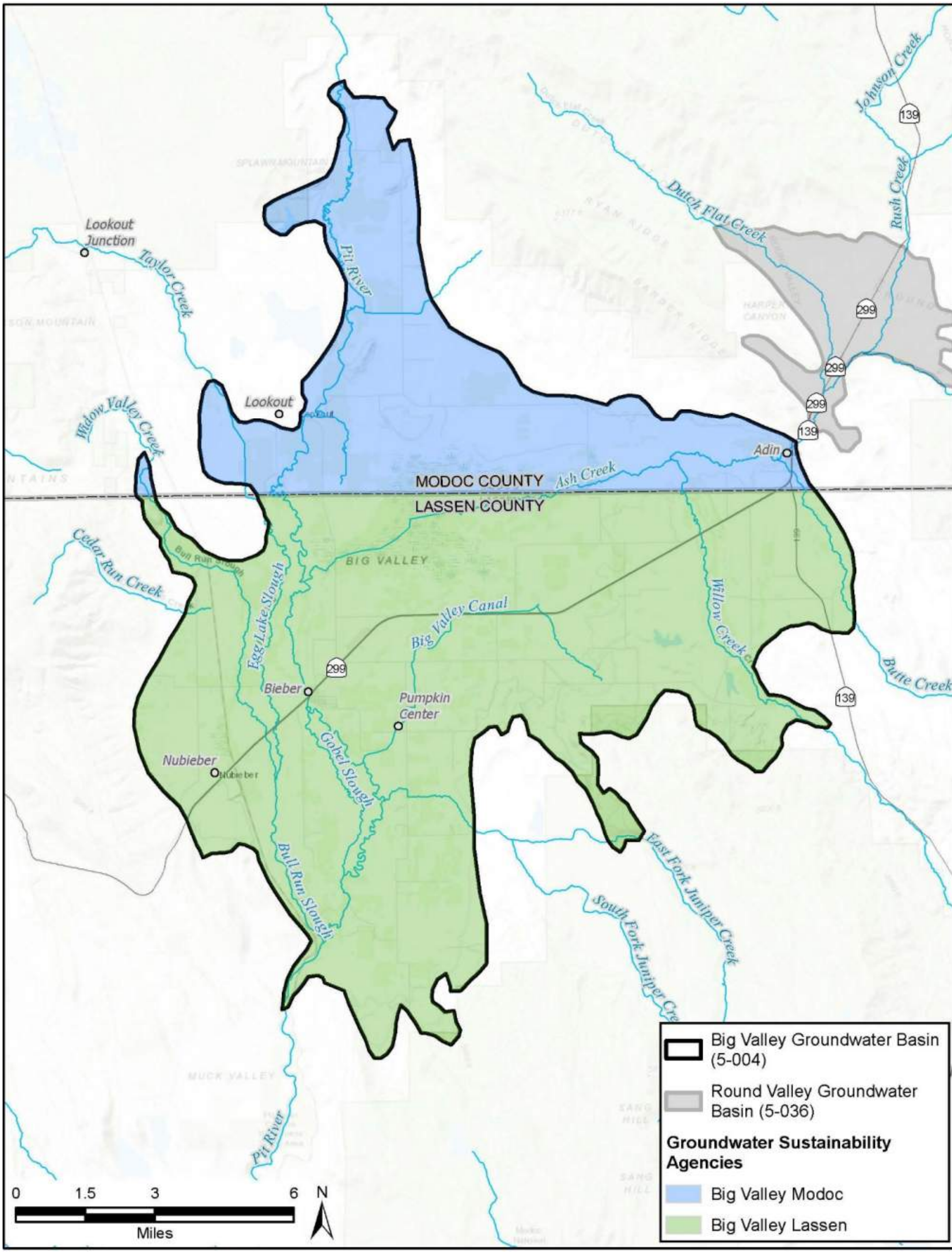

Figure 1-1 Big Valley Groundwater Basin, Surrounding Basins and GSAs
Source: DWR 2018d

with Modoc County comprising 40 square miles (28%) on the north and Lassen County comprising 104 square miles (72%) on the south. The Basin includes the towns of Adin and Lookout in Modoc County and the towns of Bieber and Nubieber in Lassen County. The ACWA is located along the boundary of both counties, occupying 22.5 square miles in the center of the Basin encompassing the marshy/swampy areas along Ash Creek.

The BVGB, as drawn by DWR, is isolated and does not share a boundary with another groundwater basin. However, Ash Creek flows into Big Valley from the Round Valley Groundwater Basin at the town of Adin. Despite the half-mile gap of alluvium which may provide subsurface flow between the two basins, DWR doesn't consider them interconnected due to the way the basin boundary was defined.

The surface expression of the Basin boundary is defined as the contact of the valley sedimentary deposits with the surrounding volcanic rocks. The sediments in the Basin are comprised of mostly Plio-Pleistocene alluvial deposits and Quaternary lake deposits eroded from the volcanic highlands and some volcanic layers interbedded within the alluvial and lake deposits. The Basin is surrounded by Tertiary- and Miocene-age volcanic rocks of andesitic, basaltic and pyroclastic composition. These volcanic deposits may be underlain by alluvial deposits in these upland areas. The boundary between the BVGB and the surrounding volcanic rocks generally correlates with change in topography along the margin of the valley.

Throughout the development of this GSP, the inaccuracies of the Basin boundary have become clear and revisions to the boundary are needed. The hydrogeology of Big Valley is complex and requiring an all or nothing (inside or outside Basin Boundary), one size fits all approach to the Basin under SGMA does not sit well with stakeholders and will be difficult to implement by the GSAs.

2. Agency Information § 354.6

The two Big Valley GSAs were established for the entire BVGB to jointly develop, adopt and implement a single mandated GSP for the BVGB pursuant to SGMA and other applicable provisions of law.

2.1 Agency Names and Mailing Addresses

The following contact information is provided for each GSA pursuant to California Water Code (CWC) §10723.8.

Modoc County
204 S. Court Street
Alturas, CA 96101
(530) 233-6201
tiffanymartinez@co.modoc.ca.us

Lassen County
Department of Planning and Building Services
707 Nevada Street, Suite 5
Susanville, CA 96130
(530) 251-8269
landuse@co.lassen.ca.us

2.2 Agency Organization and Management Structure

The two GSAs, Lassen and Modoc counties, were established in 2017 as required by the unfunded SGMA-mandated legislation. **Appendix 2A** contains the resolutions forming the two agencies. Each GSA is governed by a five-member Board of Supervisors. In 2019, the two GSAs established the BVAC through a MOU, included as **Appendix 2B**. The membership of the BVAC is comprised of:

- One member of the Lassen County Board of Supervisors selected by said Board
- One alternate member of the Lassen County Board of Supervisors selected by said Board
- One member of the Modoc County Board of Supervisors selected by said Board
- One alternate member of the Modoc County Board of Supervisors selected by said Board
- Two public members selected by the Lassen County Board of Supervisors. Said members must either reside or own property within the Lassen County portion of the BVGB
- Two public members selected by the Modoc County Board of Supervisors. Said members must either reside or own property within the Modoc County portion of the BVGB

The decisions made by the BVAC are not binding, but the committee serves the important role of providing formalized, local stakeholder input and guidance to the GSA governing bodies, GSA staff and consultants in developing and implementing the GSP.

2.3 Contact Information for Plan Manager

The plan manager is from Lassen County and can be contacted at:

Gaylon Norwood
Assistant Director
Lassen County Department of Planning and Building Services
707 Nevada Street, Suite 5
Susanville, CA 96130
(530) 251-8269
gnorwood@co.lassen.ca.us

2.4 Authority of Agencies

The GSAs were formed in accordance with the requirements of CWC §10723 et seq. Both GSAs are local public agencies organized as general law counties under the State Constitution and have land use responsibility for their respective portions of the Basin. The resolutions of formation for the GSAs are included in **Appendix 2B**.

2.4.1 Memorandum of Understanding

In addition to the MOU establishing the BVAC, the two GSAs may enter into an agreement to jointly implement the GSP for the Basin. However, this agreement is not a SGMA requirement.

3. Plan Area § 354.8

3.1 Area of the Plan

This GSP covers the BVGB, which is located within Modoc and Lassen counties and is about 144 square miles (92,057 acres). The Basin is a broad, flat plain extending about 13 miles north to south and 15 miles east to west and consists of depressed fault blocks surrounded by tilted fault-block ridges. The BVGB is designated as basin number 5-004 by the DWR and was most recently described in the 2003 update of Bulletin 118 (DWR 2003):

> The basin is bounded to the north and south by Pleistocene and Pliocene basalt and Tertiary pyroclastic rocks of the Turner Creek Formation, to the west by Tertiary rocks of the Big Valley Mountain volcanic series and to the east by the Turner Creek Formation.
>
> The Pit River enters the Basin from the north and exits at the southernmost tip of the valley through a narrow canyon gorge. Ash Creek flows into the valley from Round Valley and disperse into Big Swamp. Near its confluence with the Pit River, Ash Creek reforms as a tributary at the western edge of Big Swamp. Annual precipitation ranges from 13 to 17 inches.

Communities in the Basin are Nubieber, Bieber, Lookout and Adin which are categorized as census-designated places. Highway 299 is the most significant east to west highway in the Basin, with Highway 139 at the eastern border of the Basin. **Figure 3-1** shows the extent of the GSP area (the BVGB) as well as the significant water bodies, communities and highways.

Lassen and Modoc counties were established as the exclusive GSAs for their respective portions of the Basin in 2017. **Figure 3-1** shows the two GSAs within the Basin. Round Valley Basin (5-036) is a very low-priority basin to the northeast; DWR does not consider it to be connected to Big Valley Basin, but there is a half-mile-wide gap of alluvium between the basins. The ACWA occupies 22.5 square miles (14,400 acres) in the center of Big Valley.

No other GSAs are associated with the Basin, nor are there any areas of the Basin that are adjudicated or covered by an alternative to a GSP. **Landowners have the right to extract and use groundwater beneath their property.**

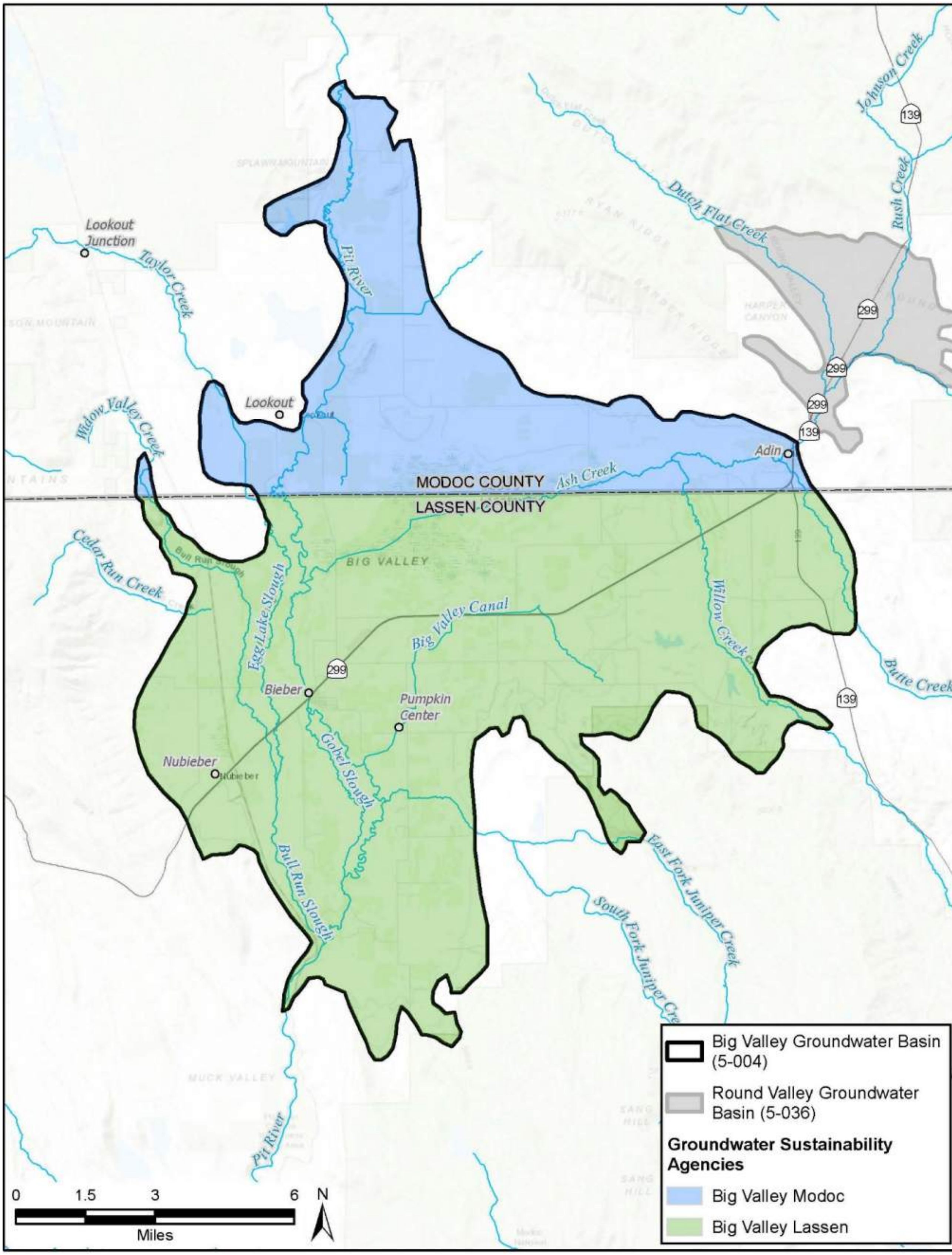

Figure 3-1 Area Covered by the GSP

Source: DWR 2018d

3.2 Jurisdictional Areas

In addition to the GSAs, other entities have water management authority or planning responsibilities in the Basin, as discussed below. A map of the jurisdictional areas within the Basin is shown on **Figure 3-2**.

3.2.1 Superior Courts

SGMA does not alter existing water rights. Therefore, water use in the Basin exists within the confines of state water law and existing water rights. These rights are ultimately governed by court decisions. In Big Valley, two decrees govern much of the surface water rights allocations: Decree 3670 (1947) for Ash Creek and Decree 6395 (1959) for the Pit River. Any changes to these and any other judgments relevant to Big Valley would have to go through the superior courts.

3.2.2 Federal Jurisdictions

The U.S. Bureau of Land Management (BLM) and the U.S. Forest Service (USFS or Forest Service) have jurisdiction over land within the Basin including portions of the Modoc National Forest, shown on **Figure 3-2**. Information on their Land and Resource Management Plan is described in Section 3.8. The Forest Service Ranger Station in Adin is a non-community public water supplier with a groundwater well, identified as Water System No. CA2500547. (SWRCB 2021)

3.2.3 Tribal Jurisdictions

The U.S. Bureau of Indian Affairs (BIA) Land Area Representations database identifies one tribal property in the BVGB (BIA 2020a). Lookout Rancheria, shown on **Figure 3-2**, is associated with the Pit River Tribe. There are other "public domain allotments" or lands held in trust for the exclusive use of individual tribal members within the Basin not shown. (BIA 2020b)

3.2.4 State Jurisdictions

The CDFW has jurisdiction over the ACWA, as shown on **Figure 3-2**.

3.2.5 County Jurisdictions

The County of Modoc and the County of Lassen have jurisdiction over the land within the Basin in their respective counties as shown on **Figure 3-1** and **Figure 3-2**. Information on their respective General Plans is provided in Section 3.7 – Land Use Plans. Within the Basin, Modoc County includes the census-designated community of Adin and part of the community of Lookout. Lassen County contains the census-designated communities of Bieber and Nubieber.

3.2.6 Agencies with Water Management Responsibilities

Upper Pit Integrated Regional Water Management Plan

Big Valley lies within the area of the Upper Pit Integrated Regional Water Management Plan (IRWMP), which was developed by the Regional Water Management Group (RWMG). The IRWMP is managed by the North Cal-Neva Resource Conservation and Development Council (North Cal-Neva), a member of the RWMG along with 27 other stakeholders. Other stakeholders include community organizations,

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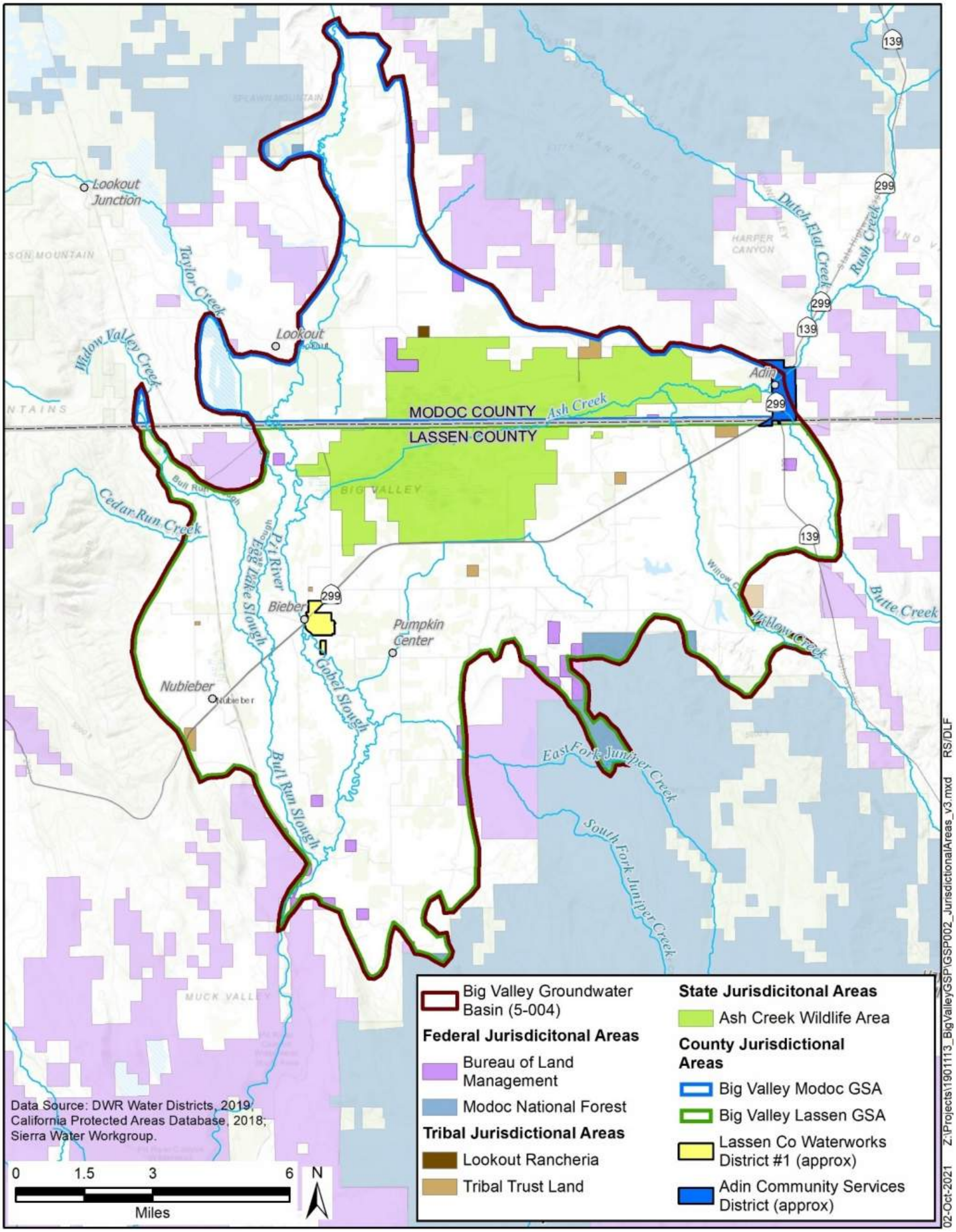


623 **Figure 3-2 Jurisdictional Areas**

environmental stewards, water purveyors, numerous local, county, state and federal agencies, industry, the University of California, and the Pit River Tribe. The IRWMP addresses a 3-million-acre watershed across four counties in northeastern California. **Figure 3-3** shows the Upper Pit IRWMP boundary and the BVGB's location in the center of the IRWMP area. **Figure 3-3** also shows the complete watershed that flows into the BVGB and the local watershed area. At 92,057 acres, the BVGB comprises about 3 percent of the IRWMP area at its center.

The IRWMP was established under the Integrated Regional Water Management Act (Senate Bill [SB]1672) which was passed in 2002 to foster local management of water supplies to improve reliability, quantity and quality and to enhance environmental stewardship. Several propositions were subsequently passed by voters to provide funding grants for planning and implementation. Beginning in early 2011, an IRWMP was developed for the Upper Pit River area and was adopted in late 2013. During 2017 and 2018, the IRWMP was revised according to 2016 guidelines.

Lassen-Modoc County Flood Control and Water Conservation District

The Lassen-Modoc County Flood Control and Water Conservation District (District) was established in 1959 by the California Legislature and was activated in 1960 by the Lassen County Board of Supervisors (LAFCo 2018). The entirety of the Lassen and Modoc counties portions of the Basin is covered by the District, extending from the common boundary northward beyond Canby and Alturas, as shown on **Figure 3-3**. In 1965, the District established Zone 2 in a nearly 1000-square mile area encompassing and surrounding Big Valley and, in 1994, the District designated boundaries for management Zone 2A for, "…groundwater management including the exploration of the feasibility of replenishing, augmenting and preventing interference with or depletion of the subterranean supply of waters used or useful or of common benefit to the lands within the zone." (LAFCo 2018) These zones are shown on **Figure 3-4**.

Watermasters

Two entities measure water diversions for reporting to the State Water Resources Control Board (SWRCB). These include the Big Valley Water Users Association (BVWUA) and the Modoc County Watermaster. The boundaries of these two entities are shown on **Figure 3-4**. Numerous private parties also measure and report their water diversions.

Lassen County Waterworks District #1

Lassen County Waterworks District #1 (LCWD #1) was established in 1932 originally for the purpose of fire protection. Homes started being added to the system in the 1940's and eventually all residential and commercial properties became part of the system, with most properties leaving their private wells unused. LCWD #1 now provides both water and sewer services to the customers within its boundary shown on **Figure 3-2**. (Hutchinson 2021)

Adin Community Services District

Adin Community Services District provides wastewater services to the town of Adin. The district boundary is shown on **Figure 3-2**.

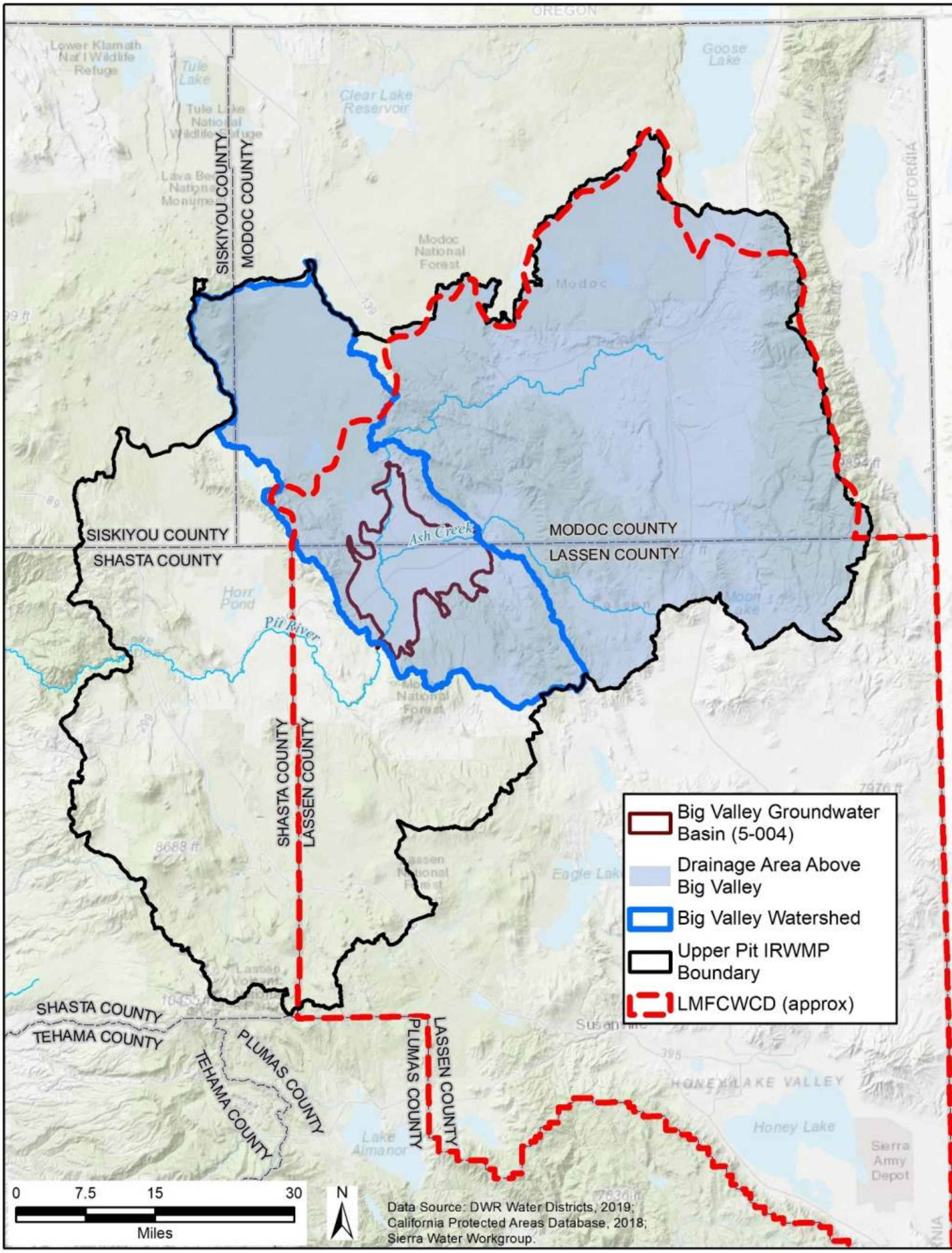


Figure 3-3 Upper Pit IRWMP, Watershed, and LMFCWCD Boundaries

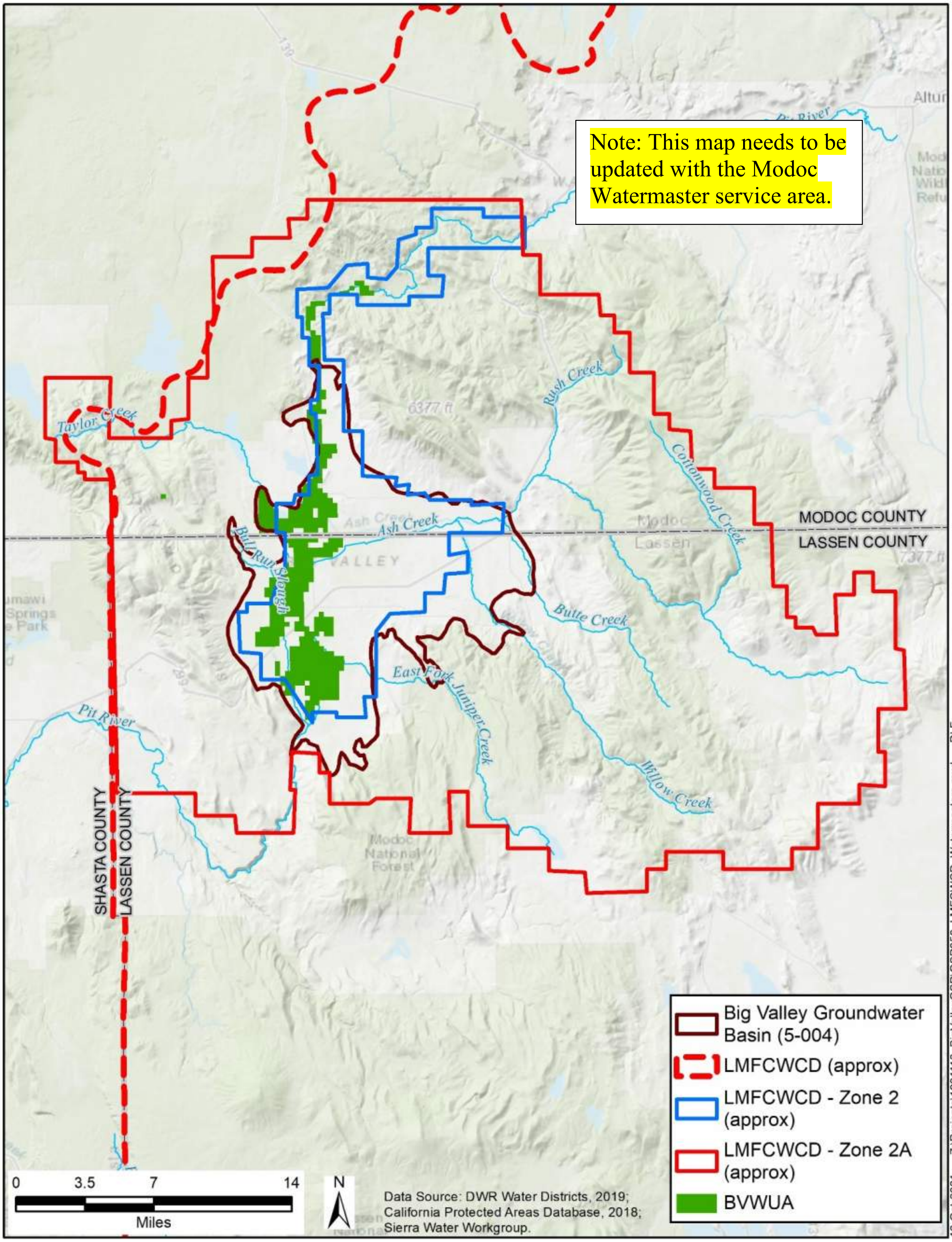


Figure 3-4 LMFCWCD Zones and Watermaster Service Areas

3.3 Land and Water Use

This section describes land use in the BVGB, water use sectors and water source types using the best available data. The most recent, best available data for distinguishing surface water and groundwater uses comes from DWR land use datasets. This data is developed by DWR "…to serve as a basis for calculating current and projected water uses." (DWR 2021d) Surveys performed prior to 2014 were developed by DWR using some aerial imagery with field verification. These previous surveys also included DWR's estimate of water source.

Since 2014, DWR has developed more sophisticated methods of performing the surveys with a higher reliance on remote sensing information. These more recent surveys do not make available the water source. **Table 3-1** is a listing of the years for which surveys are available.

Table 3-1 Available DWR Land Use Surveys

Year	Modoc County	Lassen County	Water Source Included
1997	Yes	Yes	Yes
2011	Yes	No	Yes
2013	No	Yes	Yes
2014	Yes	Yes	No
2016	Yes	Yes	No[a]

Note:
[a] DWR provided the GSAs a hybrid dataset with the 2011 and 2013 water sources superimposed onto the 2016 land use
Source: DWR 2020d

Land use in the BVGB is organized into the water use sectors listed in **Table 3-2**. These sectors differ from DWR's water use sectors identified in Article 2 of the GSP regulations because DWR's sectors don't adequately describe the uses in Big Valley. **Figure 3-5** shows the 2016 distribution of land uses and **Table 3-2** summarizes the acreages of each. Several data sources were used to designate land uses as described below, including information provided by DWR through a remote sensing process developed by Land IQ. (DWR 2016d) Other data sources are described below.

- **Community** This is non-agricultural, non-industrial water use in the census-designated places of Bieber, NuBieber and Adin, although some of these areas may also have some minor industrial uses. These community areas were delineated using the areas designated as "urban" by DWR (2016d). DWR's data included the areas north and northeast of Bieber (area of the former mill and medical center) as "urban." For this GSP, those areas were re-categorized from urban to industrial, as that is more descriptive of the actual land use. In addition, parcels that make up the core of Nubieber were included as community.
- **Industrial** There is limited industrial use in the Basin. The DWR well log inventory shows 6 industrial wells, all located at the inactive mill in Bieber. The areas north and northeast of Bieber, including the former mill and the medical center have been categorized as industrial. In addition, the parcels associated with railroad operations in Nubieber were added. There is some

industrial use associated with agriculture but that is included under the agricultural water use sector.

- **Agricultural** Agricultural use is spread across the Basin and was delineated using DWR's (2016g) land use data[10].
- **State Wildlife Area** The area delineated in **Figure 3-5** is the boundary of the ACWA, located within the center of the Basin. The area includes some wetlands created by the seasonal flow of 6 streams and year-round flow from Ash Creek. The area also has upland ecosystems.
- **Managed Recharge** Flood irrigation of some fields and natural flooding of lowland areas provides recharge to the Basin even though it is not of a formalized nature that would put it into this managed recharge category. Some of the future projects and management actions in this GSP include managed recharge.
- **Native Vegetation** Native vegetation is widespread throughout the Basin. Many of the areas under this category also have domestic users. Native vegetation and domestic land uses are categorized together because it is not possible to distinguish between the two with readily available data.
- **Domestic** This sector includes water use for domestic purposes, which aren't located in a community service district. Domestic use generally occurs in conjunction with agricultural and native vegetation and is best represented on the map categorized with native vegetation, as most of the agricultural area is delineated by field and does not include residences.

Table 3-2 2016 Land Use Summary by Water Use Sector

Water Use Sector	Acres	Percent of Total
Community[a]	250	<1%
Industrial	196	<1%
Agricultural	22,246	24%
State Wildlife Area[b]	14,583	16%
Managed Recharge	-	0%
Native Vegetation and Rural Domestic[c]	54,782	60%
Total	**92,057**	**100%**

Notes:
[a] Includes the use in the communities of Bieber, Nubieber and Adin
[b] Made up of a combination of wetlands and non-irrigated upland areas
[c] Includes the large areas of land in the Valley which have domestic wells interspersed
Source: Modified from DWR 2020d

Many of the lands within the Basin are enrolled in the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP). The CRP is a land conservation program administered by the Farm Service Agency (FSA). In exchange for a yearly rental payment, farmers enrolled in the program agree to promote plant species that will improve environmental health and quality. Contracts for land enrolled

[10] This dataset has been identified as being inaccurate and has been included as a data gap.

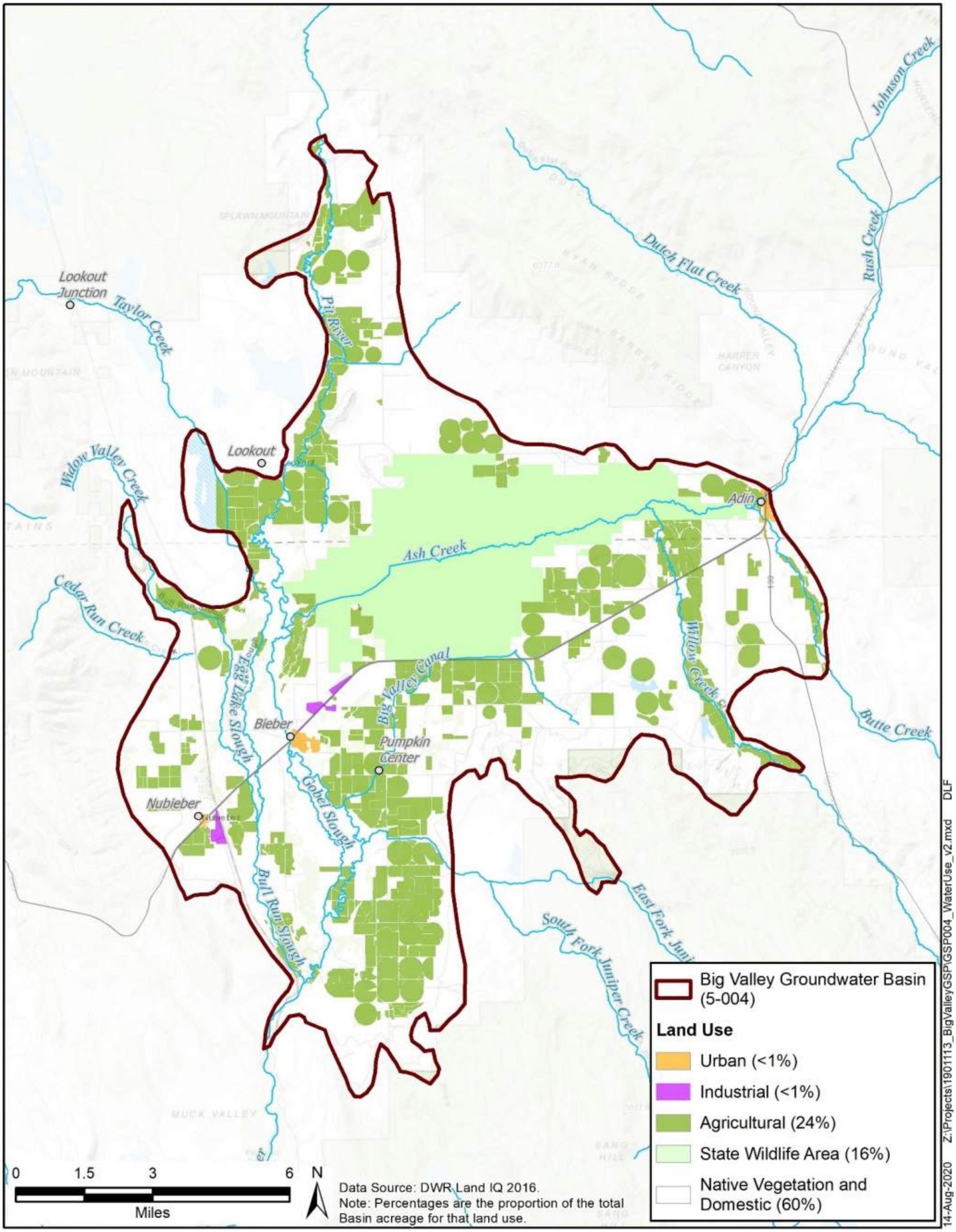


Figure 3-5 Land Use by Water Use Sector

in the CRP vary in length. The WRP is a similar program for wetlands was available for enrollment until February 7, 2014. Land enrolled in the program before the end date continues to be enrolled until the termination of the contract.

In addition to the uses described above, the Big Valley GSAs are aware of illegal land use activity within the Basin (i.e., unlicensed marijuana growers) which is likely having a negative impact on surface water quality and quantity within the Basin. This illegal activity is occurring both within the alluvial portion of the Basin and the upstream watershed and often includes groundwater use and illegal diversions of surface water. Lassen and Modoc counties have limited staff to monitor and report this situation and enforcement action is within the purview of state and federal agencies. These agencies include the Bureau of Cannabis Control, CDFW, State Water Board, USFS and the BLM. To date, these state and federal agencies have not taken aggressive enforcement action against this illegal activity and according to county staff (Norwood 2020-2021), the problem is getting noticeably worse over time. The timing and volume of these illegal diversions cannot be quantified at this time.

3.3.1 Water Source Types

The Basin has two water source types: groundwater and surface water. Recycled water[11] and desalinated water are not formally utilized in the Basin nor is stormwater used as a formal, measured supplemental water supply at the time of the development of this GSP. Informal reuse of irrigation water occurs with capture and reuse of tail water by farmers and ranchers. Storm water is stored in reservoirs for future use as a water source. **Figure 3-6** and shows an approximate distribution of water sources to lands throughout the Basin. Chapter 6 – Water Budget provides details on how the sources were mapped for this figure.

There are three public water suppliers (as designated by the State Water Board) in the Basin which use groundwater: LCWD #1 in Bieber, the Forest Service Ranger Station in Adin and the California Department of Forestry and Fire Protection (CAL FIRE) conservation camp west of the BVGB. The conservation camp is located outside the Basin boundary, but their supply well is inside the Basin and the water is pumped to the camp. Many domestic users have groundwater wells, but there are some surface water rights from Ash Creek and the Pit River that are designated for domestic use. The ACWA is fundamentally supported by surface water, but the CDFW does have three wells that are utilized in the fall for ecological enhancement.

3.4 Inventory and Density of Wells

3.4.1 Well Inventory

The best available information about the number, distribution and types of wells in Big Valley comes from well completion reports (WCRs) maintained by DWR[12]. The most recent catalog of WCRs was provided through their website (DWR, 2018c) as a statewide map layer. This data includes an inventory

[11] Recycled water generally refers to treated urban wastewater that is used more than once before it passes back into the water cycle. (WateReuse Association, 2020)

[12] All water well drillers with a C57 drilling license in California are required to submit a well completion report to DWR whenever a well is drilled, modified, or destroyed.

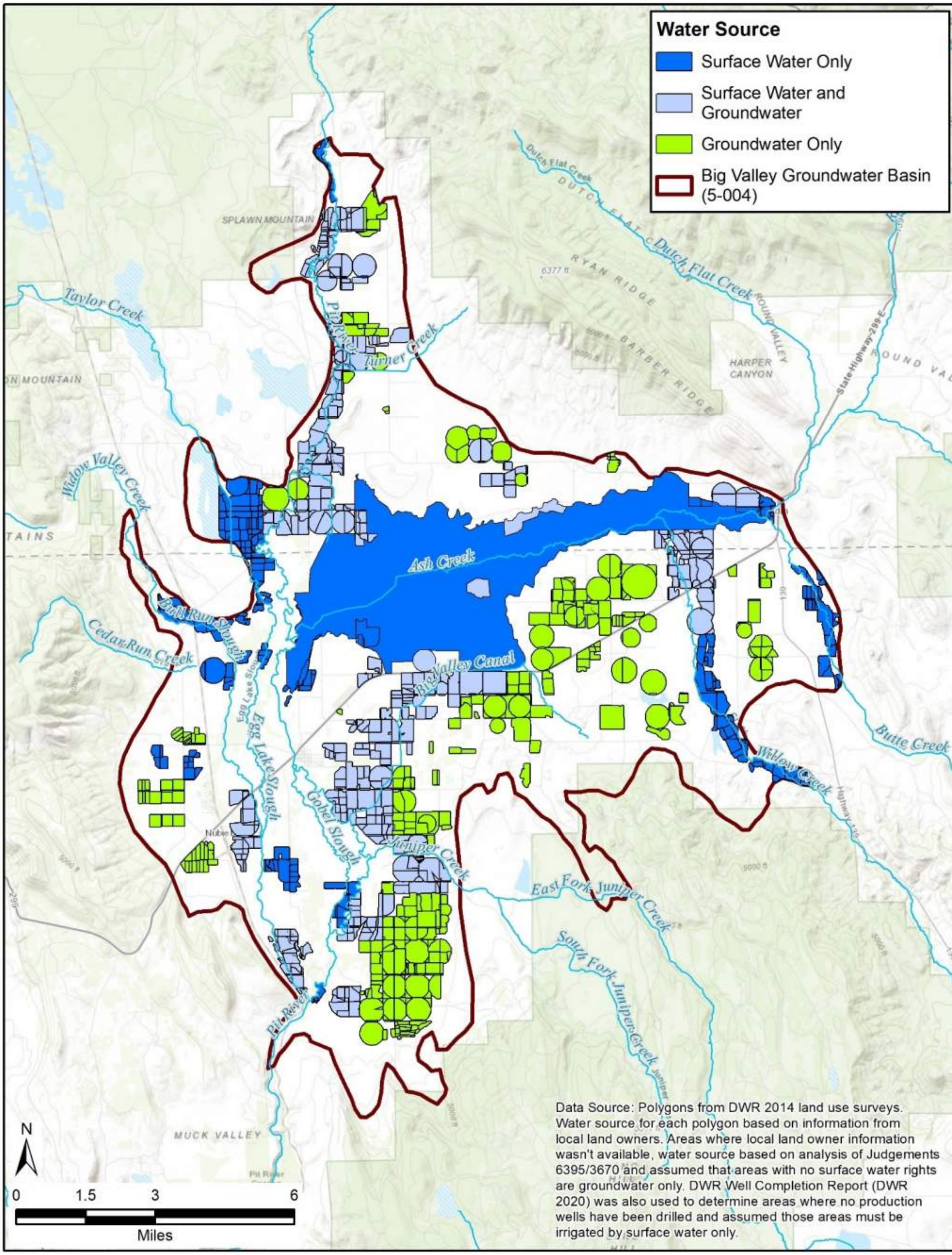


Figure 3-6 Water Sources

and statistics about the number of wells in each section[13] under three categories: domestic, production, or public supply. **Table 3-3** shows the unverified number of wells in the BVGB for each county from this data. Many wells may be inactive or abandoned and this data gap will need to be filled over time. Once this data gap is filled, Basin priority could be affected.

Table 3-3 Well Inventory in the BVGB

WCR 2018 DWR Map Layer			DWR 2015 and 2017 WCR Inventory		
Type of Well [a]	**Lassen County Total Wells**	**Modoc County Total Wells**	**Proposed Use of Well [b]**	**Lassen County Total Wells**	**Modoc County Total Wells**
Domestic	136	81	Domestic	142	79
Production	177	76	Irrigation	157	65
			Stock	11	5
			Industrial	6	0
Public Supply	5	1	Public	5	1
Subtotal =476	**318**	**158**	**Subtotal = 471**	**321**	**150**
			Monitor	55	0
			Test	25	29
			Other	7	2
			Unknown	27	7
Total =476	**318**	**158**	**Total = 623**	**435**	**188**

Source:
[a] DWR 2018 Statewide Well Completion Report Map Layer; downloaded April 2019.
[b] DWR Well Completion Report Inventories from DWR data provided to the counties in 2015 and 2017

Lassen and Modoc counties had requested and received WCRs for their areas from DWR during 2015 and 2017, respectively. An inventory of the wells was included by DWR. This data source had additional well categories included as shown in **Table 3-3**, which are more closely tied to the categories identified by the well drillers when each WCR is submitted and provides additional information about the use of the wells.

The correlation between the 2018 WCR map layer categories and the categories in the 2015 and 2017 WCR inventory provided to the counties is indicated in **Table 3-3** by the grey shading. The table shows similar totals from the two datasets for the number of domestic, production and public supply wells. It is unknown why these two datasets don’t match exactly, but both datasets are provided to represent the data available for this GSP. As stated earlier, verification of the data in this table needs to occur. This table shows that more than 600 wells have been drilled, of which 476 are of a type that could involve extraction (i.e., domestic, production, or public supply)[14]. It is unknown how many wells are actively used, as some portion of them are likely abandoned. Abandoned wells no longer in use should be

[13] A section is defined through the public land survey system as a 1 mile by 1 mile square of land.
[14] It should be noted that the majority of the stock watering wells were drilled in the 2009 to 2014 timeframe as part of the EQIP program to move watering of stock away from stream channels and that this increase in the inventory of wells in the Basin was used by DWR to put Big Valley into the medium prioritization category.

formally destroyed in accordance with state well standards. The 2015 and 2017 inventory of WCRs showed six well destructions, all on the Lassen County side of the Basin. It should be noted that some of the recent wells in the Basin were drilled in cooperation with the EQUIP program to provide stock watering outside the riparian area to improve surface water quality.

3.4.2 Well Density

Figure 3-7, **Figure 3-8** and **Figure 3-9** show the density of wells in the Basin per square mile for domestic, production and public supply, respectively, based on the 2018 WCR DWR map layer. These maps provide an approximation of extraction well distributions and give a general sense of where groundwater use occurs.

Figure 3-7 shows that domestic wells are in 74 of the 180 sections (including partial sections) that comprise the BVGB. The density varies from 0 to 18 wells per square mile with a median value of two wells per section and an average of three wells per section. The highest densities of domestic wells are located near Adin, Bieber and Lookout and in a section to the east of Lookout and a section south of Adin. In addition, 22 wells are present in the four sections around the town of Nubieber. Virtually all the domestic wells in Bieber are no longer used since the community water system was developed. (Hutchinson 2020-2021)

Figure 3-8 shows that production wells (primarily for irrigation) are located in 93 of the 180 sections with a maximum density of nine wells per section (median: 2 wells per section, average: nearly 3 wells per section). The highest densities of production wells are located between the towns of Bieber and Adin, to the southeast of Bieber and one section northeast of Lookout.

Figure 3-9 shows that public supply wells have been drilled in four sections. It should be noted that the designation as a public supply well that is depicted on the map is from the designation provided in the WCR by the driller when the well was drilled. The State Water Board identifies three public water suppliers in the BVGB: LCWD #1 which is a community system with two wells serve Bieber; the Forest Service station in Adin which maintains a well for non-community supply to its employees and visitors; and the CAL FIRE conservation camp west of the Basin. These public suppliers account for three of the six public wells with WCRs. The other three are either inactive or aren’t designated by the State Water Board as public supply. The CAL FIRE conservation camp well does not show up as a public supply well in the WCR inventory, but its location is shown on **Figure 3-9**.

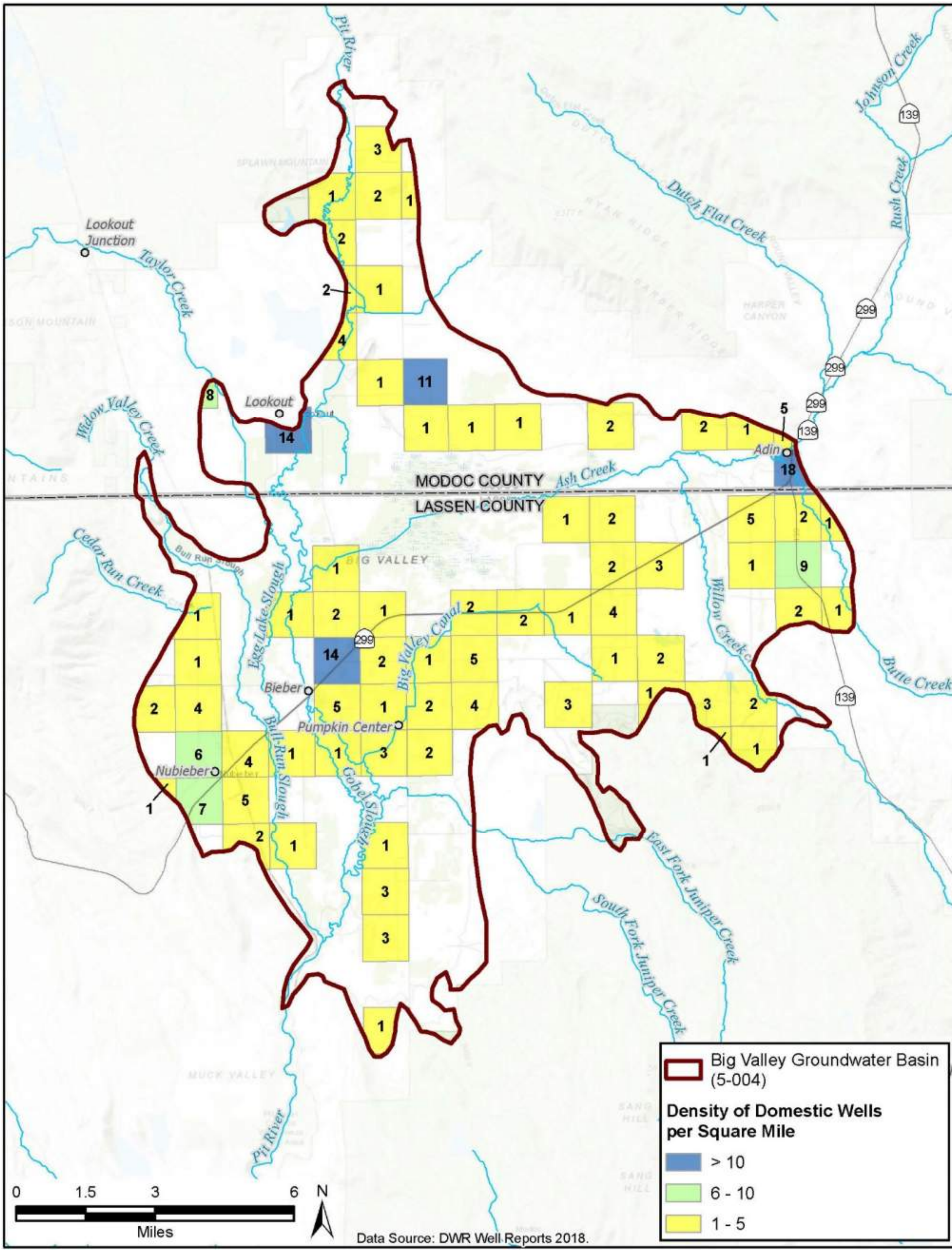


Figure 3-7 Density of Domestic Wells

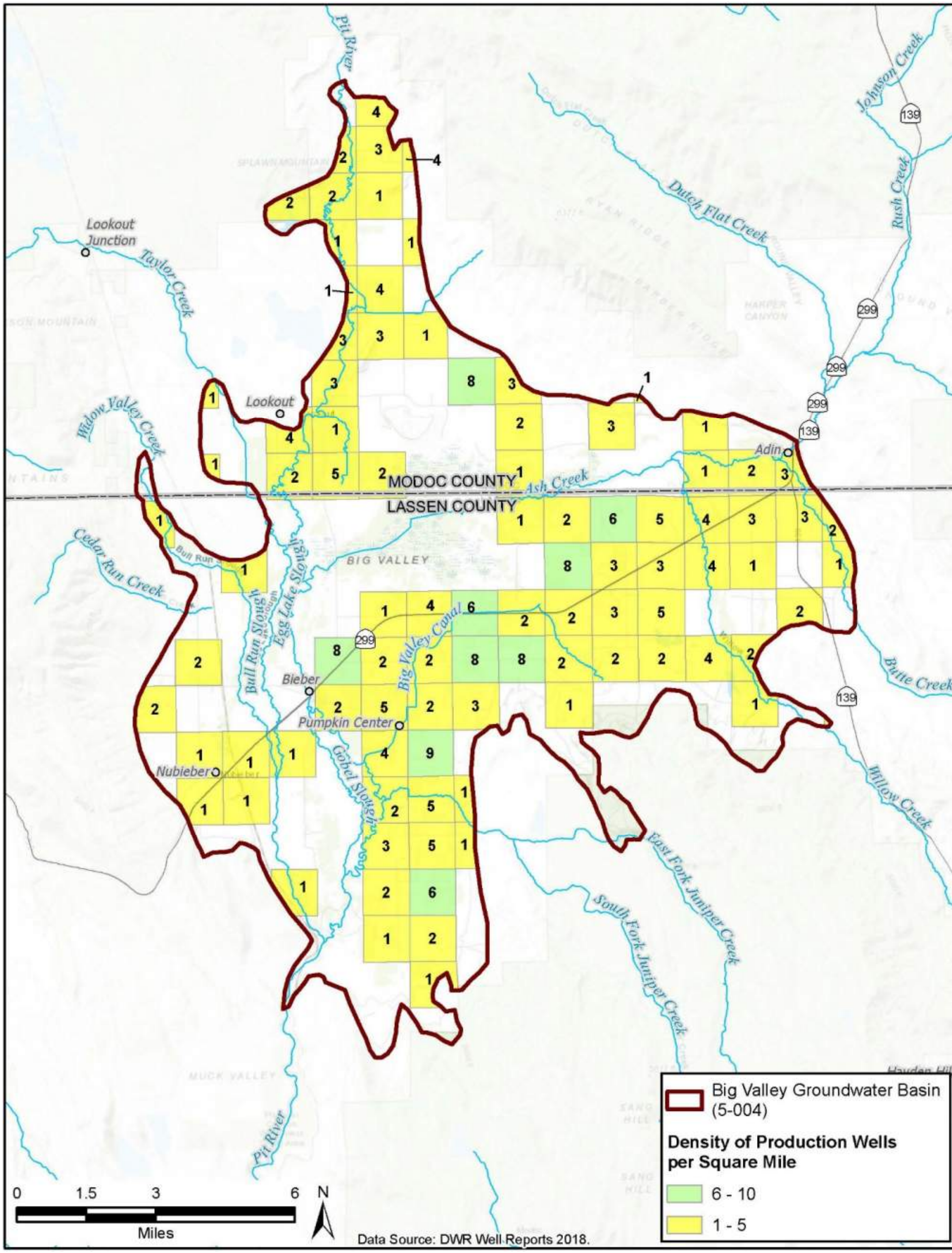


Figure 3-8 Density of Production Wells

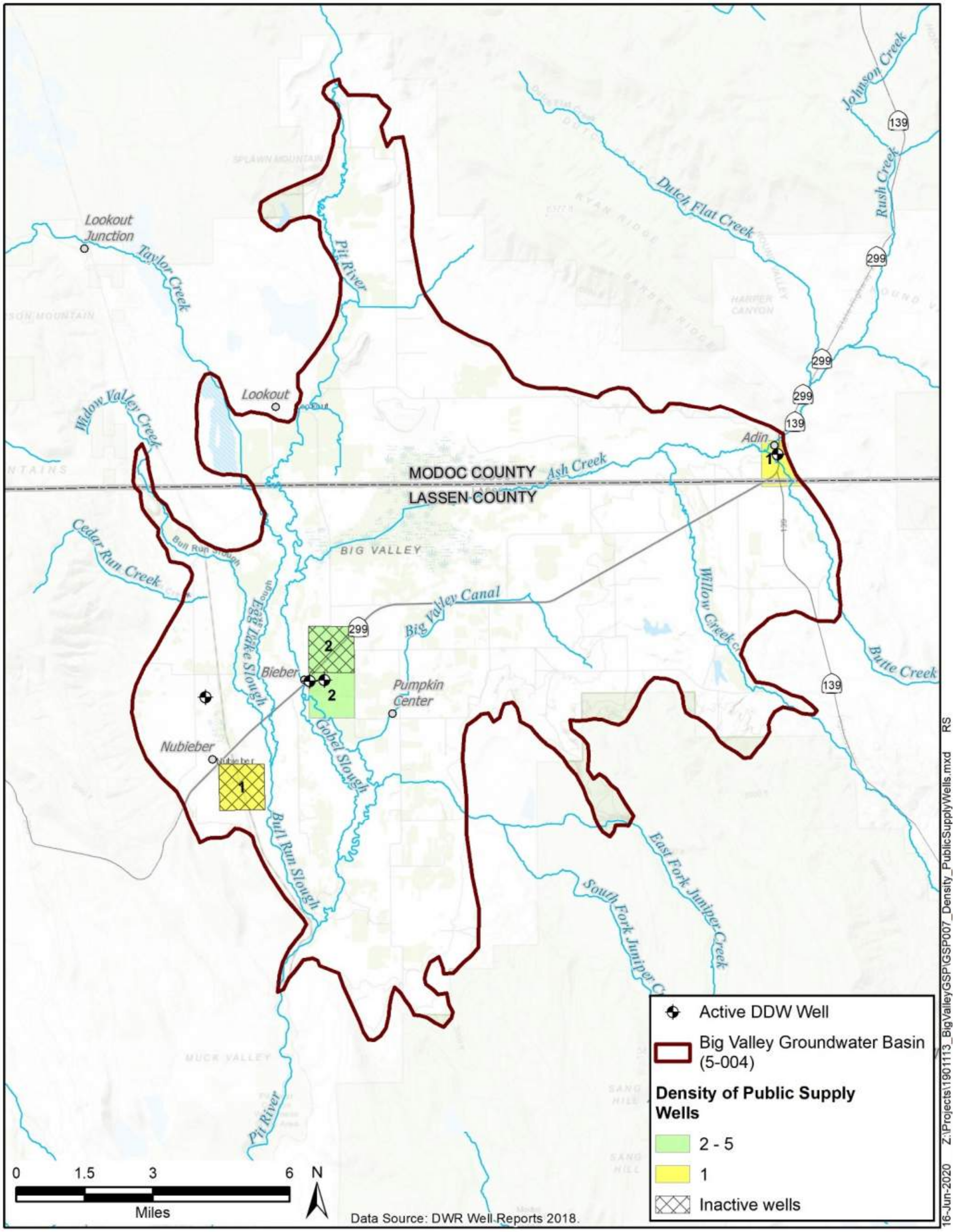


Figure 3-9 Density of Public Supply Wells

3.5 Existing Monitoring, Management and Regulatory Programs

3.5.1 Monitoring Programs

This section describes the existing monitoring programs for data used in this GSP and describes sources that can be used for the GSP monitoring networks.

3.5.1.1 Groundwater Monitoring

Levels

Lassen and Modoc counties are the monitoring entities for the CASGEM program. Each county has an approved CASGEM monitoring plan which provides for water level measurements twice a year (spring and fall) at 21 wells. The monitoring is performed by staff from DWR on behalf of the counties. All but one of the wells have depth information and depths range from 73 to 800 feet below ground surface [ft bgs], (median: 270 ft bgs, mean: 335 ft bgs). **Figure 3-10** shows the locations of the 21 CASGEM wells and one additional well which has historic data, but measurements were discontinued in the 1990's.

Lassen and Modoc counties drilled five monitoring well clusters between 2019 and 2020. Each cluster consists of three shallow wells and one deep well. The locations of these clusters and the depth of the deep well at each site is shown on **Figure 3-10**.

Quality

Water quality is regulated and monitored under a myriad of programs. **Table 3-4** describes the programs relevant to Big Valley. The State Water Board makes groundwater data from many of these programs available on their Groundwater Ambient Monitoring and Assessment (GAMA) Groundwater Information System (GAMA GIS) website (State Water Board 2019). **Table 3-5** lists and describes the groundwater programs from which historic data is available on GAMA GIS. The locations of wells with historic water quality data from GAMA GIS are shown on **Figure 3-11.**

Along with the many programs that monitor surface water quality, the following are currently in place to monitor groundwater quality on an ongoing basis:

- Public Drinking Water Systems (State Water Board's Division of Drinking Water [DDW])
- Monitoring associated with Underground Storage Tanks (USTs) and Waste Discharge Requirement

The BVGB contains three active public water suppliers regulated by the DDW: Lassen County Water District #1 in Bieber, the Forest Service station in Adin and the CAL FIRE conservation camp west of the Basin. Water quality monitoring at wells regulated by the DDW can be used for ongoing monitoring in the Basin and their locations are shown on **Figure 3-11**. At each of five newly constructed monitoring well clusters, the deep well at each site was sampled for water quality after construction. The locations of the well cluster sites are shown on **Figure 3-11**.

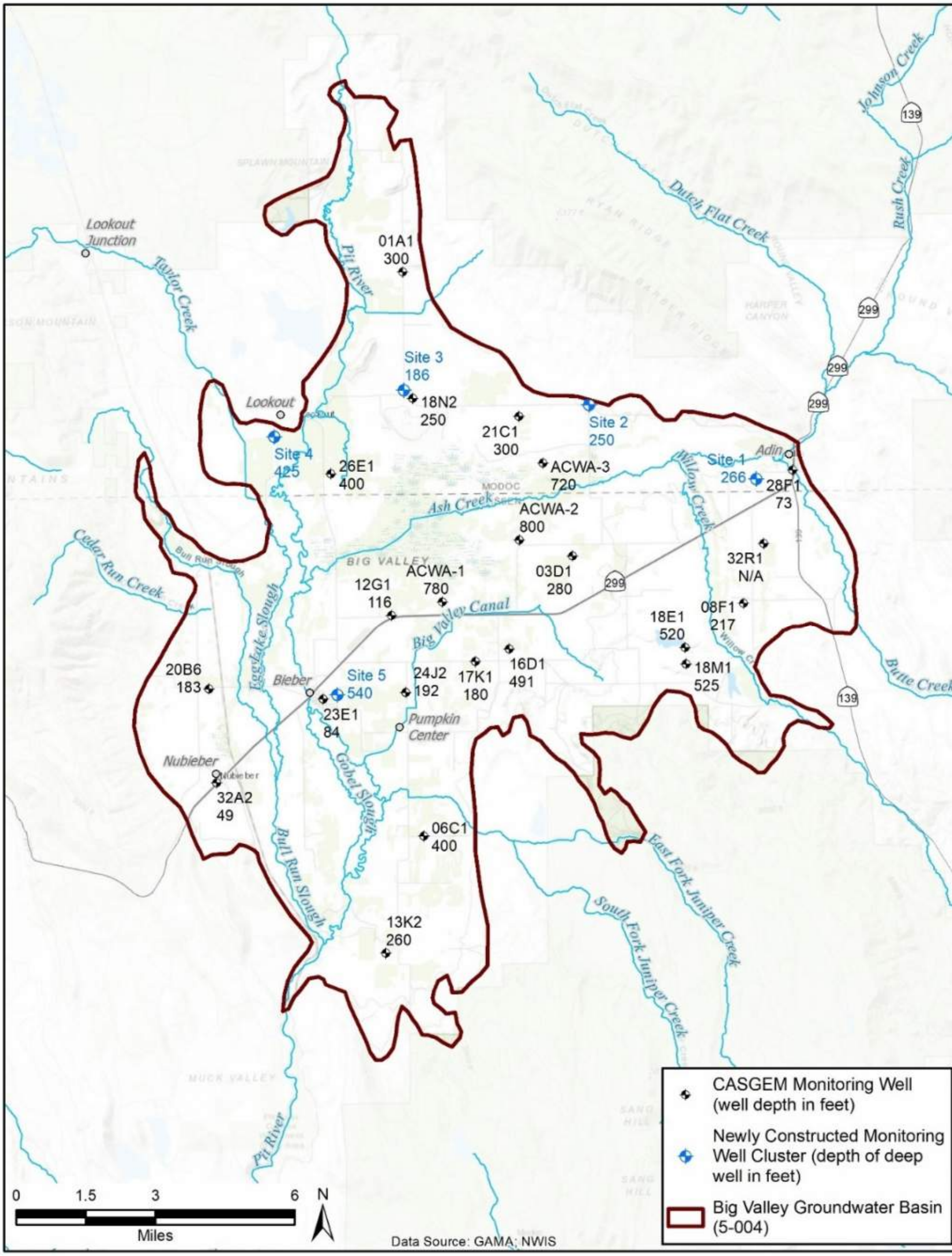


Figure 3-10 Water Level Monitoring Network

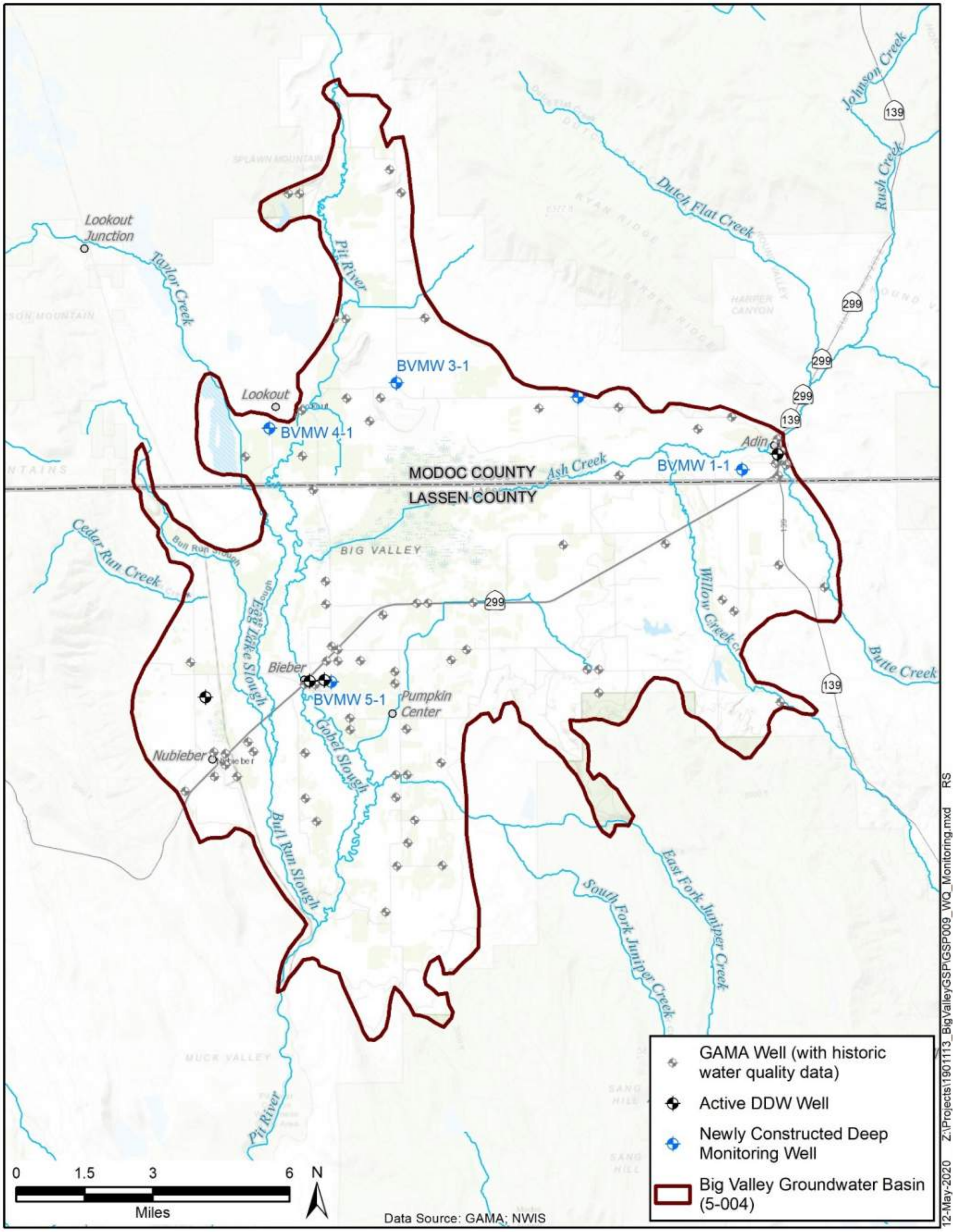


Figure 3-11 Water Quality Monitoring

Table 3-4 Water Quality Monitoring Programs

Program	Description
Irrigated Lands Regulatory Program (ILRP)	Initiated in 2003 to prevent agricultural runoff from impairing surface waters, and in 2012 groundwater regulations were added to the program. To comply with the ILRP, Big Valley growers were forced to join the Northeastern California Water Association (NECWA), which is a sub-watershed coalition of the Northern California Water Association. Growers pay increasing fees to NECWA for monitoring and compliance with the ILRP even though Big Valley farmers grow low intensity crops that generally don’t require nitrogen application or cause water quality degradation.
Waste Discharge Requirements (WDR) Program	Also known as the Non-Chapter 15 Permitting, Surveillance and Enforcement Program, is a mandated program issuing WDRs to regulate the discharge of municipal, industrial, commercial and other wastes to the land that will or have the potential to affect groundwater.
Central Valley Salinity Coalition (CVSC)	Represents the stakeholder groups working with the State Water Board in the CV-SALTS collaborative basin planning process.
RWQCB Basin Plan	Adopted by the Regional Water Board and approved by the State Water Board and the Office of Administrative Law. The U.S. Environmental Protection Agency approves the water quality standards contained in the Basin Plan, as required by the Clean Water Act (CWA).
Public Drinking Water Regulations	Effective July 1, 2018, various sections of California Code of Regulations, Title 27 were revised. Revisions to Title 27 were necessary in order to reorganize, update and incorporate new parameters for administering the Unified Program and accomplishing the objectives of coordination, consolidation and consistency in the protection of human health, safety and the environment.
Total Maximum Daily Load Program (TMDL) Program	TMDLs are established at the level necessary to implement the applicable water quality standards.
Local Agency Management Programs	These programs regulate Onsite Water Treatment Systems (OWTSs) and the programs are designed to “correct and prevent system failures due to poor siting and design and excessive OWTS densities.” (RWQCB 2021)
Underground Storage Tank Site Cleanup Program (UST)	The purpose of the UST Program is to protect the public health and safety and the environment from releases of petroleum and other hazardous substances from USTs.
National Pollutant Discharge Elimination System (NPDES)	The NPDES permit program, created in 1972 by the CWA, helps address water pollution by regulating point sources that discharge pollutants to waters of the U.S.. The permit provides two levels of control: technology-based limits and water quality-based limits (if technology-based limits are not sufficient to provide protection of the water body).
Nonpoint Source Program (NSP)	NSP focuses and expands the state’s efforts over the next 13 years to prevent and control nonpoint source pollution. Its long-term goal is to implement management measures by the year 2013 to ensure the protection and restoration of the state’s water quality, existing and potential beneficial uses, critical coastal areas and pristine areas. The state’s nonpoint source program addresses both surface and ground water quality.
Other	Water quality samples are required when a property is sold and when a foster child is placed.

Table 3-5 Datasets Available from State Water Board's GAMA Groundwater Information System

Name	Source
DDW	Division of Drinking Water, State Water Board
DPR	Department of Pesticide Regulation
DWR	California Department of Water Resources
GAMA_USGS	Groundwater Ambient Monitoring and Assessment Program performed by USGS
USGS_NWIS	USGS National Water Information System
WB_CLEANUP	Water Board Cleanup
WB_ILRP	Water Board Irrigated Lands Regulatory Program

Source: GAMA GIS available at https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/

The Basin has five active groundwater cleanup sites in various stages of assessment and remediation, all located in the town of Bieber. These sites are not appropriate for ongoing monitoring for the GSP because they monitor only the shallow aquifer and represent a localized condition that may not be representative of the overall quality of groundwater resources in the Basin. One of the open sites is the Bieber Class II Solid Waste Municipal Landfill which has ongoing water quality monitoring. The Lookout Transfer Station also has ongoing water quality monitoring but is located outside the boundaries of the BVGB.

Growers in Big Valley are required to participate in the ILRP, which imposes a fee per acre, through the Sacramento Valley Water Quality Coalition (SVWQC). The SVWQC Monitoring and Reporting Plan does not include any wells within the BVGB. Basin residents have expressed concerns with regulatory programs that involve costs, especially ongoing costs, particularly for a disadvantaged community. The Goose Lake Basin, which has similar land use and land use practices, has been exempted from the ILRP.

3.5.1.2 Surface Water Monitoring

Streamflow

Streamflow gages have historically been constructed and monitored within the BVGB, but active, maintained streamflow gages for streams in BVGB are limited. For the Pit River, the closest active gage that monitors stage and streamflow is located at Canby, 20 miles upstream of Big Valley. Flow on Ash Creek was measured at a gage in Adin from 1981 to 1999 and was reactivated in Fall 2019 to provide stream stage data at 15-minute intervals. There is a gage where the Pit River exits the Basin in the south at the diversion for the Muck Valley Hydro Power Plant. Stream gages are shown on **Figure 3-12**.

Diversions

Two watermasters, described below, measure diversions in the BVGB. Those surface water rights holders who divert more than 10 AFY whose rights are not measured by a watermaster must measure and report their diversions to the State Water Board.

Diversions from the Pit River are detailed in water rights Decree #6395. In 2006, the BVWUA petitioned the Modoc Superior Court who granted permission to separate from the costly state watermaster service. A private watermaster service is now contracted by the BVWUA to

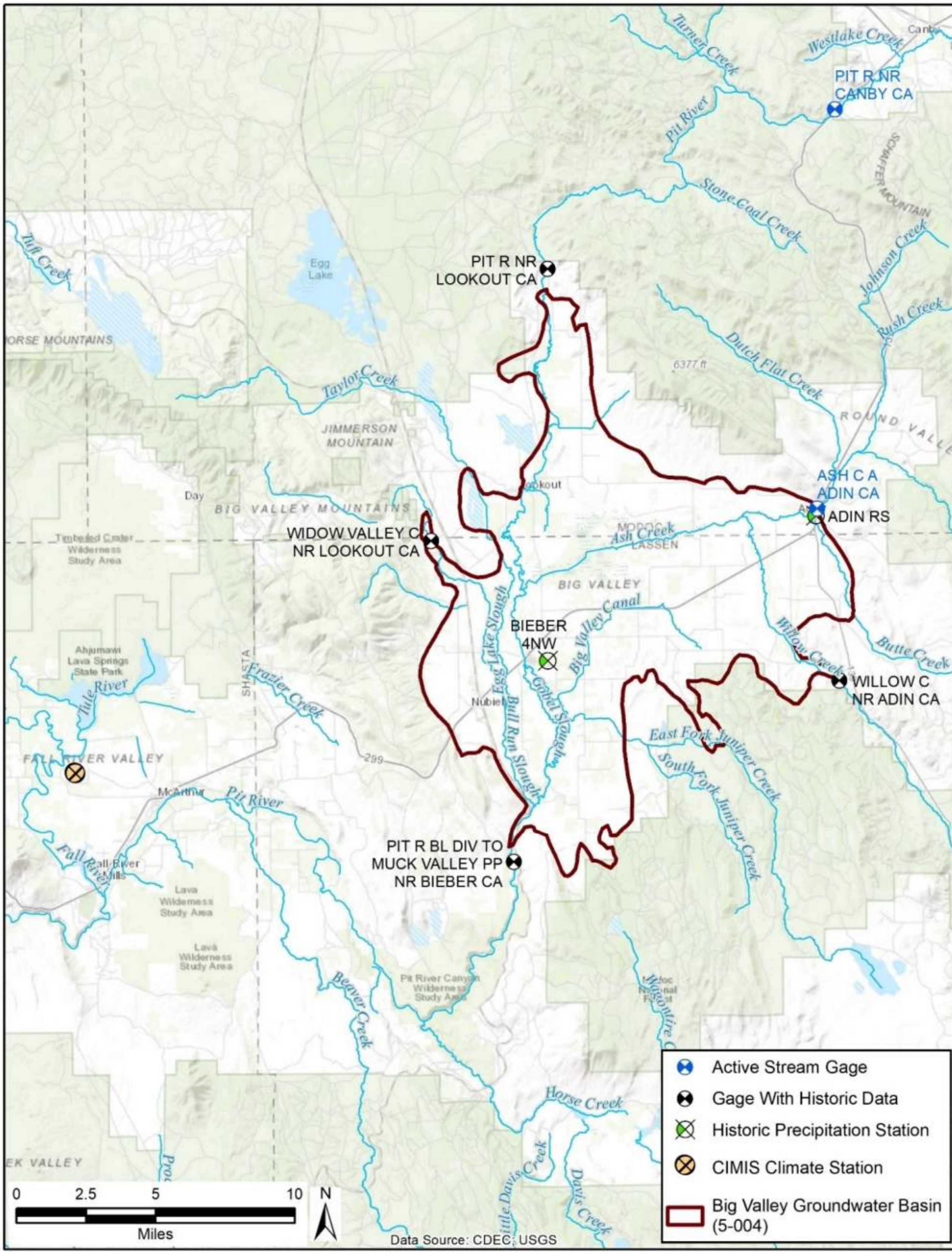


Figure 3-12 Surface Water and Climate Monitoring Network

administer/distribute allocated 2nd priority rights in conjunction with state watermaster guidelines during the irrigation season (April 1 through September 30) each year as a neutral 3rd party. The watermaster service measures diversions every two weeks and reports the data to each water rights holder. At the end of the irrigation season, the watermaster sends each member a yearly use report. The water rights holder is responsible to submit their reports to the State Water Board. Currently there are five Pit River water rights holders that do not participate in the BVWUA watermaster service. (Hutchinson 2021)

Ash Creek and Willow Creek are within the Ash Creek Watermaster Service Area (WMSA). The WMSA also includes Butte and Rush Creeks. The Modoc County Watermaster is under the jurisdiction of and reports to DWR. (Martinez 2021)

3.5.1.3 Climate Monitoring

The National Oceanic and Atmospheric Administration (NOAA) has two stations located in the Basin: Bieber 4 NW and Adin RS. Neither station is active, thus they only provide historic data. Annual precipitation at the Bieber station is shown for 1985 to 1995 in **Table 3-6**.

Table 3-6 Annual Precipitation at Bieber from 1985 to 1995

Water Year	Precipitation at Station ID: BBR (inches)
1985	14.1
1986	25.4
1987	11.6
1988	10.9
1989	20.2
1990	16.1
1991	16.5
1992	10.4
1993	28.2
1994	16.3
1995	31.8
Minimum	10.4
Maximum	31.8
Average	18.3

Source: DWR 2021b

The closest California Irrigation Management Information System (CIMIS) station, number 43, is in McArthur, CA, and measures several climatic factors that allow a calculation of daily reference evapotranspiration for the area. This station is approximately 10 miles southwest of the western boundary of the Basin. **Table 3-7** provides a summary of average monthly rainfall, temperature and reference evapotranspiration (ETo) for the Basin, and **Figure 3-13** shows annual rainfall for 1984 through 2018. The bar graph along the bottom shows annual precipitation, and the line graph on top shows the cumulative departure from average. The cumulative departure graph indicates when there are dry periods (downward slope of the line), wet periods (upward slope of the line), and average periods (flat slope of the line). Each time the line graph crosses the dashed line indicates that an average set of years has occurred. A set of average years has occurred between 1983-1997, 1997 to 2010, and 2010 to 2019. The locations of all climate monitoring stations are shown on **Figure 3-12**. Climate monitoring is a data gap that could be filled with a CIMIS station located in the Basin.

Table 3-7 Monthly Climate Data from CIMIS Station in McArthur (1984-2018)

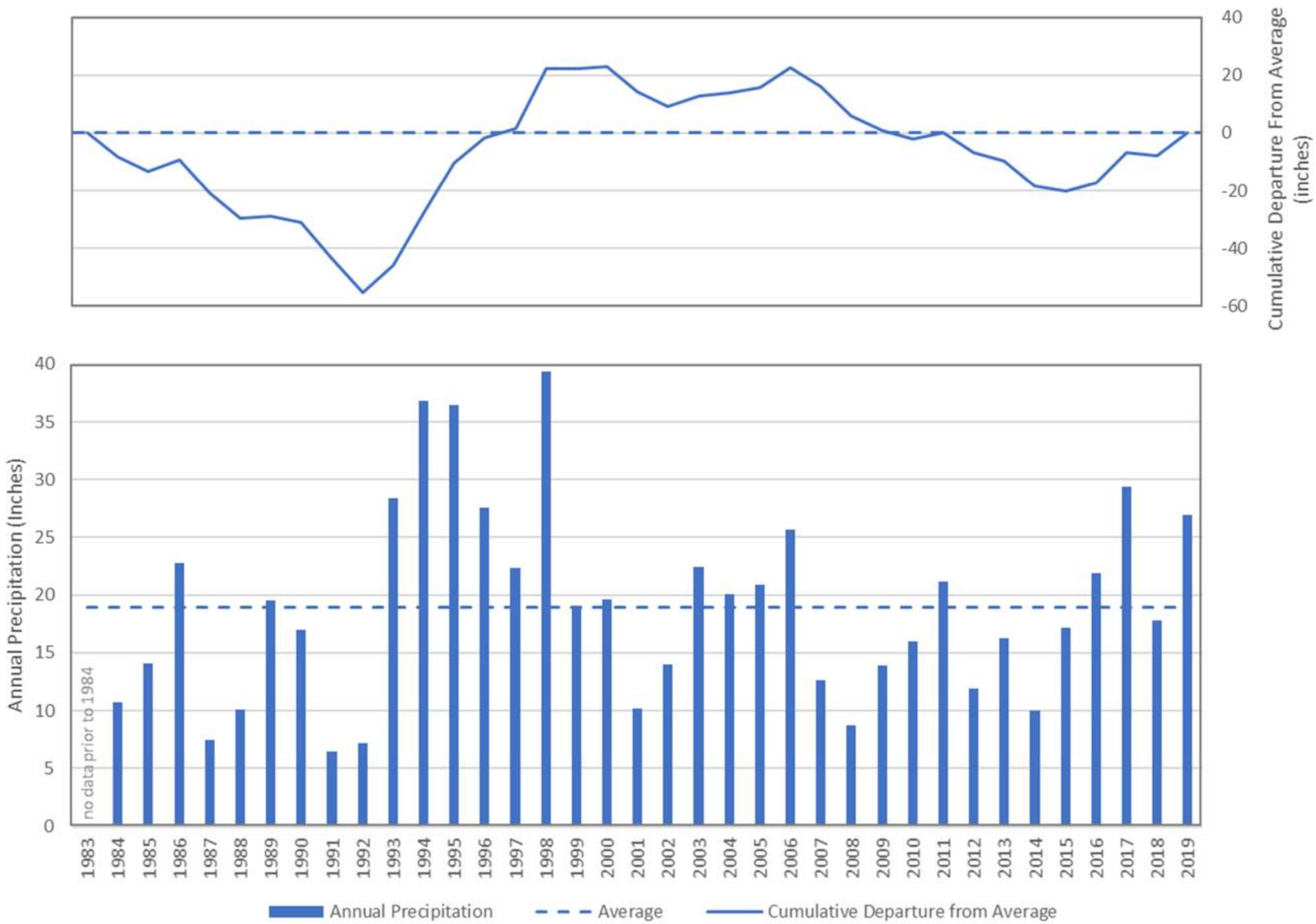
Month	Average Rainfall (inches)	Average ET_o (inches)	Average Daily Temperature (°F)
October	1.4	3.02	49.5
November	2.3	1.21	38.2
December	2.9	0.75	32.1
January	2.5	0.89	32.5
February	2.6	1.57	36.8
March	2.4	3.01	42.4
April	1.8	4.39	48.2
May	1.6	5.93	55.1
June	0.7	7.24	62.8
July	0.2	8.17	69.1
August	0.2	7.18	66.1
September	0.4	5.02	59.5
Monthly Average	1.6	4.03	49.4
Average Water Year	18.8	48.3	49.4

Source: DWR 2020c

3.5.1.4 Subsidence Monitoring

Subsidence monitoring is available in the BVGB at a single continuous global positioning satellite station (P347) on the south side of Adin. P347 began operation in September 2007 and provides daily readings. The five monitoring well clusters constructed in 2019-2020 were surveyed and a benchmark established at each site. These sites can be reoccupied in the future to determine changes in ground elevation at those points if needed. The surveyor's report is included as **Appendix 3A**.

In addition, DWR has provided data processed from InSAR collected by the European Space Agency. The InSAR data currently available provides vertical displacement information between January 2015 and September 2019. InSAR is a promising, cost-effective technique, and DWR will likely provide additional data and information going forward.



925
926 **Figure 3-13 Annual Precipitation at the McArthur CIMIS Station**

3.5.2 Water Management Plans

Two water management plans exist that cover the BVGB: the Lassen County Groundwater Management Plan (LCGMP) and the Upper Pit River IRWMP.

Lassen County Groundwater Management Plan

The LCGMP was completed in 2007 and covers all groundwater basins in Lassen County, including the Lassen County portion of the BVGB. The goal of the LCGMP is to, "…maintain or enhance groundwater quantity and quality, thereby providing a sustainable, high-quality supply for agricultural, environmental and urban use…" (Brown and Caldwell 2007). The LCGMP achieves this through the implementation of Basin Management Objectives[16] (BMOs), which establish key wells for monitoring groundwater levels and define "action levels," which, when exceeded, activate stakeholder engagement to determine actions to remedy the exceedance. Action levels are similar to minimum thresholds in SGMA. A BMO ordinance was passed by Lassen County in 2011 and codified in Chapter 17.02.

Upper Pit River Watershed IRWMP

The Upper Pit IRWMP was adopted by the RWMG in 2013. Twenty-five regional entities were involved in the plan development, which included water user groups, federal, state and county agencies, tribal groups and conservation groups. The management of the IRWMP has now transferred to North Cal-Neva who has been working to update the IRWMP. The goal of the IRWMP is to:

> …maintain or improve water quality within the watershed; maintain availability of water for irrigation demands and ecological needs (both ground and surface water); sustain/improve aquatic, riparian and wetland communities; sustain and improve upland vegetation and wildlife communities; control & prevent the spread of invasive noxious weeds; strengthen community watershed stewardship; reduce river and stream channel erosion and restore channel morphology; support community sustainability by strengthening natural-resource-based economies; support and encourage better coordination of data, collection, sharing and reporting in the watershed; improve domestic drinking water supply efficiency/reliability; address the water-related needs of disadvantaged communities; conserve energy, address the effects of climate variability and reduce greenhouse gas emissions. (NECWA 2017)

The Upper Pit IRWMP contains the entire Watershed above Burney and extends past Alturas to the northeast (see **Figure 3-3**) and includes the entire BVGB. This GSP has been identified as a "Project" in the IRWMP.

3.5.3 Groundwater Regulatory Programs

The Basin is located within the jurisdiction of the Regional Water Quality Control Board (RWQCB) Region 5 (R5) and subject to a Basin Plan, which is required by the CWC (§13240) and supported by the federal Clean Water Act. The Basin Plan for the Sacramento River Basin and the San Joaquin River

[16] Codified as Chapter 17.02 of Lassen County Code.

Basin was first adopted by the RWQCB-R5 in 1975. The current version of the Basin Plan was adopted in 2018. The Porter-Cologne Water Quality Control Act requires that basin plans address beneficial uses, water quality objectives and a program of implementation for achieving water quality objectives. Water Quality Objectives for both groundwater (drinking water and irrigation) and surface water are provided in Chapter 3 of the Basin Plan. (State Water Board, 2020c)

Lassen County Water Well Ordinance

Lassen County adopted a water well ordinance in 1988 to provide for the construction, repair, modification and destruction of wells in such a manner that the groundwater of Lassen County aquifers will not be contaminated or polluted. The ordinance ensures that water obtained from wells will be suitable for beneficial use and will not jeopardize the health, safety or welfare of the people of Lassen County. The ordinance includes requirements for permits, fees, appeals, standards and specifications, inspection, log of the well (lithology and casing), abandonment, stop work, enforcement and violations and well disinfection. Lassen County Environmental Health Department is responsible for the code enforcement related to wells.

In 1999, Lassen County adopted an ordinance requiring a permit for export of groundwater outside the county (Lassen County Code 17.01).

Modoc County Water Well Requirements

Modoc County Environmental Health Department established its requirements for the permitting of work on water wells in 1990, based on the requirements of the CWC (§13750.5). The fee structure was last revised in 2018. Modoc County also has an ordinance prohibiting the extraction of groundwater for use outside of the groundwater basin from which it was extracted. (Title 20 Chapter 20.04)

California DWR Well Standards

DWR is responsible for setting the minimum standards for the construction, alteration and destruction of wells in California to protect groundwater quality, as allowed by CWC §13700 to §13806. DWR began this effort in 1949 and has published several versions of standards in Bulletin 74, beginning in 1962 and is currently working on a significant update, but hasn't yet released it. Current requirements are provided in Bulletin 74-81, Water Well Standards: state of California and in Bulletin 74-90 (Supplement). (DWR 2021c) Cities, counties and water agencies have regulatory authority over wells and can adopt local well ordinances that meet or exceed the state standards. Lassen and Modoc Counties are the well permitting agencies for their respective portions of the Basin.

Title 22 Drinking Water Program

The DDW was established in 2014 when the regulatory responsibilities were transferred from the California Department of Public Health. DDW regulates public water systems that provide, "…water for human consumption through pipes or other constructed conveyances that have 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year," as defined by the Health and Safety Code (§116275(h)). DDW further defines public water systems as:

- Community: Serves at least 15 service connections used by year-round residents or regularly serves 25-year-round residents. LCWD #1 is a community system that provides groundwater in Bieber.
- Non-Transient Non-Community: Serves at least the same 25 non-residential individuals during 6 months of the year. The Adin Ranger Station and the Intermountain Conservation Camp are systems in this category which serve groundwater.
- Transient Non-Community: Regularly serves at least 25 non-residential individuals (transient) during 60 or more days per year. There is no system of this category in the BVGB.

Private domestic wells, industrial wells and irrigation wells are not regulated by the DDW.

The State Water Board-DDW enforces the monitoring requirements established in Title 22 of the California Code of Regulations for public water system wells and all the data collected must be reported to the DDW. Title 22 designates the regulatory limits (e.g., MCLs) for various constituents, including naturally occurring inorganic chemicals and metals and general characteristics; and limits for man-made contaminants, including volatile and non-volatile organic compounds, pesticides, herbicides, disinfection byproducts and other parameters.

3.5.4 Incorporation Into GSP

Information in these and other various and numerous programs have been incorporated into this GSP and used during the preparation of Sustainability Management Criteria (minimum thresholds, measurable objectives, interim milestones) and have been considered during development of Projects and Management Actions.

3.5.5 Limits to Operational Flexibility

While some of the existing management programs and ordinances may have the potential to affect operational flexibility, they are not likely to be a factor in the Basin. For example, runoff and stormwater quality is of high quality and would not constrain recharge options. Similarly, groundwater export limitations by Lassen County and Modoc County would be considered for any decisions in the Basin.

3.6 Conjunctive Use Programs

Formally established conjunctive use programs are not currently operating within the Basin.

3.7 Land Use Plans

The following sections provide a general description of the land use plans and how implementation may affect groundwater. Section 3.2 – Jurisdictional Areas, describes the jurisdictional areas within the BVGB and many of these entities have developed land use plans for their respective jurisdictions. This includes the general plans (GPs) for Modoc County and Lassen County and the Modoc National Forest Land and Resource Management Plan.

3.7.1 Modoc County General Plan

The 1988 Modoc County GP was developed to meet a state requirement and to serve as the "constitution" for the community development and use of land. The GP discusses the mandatory elements of a GP, including land use, housing, circulation (transportation), conservation and open space, noise and safety, as well as economic development and an action program in the county. The GP was intended to serve as a guide for growth and change in Modoc County. Under the Conservation Element, Modoc County recognizes the importance of "use-capacity" for groundwater, among other issues, and the minimization of "adverse resource-use," such as "groundwater mining." The Water Resources section advocates the "wise and prudent" management of groundwater resources to support a sustainable economy as well as maintaining adequate supplies for domestic wells for rural subdivisions. Groundwater quality was recognized as good to excellent within the county's basins.

Policy items from the Modoc GP related to groundwater include:

- Cooperate with responsible agencies and organizations to solve water quality problems
- Work with the agricultural community to resolve any groundwater overdraft problems
- Require adequate domestic water supply for all rural subdivisions

The action program included several general statements for water, including:

- Initiate a cooperative effort among state and local agencies and special districts to explore appropriate actions necessary to resolve long-term water supply and quality problems in the counties
- Require as a part of the review of any subdivision approval a demonstration to the satisfaction of the county that the following conditions exist for every lot in the proposed development:
    - An adequate domestic water supply
    - Suitable soil depth, slope and surface acreage capable of supporting an approved sewage disposal system

In 2018, a GP amendment was adopted to update the housing element section.

3.7.2 Lassen County General Plan

The Lassen County GP 2000 was adopted in 1999 by the Lassen County Board of Supervisors (Resolution 99-060) to address the requirements of California Government Code Section 65300 et seq and related provisions of California law pertaining to GPs. The GP reflects the concerns and efforts of the County to efficiently and equitably address a wide range of development issues which confront residents, property owners and business operators. Many of these issues also challenge organizations and agencies concerned with the management of land and resources and the provisions of community services within Lassen County.

The goals of the GP are to:

- Protect the rural character and culture of Lassen County life
- Maintain economic viability for existing industries such as agriculture, timber and mining
- Promote new compatible industries to provide a broader economic base
- Create livable communities through carefully planned development which efficiently utilize natural resources and provide amenities for residents
- Maintain and enhance natural wildlife communities and recreational opportunities
- Sustain the beauty and open space around use in this effort

The GP addresses the mandatory elements (land use, circulation, housing, conservation, open space, noise and safety) *via* several GP documents and alternate element titles. The 1999 GP elements include land use, natural resources (conservation), agriculture, wildlife, open space, circulation and safety. Separate documents were produced for housing, noise and energy. The land use element designates the proposed general distribution and intensity of uses of the land, serves as the central framework for the entire GP and correlates all land use issues into a set of coherent development policies. The GP land use map from 1999 is shown in **Figure 3-14** shows intensive agriculture as the dominant land use within the Big Valley area, along with scattered population (small) centers. Otherwise, Extensive Agriculture is the dominant land use.

Groundwater is addressed in several elements, including agriculture, land use and natural resources. The GP identified the BVGB as a 'major ground water basin' due to the operation of wells at over 100 gallons per minute [gpm]. Moreover, the GP expressed concern about water transfers and their impact on local water needs and environmental impacts due to the possibility of water marketeers either pumping groundwater from the BVGB into the Pit River and selling it to downstream water districts or municipalities, or using groundwater to augment summer flow through the Delta. The GP recognized that safe yield is dependent on recharge and that overdraft pumping would increase operating costs due to a greater pumping lift. The GP also recognized that overdraft pumping could result in subsidence and water quality degradation. In addition, the GP referred to 1980s legislation that authorized the formation of water districts in Lassen County to manage and regulate the use of groundwater resources and to the 1959 Lassen-Modoc County Flood Control and Water Conservation District, as discussed above. The SGMA process established the requirements for a GSP in the BVGB and creation of the two GSAs. The land use element identified several issues related to groundwater, including public services where 62 percent of rural, unincorporated housing units relied on individual (domestic) wells for their water.

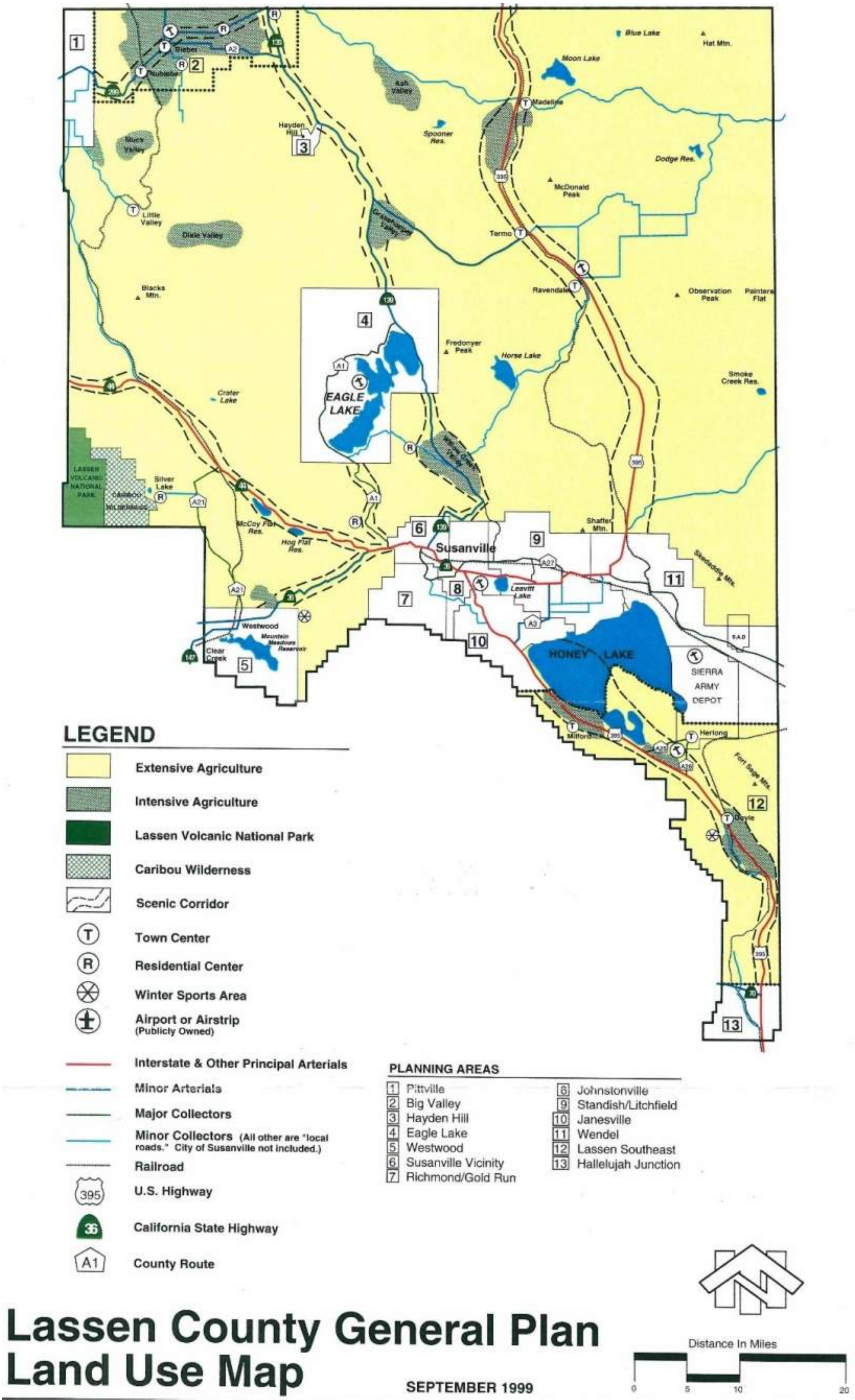


Figure 3-14 Lassen County General Plan Land Use Map

Another issue included open space and the managed production of resources, which includes areas for recharge of groundwater among others. The GP referred to the 1972 Open Space Plan, which required that residential sewage disposal systems would not contaminate groundwater supplies. The agriculture element identified an issue with incompatible land uses where agricultural pumping lowers the groundwater level and impacts the use of domestic wells. The wildlife element recognized that changes in groundwater storage could impact wet meadow ecosystem and threaten fish and wildlife species. Groundwater is included in polices under the water resources section of the Natural Resources (NR) and Open Space (OS) Elements, as listed below:

- NR15 POLICY: Lassen County advocates the cooperation of state and federal agencies, including the State Water Board and its regional boards, in considering programs and actions to protect the quality of ground water and surface water resources.
- NR17 POLICY: Lassen County supports measures to protect and ensure the integrity of water supplies and is opposed to proposals for the exportation of ground water and surface waters from ground water basins and aquifers located in Lassen County (in whole or part) to areas outside those basins.
    - Implementation Measure:

      NR-H: Lassen County will maintain ground water ordinances and other forms of regulatory authority to protect the integrity of water supplies in the county and regulate the exportation of water from ground water basins and aquifers in the county to areas outside those basins.
- NR19 POLICY: Lassen County supports control of water resources at the local level, including the formation of local ground water management districts to appropriately manage and protect the long-term viability of ground water resources in the interest of county residents and the county's resources.
- OS27 POLICY: Lassen County recognizes that its surface and ground water resources are especially valuable resources which deserve and need appropriate measures to protect their quality and quantity.
- OS28 POLICY: Lassen County shall, in conjunction with the Water Quality Control Board, adopt specific resource policies and development restrictions to protect specified water resources (e.g., Eagle Lake, Honey Lake, special recharge areas, etc.) and to support the protection of those resources from development or other damage which may diminish or destroy their resource value.
    - Implementation Measure:

      OS-N: When warranted, Lassen County shall consider special restrictions to development in and around recharge areas of domestic water sources and other special water resource areas to prevent or reduce possible adverse impacts to the quality or quantity of water resources.

3.7.3 Modoc National Forest Land and Resource Management Plan

Modoc National Forest lies in the mountain areas surrounding Big Valley to the south and northeast. A small portion of the National Forest extends into the Basin boundary in the south as shown in **Figure**

3-2. The U.S. Forest Service developed their Land and Resource Management Plan in 1991 to, "…guide natural resource management activities and establish management standards and guidelines." Regarding water resources, the Modoc National Forest Land and Resource Management Plan seeks to "maintain and improve the quality of surface water" through the implementation of Best Management Practices (BMPs) among other goals. The plan is available on the Modoc National Forest website (USFS 1991).

3.7.4 GSP Implementation Effects on Existing Land Use

The implementation of this GSP is not expected to affect existing designation of land use.

3.7.5 GSP Implementation Effects on Water Supply

The implementation of this GSP is not expected to influence water supply. Prior to the development of this GSP, the counties had established several policies and ordinances for the management of water and land use in the BVGB. This GSP will incorporate the previous work and will establish sustainable management criteria to continue the successful use of the groundwater resources during the SGMA implementation period and beyond.

3.7.6 Well Permitting

Lassen and Modoc counties both require a permit to install a well. The Lassen County Municipal Code (§7.28.030) states that, "…no person, firm, corporation, governmental agency or any other legal entity shall, within the unincorporated area of Lassen County, construct, repair, modify or destroy any well unless a written permit has first been obtained from the health officer of the county." Further, Modoc County Code (§13.12.020) states that, "…No person shall dig, bore, drill, deepen, modify, repair or destroy a water well … without first applying for and receiving a permit…"

3.7.7 Land Use Plans Outside of the Basin

Areas inside and outside the Basin are subject to the Lassen and Modoc County General Plans or the Modoc National Forest Land Resource and Management Plan. Other land use plans by organizations such as the BLM also exist in the watershed.

3.8 Management Areas

SGMA allows for the Basin to be delineated into management areas which:

> "…may be defined by natural or jurisdictional boundaries, and may be based on differences in water use sector, water source type, geology, or aquifer characteristics. Management areas may have different minimum thresholds and measurable objectives than the basin at large and may be monitored to a different level. However, GSAs in the basin must provide descriptions of why those differences are appropriate for the management area, relative to the rest of the basin." (DWR 2017)

It should be noted that minimum thresholds and measurable objectives can vary throughout the Basin even without established management areas. The GSAs have not defined management areas within the BVGB.

3.9 Additional GSP Elements, if Applicable

The plan elements from CWC Section 10727.4 require GSPs to address numerous components listed in **Table 3-8**. The table lists the agency or department with whom the GSA will coordinate or where it is addressed in the GSP.

Table 3-8 Plan Elements from CWC Section 10727.4

Element of Section 10727.4	Approach
(a) Control of saline water intrusion	Not applicable
(b) Wellhead protection areas and recharge areas	To be coordinated with county environmental health departments
(c) Migration of contaminated groundwater	Coordinated with RWQCB
(d) A well abandonment and well destruction program	To be coordinated with county environmental health departments
(e) Replenishment of groundwater extractions	Chapter 9, Projects and Management Actions
(f) Activities implementing, opportunities for and removing impediments to, conjunctive use or underground storage	Chapter 9, Projects and Management Actions
(g) Well construction policies	To be coordinated with county environmental health departments
(h) Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance and extraction projects	Coordinated with RWQCB and in Chapter 9, Projects and Management Actions
(i) Efficient water management practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use	To be coordinated with county farm advisors
(j) Efforts to develop relationships with state and federal regulatory agencies	Chapter 8, Plan Implementation
(k) Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity	To be coordinated with appropriate county departments.
(l) Impacts on groundwater dependent ecosystems	Chapter 5, Groundwater Conditions

4. Hydrogeologic Conceptual Model §354.14

A hydrogeologic conceptual model (HCM) is a description of the physical characteristics of a groundwater basin related to the hydrology and geology and defines the principal aquifer, based on the best available information. The HCM provides the context for the water budget (Chapter 6), sustainable management criteria (Chapter 7) and monitoring network (Chapter 8).

This chapter presents the HCM for the BVGB and was developed by GEI Consultants Inc. (GEI) for the Lassen and Modoc GSAs. The content of this HCM is defined by the regulations of SGMA – Chapter 1.5, Article 5, Subarticle 2: 354.14.

Groundwater characteristics and dynamics in the Basin are variable. Located in a sparsely populated area, the amount of existing data and literature to support this HCM is limited, with the most thorough studies being conducted prior to the 1980s. This HCM provides some limited new data and analyses that further the understanding. With that said, there are many data gaps in the HCM that have been identified in this chapter. The HCM presents best available information and expert opinion to form the basis for descriptions of elements of this GSP: basin boundary; confining conditions; definable bottom, nature of flows near or across faults, soil permeability and recharge potential. Significant uncertainty exists in this HCM and stakeholders have expressed concern about the possible regulatory repercussions associated with making decisions using incomplete and/or uncertain information that become less relevant in the future as the regulatory framework changes.

Recommendations and options for prioritizing and addressing the data gaps are part of this document. The stakeholders in the disadvantaged communities of the BVGB have limited financial means to address data gaps, so the data gaps presented at the end of this chapter are contingent on outside funding.

4.1 Basin Setting

BVGB is located in Lassen and Modoc counties in northeastern California, 50 miles north-northwest of Susanville and 70 miles east-northeast of Redding (road distances are greater). Most of BVGB is in Lassen County (72%) with the remainder in Modoc County. At its widest points, the BVGB is approximately 21 miles long (north-south) in the vicinity of the Pit River and 15 miles wide (east-west) south of ACWA. The Basin has an irregular shape totaling about 144 square miles or 92,057 acres. (DWR 2004) The topography of BVGB is relatively flat within the central area with increasing elevations along the perimeter, particularly in the eastern portions where Willow and Ash creeks enter the Basin. Ground surface elevations range from about 4,100 feet above mean sea level (msl) near the south end of BVGB to over 4,500 feet msl at the eastern edge of the Basin. In the north central portion of the Basin, two buttes protrude from the valley (Pilot Butte and Roberts Butte). The Pit River enters the BVGB at an elevation of 4,150 feet msl and leaves the Basin at 4,100 feet msl over the course of about 30 river miles, giving the Pit River a gradient of less than 2 feet per mile. By contrast, the Pit River above and below Big Valley has a gradient over 50 feet per mile. This low gradient in the Basin results in a meandering river morphology and widespread flooding during large storm events. Ash Creek enters the Basin at Adin at an elevation of 4,200 feet msl, eventually joining the Pit River when flows are sufficient to make it past Big Swamp. **Figure 4-1** shows the ground topography for the BVGB.

Portions of eight topographic maps (7.5-minute) cover the BVGB area and are named as follows (north-south, west-east):

Donica Mountain	Halls Canyon	
Lookout	Big Swamp	Adin
Bieber	Hog Valley	Letterbox Hill

4.2 Regional Geology and Structure

The regional geology is depicted on the Alturas Sheet (CGS 1958), a 1:250,000 scale map with an excerpt shown on **Figure 4-2**. The BVGB is in the central area of the Modoc Plateau geomorphic province. According to the California Geological Survey (CGS 2002), the Modoc Plateau is, "…a volcanic table land" broken into blocks by north-south faults. The Basin is underlain by a thick sequence of lava flows and tuffs. The volcanic material is variable in composition as described below, is Miocene to Holocene age[17] and erupted into sediment-filled basins between the block-faulted mountain ranges (Norris and Webb 1990).

According to MacDonald (1966), the Modoc Plateau is transitional between two geomorphic provinces: block faulting of the Basin and Range to the east and volcanism of the Cascade Range to the west. This transition can be observed on **Figure 4-2** with the numerous faults trending north-northwest surrounding Big Valley and the most recent center of volcanism (indicated by the numerous cinders [asterisks] centered around Medicine Lake, with several eruptions about 1000 years before present) about 30 miles northwest of Big Valley. Moreover, the historic volcanism and tectonics occurred concurrently, which disrupted the drainage from the province and resulted in the formation of numerous lakes, including an ancestral lake in Big Valley. Volcanic material was deposited as lava flows, ignimbrites (hot ash flows), subaerial and water-laid layers of ash (cooler) and mudflows combined with sedimentary material, although thick sections of rock can be either entirely sedimentary or volcanic. The composition of the lava flows is primarily basalt[18] and basaltic andesite[19], while pyroclastic[20] ash deposits are rhyolitic[21] composition.

[17] Miocene is 23 million to 5.3 million years ago; Holocene is 12,000 years ago to present.
[18] Basalt is an extrusive (volcanic) rock with relatively low silica content and high iron and magnesium content.
[19] Andesite is an extrusive rock with intermediate silica content and intermediate iron and magnesium content.
[20] Pyroclastic means formed from volcanic eruptions, typically not from lava flows, but from material (clasts) ejected from the eruption such as ash, blocks, or "bombs."
[21] Rhyolitic rocks are extrusive with relatively high silica content and low iron and magnesium. Rhyolites are the volcanic equivalent of granite.

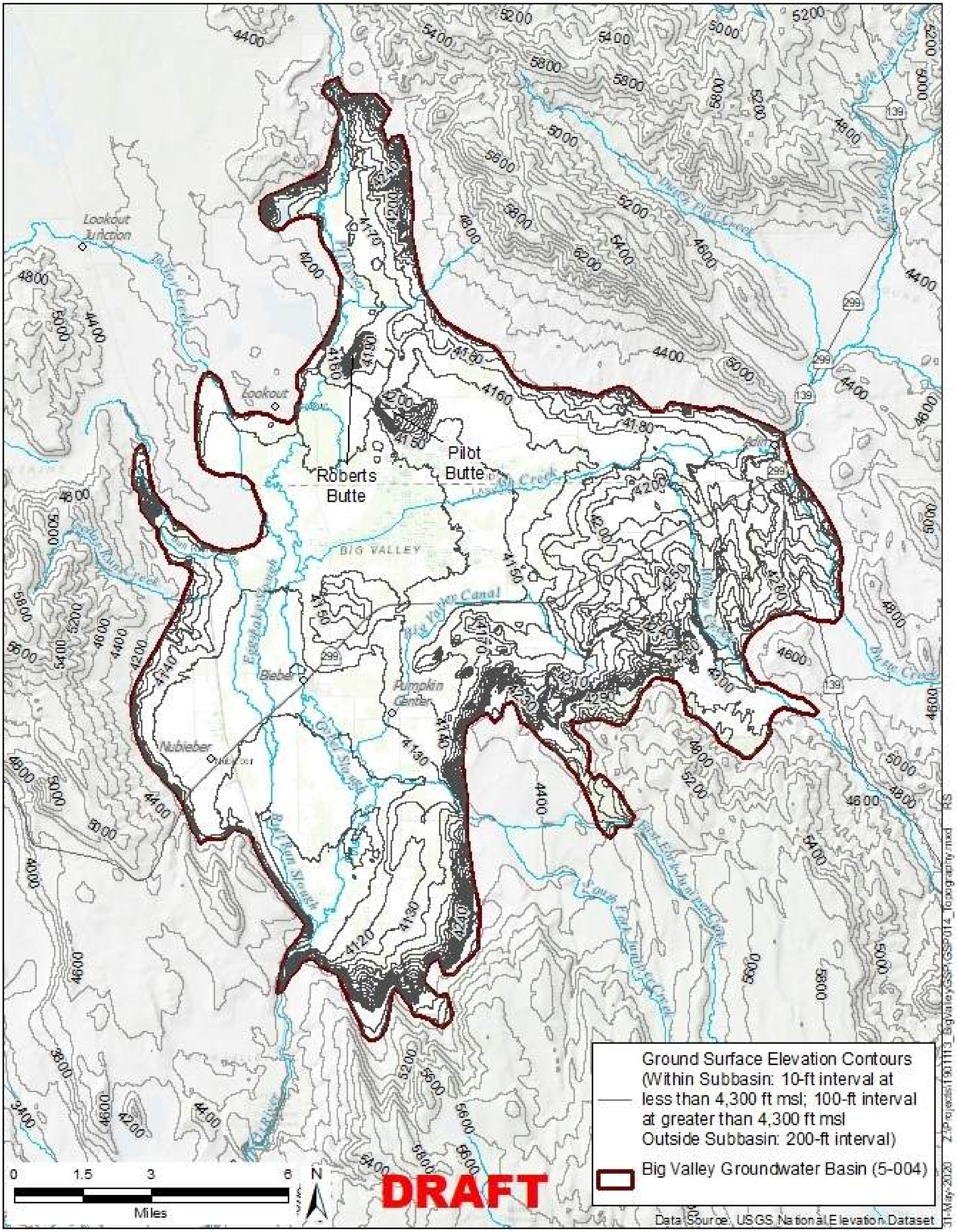


Figure 4-1 Topography

Source: USGS 2016

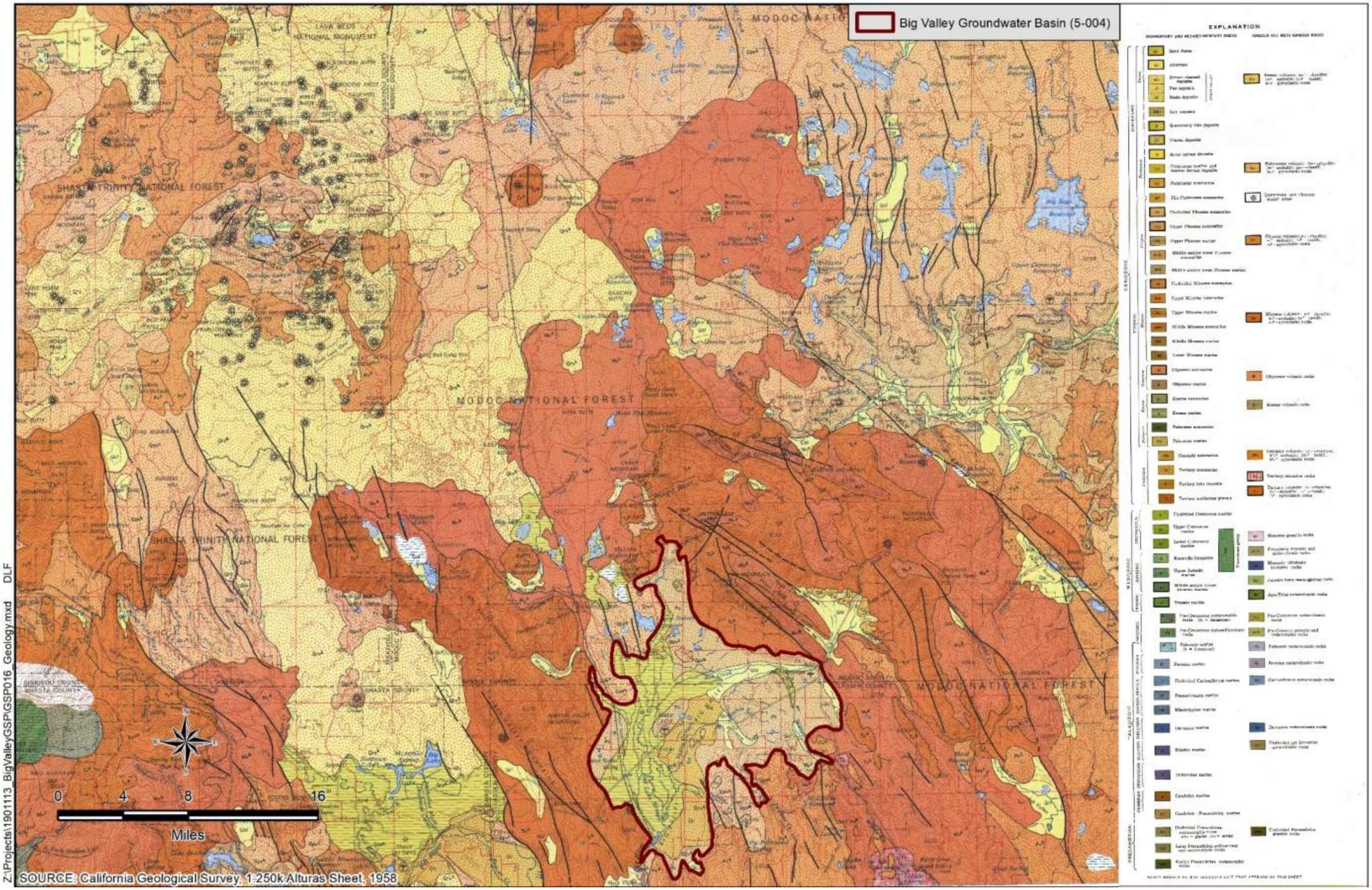


Figure 4-2 Regional Geologic Map

4.2.1 Lateral Basin Boundaries

The CGS (1958) geology map (**Figure 4-2**) was used by DWR to draw the BVGB boundary. That63-year-old map has proven to be inaccurate in many places, and more recent, more accurate geologic maps are available (DWR 1963, GeothermEx 1975). The lateral boundaries of BVGB are described by DWR (2004) as, "…bounded to the north and south by Pleistocene and Pliocene basalt and Tertiary pyroclastic rocks of the Turner Creek Formation, to the west by Tertiary rocks of the Big Valley Mountain volcanic series, and to the east by the Turner Creek Formation." In general, the boundary drawn by DWR was intended to define the contact between the valley alluvial deposits and the surrounding volcanic rocks. Because this boundary was drawn using a regional-scale map from 1958 that was drawn with the surface expression of geologic units, a basin boundary modification at a future date would be more precise and would include the aquifer materials which extend outside of the current boundary. This future modification could include consideration of the "upland recharge areas" described by DWR (1963).

Additionally, the Basin boundary is inaccurate in the southeastern portion of the Basin where two fingers extend into the uplands area. The narrower of the two fingers extends too far into the upland elevations and intersects with East Fork Juniper Creek which doesn't drain into the finger, as shown in **Figure 4-1**. East Fork Juniper Creek actually flows to the west and is confluent with the Pit River south of Pumpkin Center. A more thorough mapping of the elevations and geologic contacts in the upper area of East Fork Juniper Creek would help to refine the boundary between alluvium and upland volcanics as some areas are clearly not underlain by alluvial deposits.

In the northeastern portion of the Basin, the boundary curves around the base of the Barber Ridge and Fox Mountain. The CGS contact between the alluvium and volcanics here is well below the change in slope of the mountain range. More recent mapping (GeothermEx 1975) extends alluvium 1.5 miles further upslope as shown on **Figure 4-3**. This 1975 mapping also shows other locations along the current basin boundary that should be modified, including the aforementioned narrow finger at East Fork Juniper Creek.

4.3 Local Geology

Several geologic maps were available at a more detailed scale than the CGS (1958) map. Two of them had accompanying studies that more thoroughly described the geology. Although relatively old studies, they both provide useful information. However, they differ slightly on some details, particularly the surface geology and further refinement of their contacts may be necessary. The two maps are shown on **Figure 4-3** and **Figure 4-4**.

The two different reports were written for different purposes, with DWR (1963) being developed as a general investigation of the potential groundwater resources and GeothermEx (1975) as a specific investigation of potential hydrothermal groundwater resources. All reviewed sources agree that the BVGB is surrounded by mountain blocks of volcanic rocks of somewhat variable composition, but primarily basalt. Although these mountains are outside of the groundwater basin, they may be underlain by alluvial formations. The mountains capture and accumulate precipitation, which produces runoff that flows into BVGB. Moreover, DWR (1963) stated that these mountains serve as "upland recharge areas" and provide subsurface recharge to the BVGB. These recharge areas suggested by DWR are shown in red shading on **Figure 4-5** and correlate with Pliocene

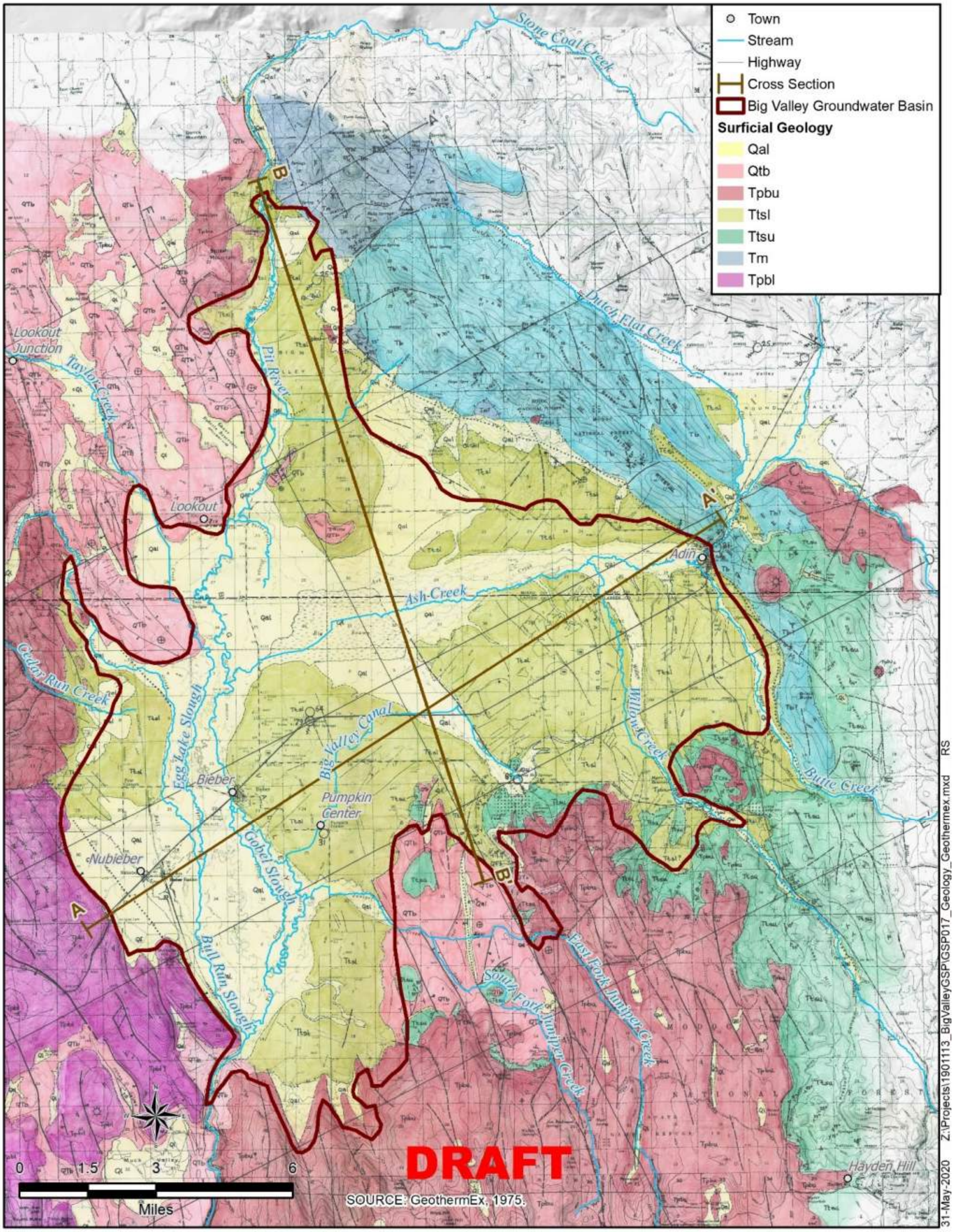
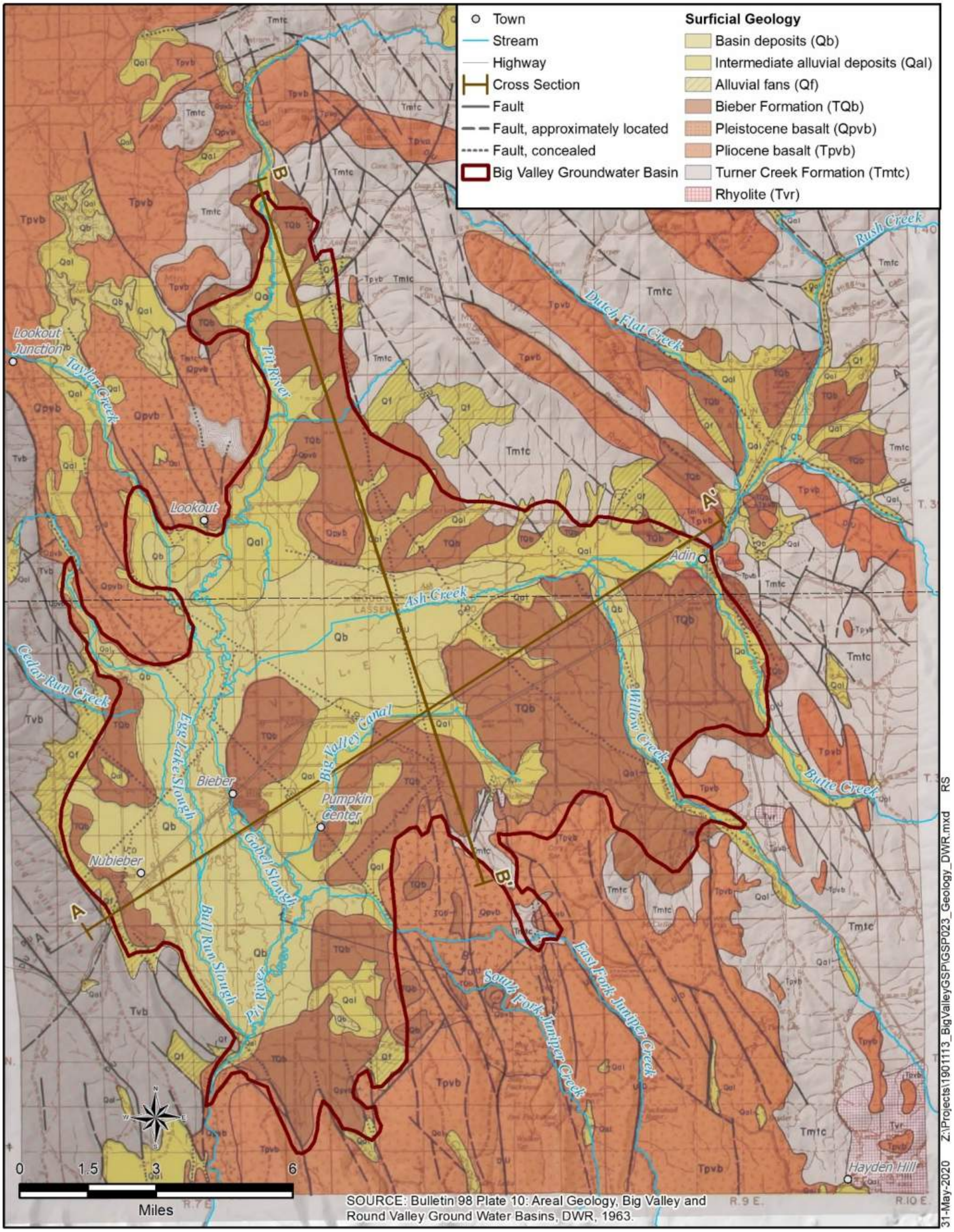


Figure 4-3 GeothermEx 1975 Local Geologic Map



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1293 **Figure 4-4 DWR 1963 Local Geologic Map**

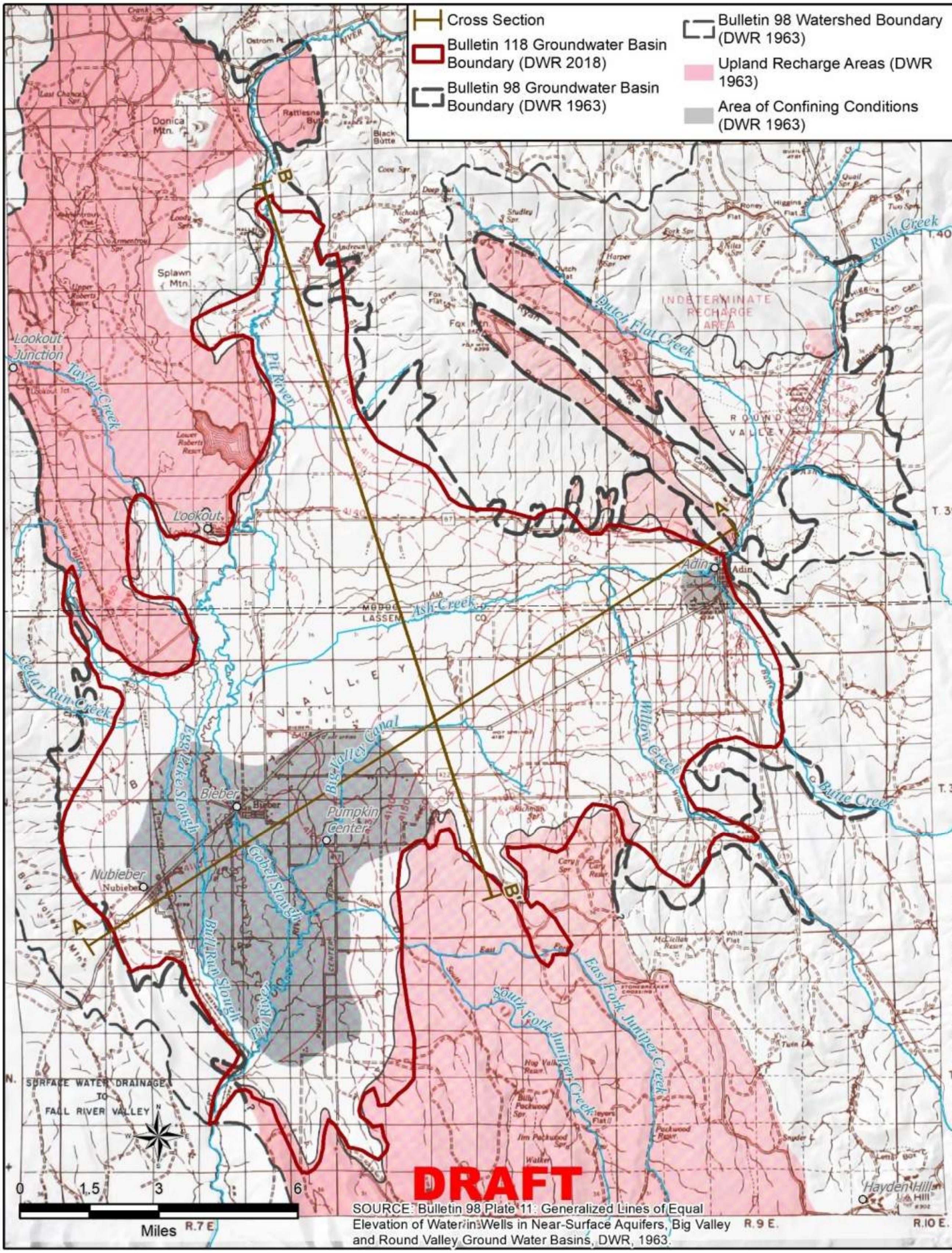


Figure 4-5 DWR 1963 Upland Recharge Areas and Areas of Confining Conditions

to Pleistocene[22] basalts (Tpbv and Qpbv). These units are mapped by DWR (1963) outside the Basin to the northwest and southeast as well as along the crests of Barber and Ryan Ridges to the northeast of Big Valley.[23] GeothermEx (1975) generally concurs with this mapping, except for the areas along Barber and Ryan Ridges, which they map as a much older unit (Miocene) which is corroborated by a radiometric age date measured at 13.8 million years. This distinction is important because an older unit is more likely to underlie the Basin sediments and is less likely to be hydraulically connected to the BVGB. At the northwestern end of Barber Ridge, GeothermEx mapped the oldest unit in the BVGB area (Tm) of andesitic composition. This unit contains the site of the Shaw Pit quarry.

4.4 Principal Aquifer

4.4.1 Formation Names

The Pliocene-Pleistocene[22] age Bieber Formation (TQb) is the main formation of aquifer material defined within BVGB and DWR (1963) estimates that it ranges in thickness from a thin veneer to over 1,000 feet. It meets the ground surface around the perimeter of the Basin, especially on the southeast side (DWR 1963). The formation was deposited in a lacustrine (lake) environment and is comprised of unconsolidated to semi-consolidated layers of interbedded clay, silt, sand, gravel and diatomite[24]. Layers of black sand and white sand (pumiceous) were identified as highly permeable but discontinuous and mostly thin. GeothermEx (1975) did not embrace the DWR name and identified this formation as an assemblage of tuffaceous, diatomaceous lacustrine and fluvial sediments (Ttsu, Ttsl). Both investigations identified the formation in the same overall location, based on a comparison of the two geologic maps, but the GeothermEx map provides more detail and resolution than the DWR map. For the purposes of the GSP, the name Bieber Formation will be used.

Recent Holocene[25] deposits (labeled with Q) were mapped within the center of the Basin and along drainage courses from the upland areas and are identified by DWR (1963) as alluvial fans (Qf), intermediate alluvium (Qal) and Basin deposits (Qb). The composition of these unconsolidated deposits varies from irregular layers of gravel, sand and silt with clay to poorly sorted silt and sand with minor clay and gravel (Qal) to interbedded silt, clay and "organic muck" (Qb). The latter two deposits occur in poorly drained, low-lying areas where alkali[26] could accumulate. The thickness of these sediments is estimated to be less than 150 feet. GeothermEx (1975) identified these deposits as older valley fill (Qol), lake and swamp deposits (Ql), fan deposits (Qf) as well as undifferentiated alluvium (Qal). All these recent deposits are aquifer material[27] and are part of the Big Valley principal aquifer. There is discrepancy between the two maps is in the northeastern portion of the Basin, where GeothermEx

[22] 5.3 million years to 12 thousand years ago.
[23] The GSAs specifically requested a basin boundary modification to include these upland recharge areas within the Basin boundary. The request was denied by DWR as not being sufficiently substantiated. (*See* **Appendix 1A**)
[24] Diatomite is a fine-grained sedimentary rock made primarily of silica, and is formed from the deposition of diatoms, which are microscopic creatures with shells made from silica.
[25] Recent geologic period from 12 thousand years old to present.
[26] Alkali means relatively high in alkali and alkali earth metals (primarily sodium, potassium, calcium and magnesium) and generally results in a high pH (greater than 7 or 8).
[27] Meaning they contain porous material with recoverable water.

extends the alluvial sediments much further upslope toward Barber Ridge and Fox Mountain as discussed in Section 4.3 – Local Geology.

The principal aquifer consists of the Bieber Formation (TQb and recent deposits (Qal, Qg, Qb). While DWR (1963) delineates an "area of confining conditions" in the southwest area of the Basin on **Figure 4-5**, the data to support the confinement and the definition of a broad-scale, well-defined aquitard[28] is not currently available.

As described herein, aquifer conditions vary greatly throughout the Basin. However, clearly defined, widespread distinct aquifer units have not been identified, and with the data currently available all the water bearing units in the Basin are defined as a single principal aquifer for this GSP.

4.4.2 Geologic Profiles

Figure 4-6 and **Figure 4-7** show cross-sections across Big Valley. The locations of the cross-sections are shown on **Figure 4-3**, **Figure 4-4** and **Figure 4-5**. The locations of these sections were drawn to be similar to those drawn by DWR (1963) and GeothermEx (1975) and characterize the aquifers in two directions (southwest-northeast and northwest-southeast). The sections show the lithology of numerous wells across the Basin. Very little geological correlation could be made across each section which is likely to be related to the concurrent block faulting and volcanic and alluvial depositional input from various highland areas flowing radially into Big Valley. These complex structural and depositional variables result in great stratigraphic variation over short distances. The pertinent information from cross-sections presented by DWR (1963) and GeothermEx (1975) are shown on the sections.

4.4.3 Definable Bottom

The SGMA and DWR GSP regulations do not provide clear guidance for what constitutes a "definable bottom" of a basin. However, DWR (2016a) Bulletin 118 Interim Update describe the "physical bottom" as where the porous sediments contact the underlying bedrock and the "effective bottom" as the depth below which water could be unusable because it is brackish or saline.

The "physical bottom" of BVGB is difficult to define because few borings have been drilled deeper than 1200 ft and the compositions of the alluvial and bedrock formations are similar (derived from active volcanism), with contacts that are gradational. Also, some of the lavas most likely flowed into Big Valley forming lava lenses that are now interlayered with permeable aquifer sediments. Moreover, the base of the aquifer system is likely variable across BVGB due to the concurrent volcanism and horst/graben faulting of the bedrock.

The deepest lithologic information in the Basin is derived from two test borings by DWR to depths of 1843 and 1231 feet and from two geothermal test wells near Bieber to depths of 2125 and 7000 feet. The 7000-foot well is east of Bieber, but only has lithologic descriptions to a depth of 4100 feet, including descriptions of aquifer-type materials (sands) throughout. The other three deep lithologies give similar indication of aquifer material to their total depth.

[28] Layer of low permeability that prevents significant flow, except at very slow rates.

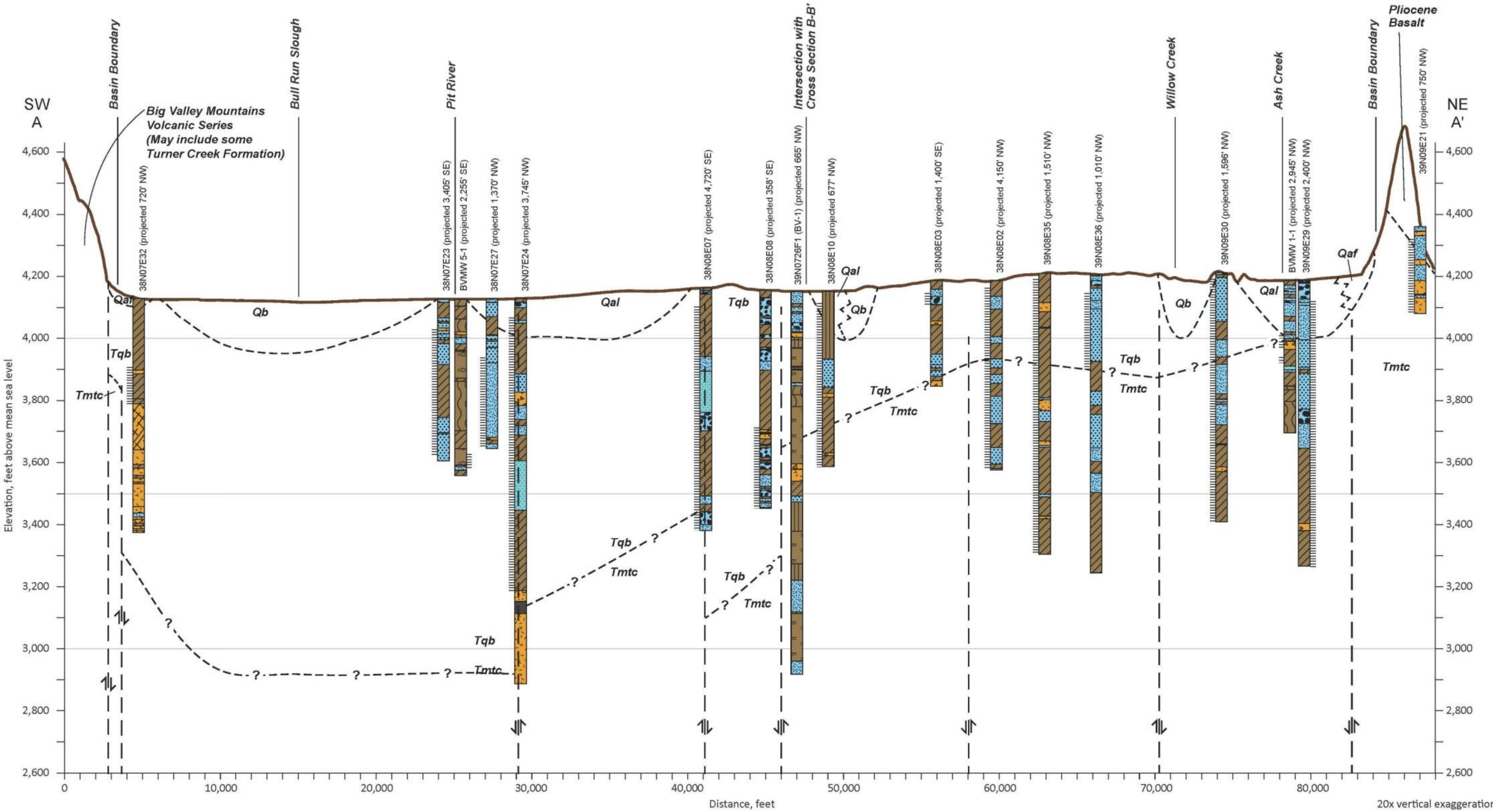


Figure 4-6 Geologic Cross Section A-A'

Note: Key to lithologic symbologies is in development and will be included in future draft(s)

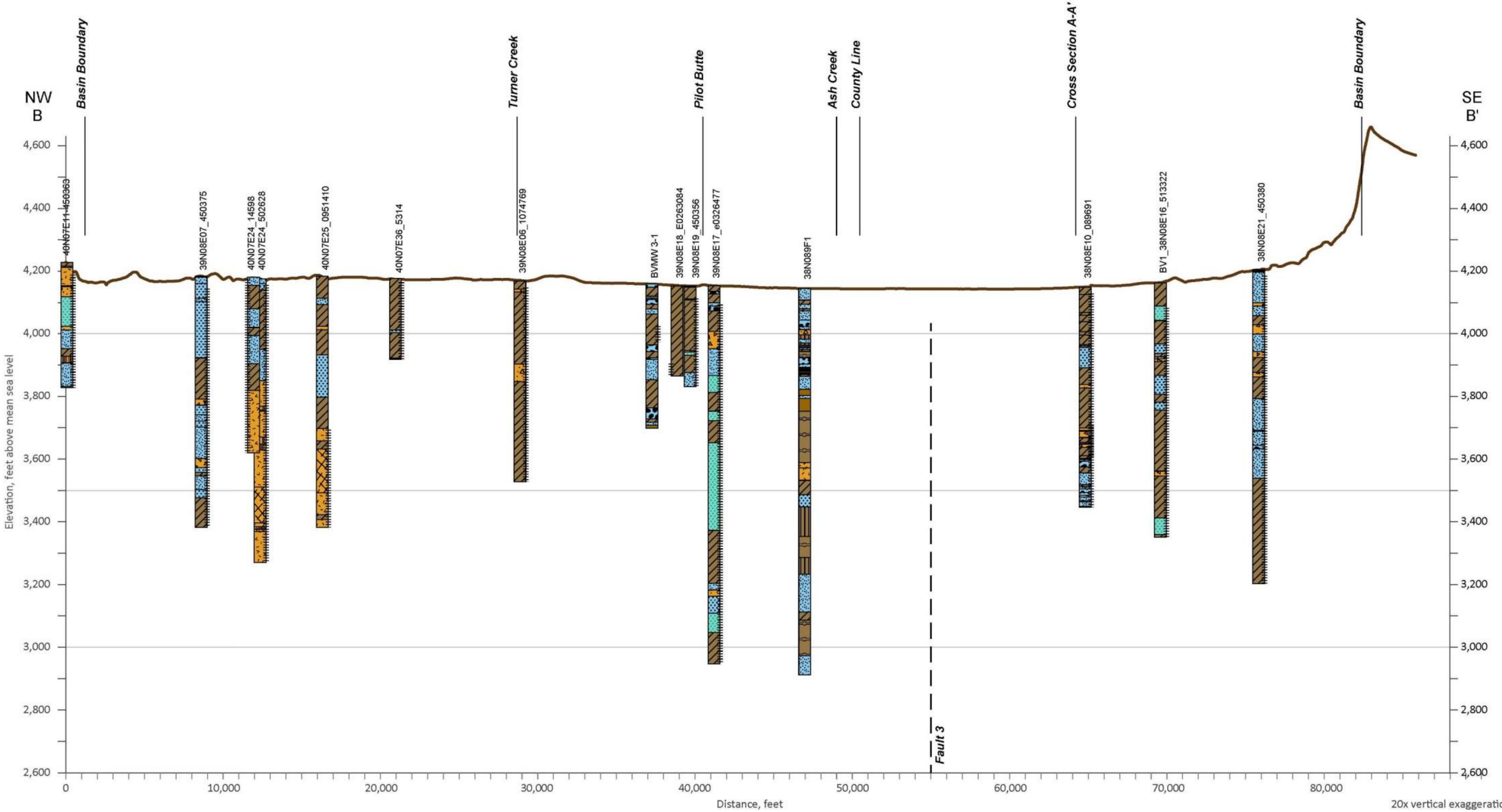


Figure 4-7 Geologic Cross Section B-B'

Note: Key to lithologic symbologies is in development and will be included in future draft(s)

The two geothermal wells also had temperature logs and some water quality. Water temperatures increased to over 100°F at depths of about 2000 to 3000 feet. One of them located near the Bieber School had water quality samples collected from the 1665- to 2000-foot interval and indicated water quality higher in total dissolved solids (632 milligrams per liter) than is present in shallower portions of the Basin.

The information from these two wells indicated that temperature and water quality concerns increase with depth, but a clear delineation of where water becomes unusable cannot be determined with the data available. With limited scientific evidence to clearly define a physical or effective bottom of the aquifer, an approach to define a practical bottom is being used to satisfy the GSP Regulations which require the aquifer bottom to be defined (§ 354.14(a)(1)), as described below.

The approach for defining the practical bottom is to ensure that all known water wells are included within the aquifer. DWR's well log inventory shows that over 600 wells have been installed in the BVGB. Although DWR's well log inventory does not completely and precisely assess the total number or status of the wells (i.e., abandoned), it is the only readily available data. The well inventory has been identified as a data gap within this GSP. Wells in this inventory with known depths are summarized in **Table 4-1**. The only borings drilled deeper than 1,200 feet are the two DWR test borings and two geothermal wells discussed previously.

Table 4-1 Well Depths in DWR Inventory

Depth Interval (ft bgs)	Deepest Well per Section[a]		Count of All Wells
< 200	10%		41%
200 – 400	16%	43%	25%
400 – 600	27%		17%
600 – 800	28%	42%	12%
800 – 1000	14%		4%
1000 – 1200	4%		1%
> 1200[b]	1%		< 1%

Notes:
[a] Section is a 1 mile by 1 mile square. There are 134 sections in the BVGB
[b] Test borings: BV-1 and BV-2 were drilled deeper than 1200 feet

For this GSP, the "practical bottom" of the aquifer is set at 1200 feet but may extend to 4,100 or deeper. This delineation of 1200 feet is consistent with DWR's approach, established over 50 years ago, which declared a practical bottom of 1000 feet. A depth of 1200 feet encompasses the levels where groundwater can be accessed and monitored for beneficial use but does not preclude drilling and pumping from greater depths.

4.4.4 Structural Properties with Potential to Restrict Groundwater Flow

Faults can sometimes affect flow, but sufficient evidence has not been gathered and analyzed to determine whether any of the faults in Big Valley restrict or facilitate flow. The mountains around BVGB are heavily faulted, with older basalt units more faulted than younger basalt units.

Most of the faults trend to the north/northwest with some perpendicular faulting oriented northeasterly. **Figure 4-8** is an excerpt of the regional fault map by the California Geological Survey (2010). Faults on the western side of BVGB are shown to be Quaternary in age while faults on the eastern side are pre-Quaternary (older than 2.6 million years). Note that numerous faults to the west of BVGB were identified as late Quaternary to Holocene-age faults (displacement during the last 700,000 years or within the last 12 thousand years, respectively).

Some of the faults extend across the Basin, concealed beneath the alluvial materials. Two hot springs are located in the Basin near these faults. DWR (1963) acknowledged the potential restriction of groundwater flow by faults but did not provide specific information. However, such fault impacts on groundwater flow cannot be determined with certainty at this time with the available groundwater level data, given the limited number and the wide spacing of wells, and the absence of a pumping test to verify restricting conditions.

4.4.5 Physical Properties and Hydraulic Characteristics

The physical properties of a groundwater system are typically defined by the hydraulic conductivity[29], transmissivity[30] and storativity[31] of the aquifer. The preferred method of defining hydraulic characteristics is a pumping test with pumping rates and water levels monitored (either in the pumping well or preferably a nearby monitoring well) throughout the test. Such pumping tests were performed after the construction of five sets of monitoring wells (MWs) in late 2019 and early 2020.

The tests were performed by pumping each 2.5-inch-diameter MW for 1 hour at a rate of 8 gpm while measuring water level drawdown in the pumping well. A well efficiency[32] of 70 percent was assumed, and the length of the well screen was used as a proxy for the aquifer thickness (b). **Table 4-2** shows the results of the Theis[33] solution that best matched the drawdown curve at each well. Storativity (S) ranged from highly confined ($3.0x10^{-6}$ at BVMW 3-1) to unconfined ($1.5x10^{-1}$ at BVMW 4-1). Hydraulic

[29] Hydraulic conductivity (K) is defined as the volume of water that will move in a unit of time under a unit hydraulic gradient through a unit area. It is a measure of how easily water moves through a material and is usually given in gallons per day per square foot (gpd/ft^2) or feet per day (ft/day).

[30] Transmissivity (T) is the product of K and aquifer thickness (b) and is a measure of how easily water moves through a thickness of aquifer. It is usually expressed in units of gallons per day per foot of aquifer (gpd/ft) or square feet per day (ft^2/day).

[31] Storativity (S, also called storage coefficient) is defined as the volume of water that an aquifer releases from or takes into storage per unit surface area per unit change in groundwater elevation. High values of S are indicative of unconfined or water table aquifers, while low values indicate confined (pressurized) aquifers. S does not have units.

[32] A pumping well will experience more groundwater level drawdown than a nearby non-pumping well due to inefficiency in the movement of groundwater from the aquifer into the well. The predicted drawdown divided by the actual drawdown is well efficiency.

[33] Theis is a mathematical solution to estimate K, T, and S and is based on pumping rate and the resultant rate of groundwater level drawdown (Theis, 1935).

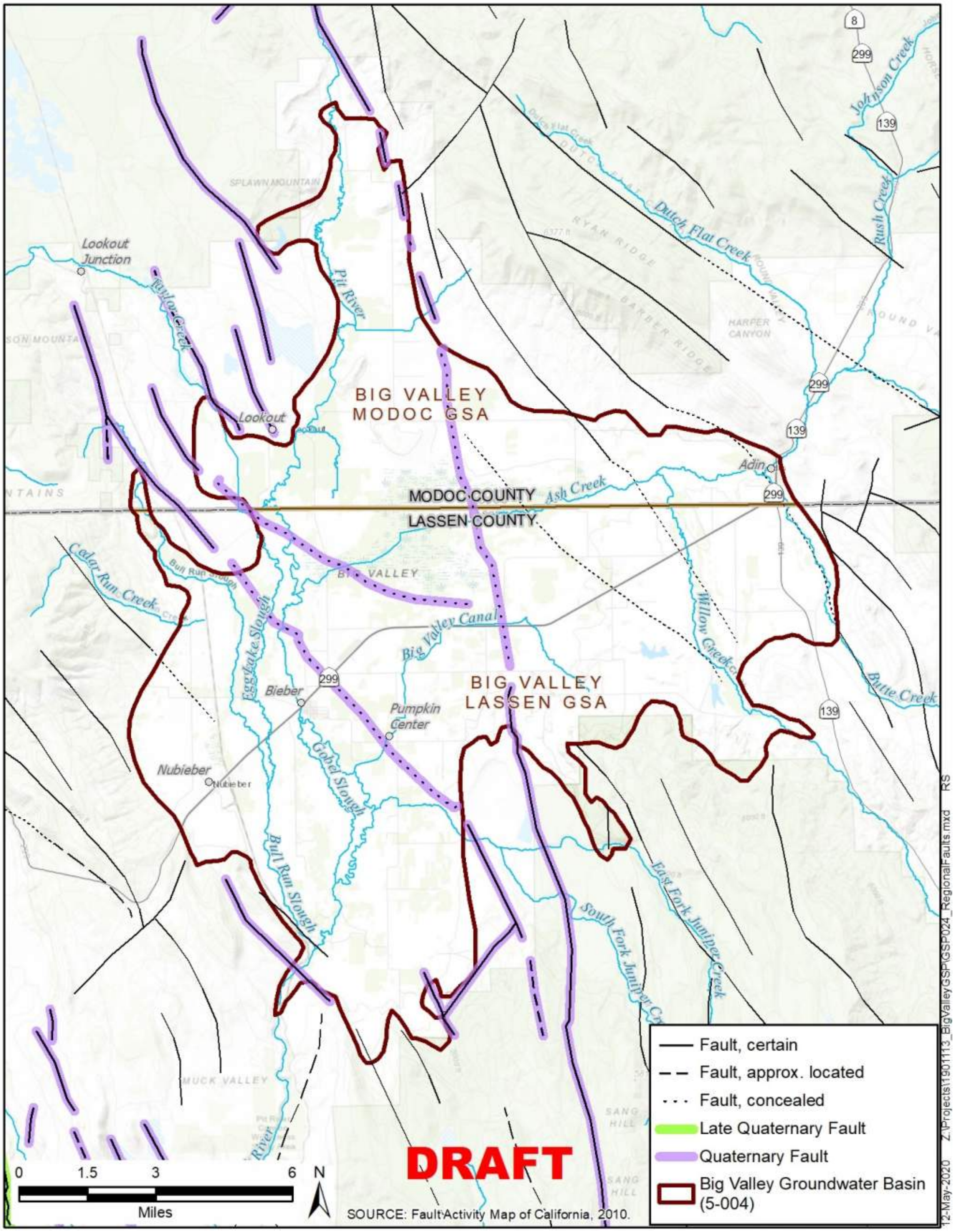


Figure 4-8 Local Faults

Table 4-2 Aquifer Test Results

Parameter	Units	BVMW 1-1	BVMW 2-1	BVMW 3-1	BVMW 4-1	BVMW 5-1
Well depth	ft	265.5	250.5	185.5	425	540
Thickness[a] (b)	ft	50	40	50	30	50
Flow (Q)	gpm	8	8	8	8	8
Drawdown after 1 hour	ft	4.3	16.0	27.5	2.0	3.0
Transmissivity (T)	gpd/ft	3000	750	700	4200	4500
Storativity (S)	unitless	$1.5x10^{-3}$	$1.0\ x10^{-3}$	$3.0x10^{-6}$	$1.0\ x10^{-1}$	$2.0\ x10^{-3}$
Hydraulic Conductivity (K)	ft/d	8	3	2	19	12

[a] Assumed to be the length of the screen interval
Source: GEI 2021

conductivity (K) ranged from 2 feet per day (ft/d) to 19 ft/d, which is consistent with silty sand and clean, fine sand. The K values may range higher since pumping tests in larger wells with larger pumps for longer periods of time tend to give higher T and K values. The results of these five pumping tests are documented further in **Appendix 4A**. More thorough assessment of Basin aquifer characteristics is needed and is identified as a data gap.

Specific yield (SY) is another important aquifer characteristic, as it defines the fraction of the aquifer that contains recoverable water and therefore governs the volume of groundwater stored in the Basin. Reclamation (1979) discussed the SY in Big Valley and postulated that it varies with depth, at 7 percent for the first 100 ft bgs, 6 percent for the 100 to 200 feet bgs and 5 percent from 200 to 1000 ft bgs. However, Reclamation doesn't give any supporting evidence for these percentages. SY in the Sacramento Valley has been estimated to vary between 5 to 10 percent (DWR 1978). Since Big Valley aquifer materials were primarily deposited in a lacustrine environment (as opposed to Sacramento Valley which has a higher percentage of riverine deposits), Big Valley's SY is likely on the lower end at 5 percent. This conservative percentage will be used for all depth intervals in this GSP.

4.5 Soils

Information on soils within the BVGB were obtained from the Soil Survey Geographic Database (SSURGO) of the NRCS. The SSURGO data includes two categories of information relevant to the GSP: taxonomic soil orders and hydrologic soil groups. Taxonomic data include general characteristics of a soil and the processes of formation while hydrologic data relate to the soil's ability to transmit water under saturated conditions and is an important consideration for hydrology, runoff and groundwater recharge. The following section describes the soils of BVGB.

4.5.1 Taxonomic Soil Orders

Of the 12 established taxonomic soil orders, three were found within the BVGB, as listed below, and their distributions are presented in **Figure 4-9**. Descriptions below were taken from the Illustrated Guide to Soil Taxonomy (NRCS, 2015):

- Alfisol – Naturally fertile soils with high base saturation and a clay-enriched subsoil horizon. Alfisols develop from a wide range of parent materials and occur under broad environmental conditions, ranging from tropical to boreal. The movement of clay and other weathering products from the upper layers of the soil and their subsequent accumulation in the subsoil are important processes. The soil-forming processes are in relative balance. As a result, nutrient bases (such as calcium, magnesium and potassium) are supplied to the soil through weathering and the leaching process is not sufficiently intense to remove them from the soil before plants can use and recycle them.
- Mollisol – Very dark-colored, naturally very fertile soils of grasslands. Mollisols develop from predominantly grasslands in temperate regions at mid-latitudes and result from deep inputs of organic matter and nutrients from decaying roots, especially the short, mid and tall grasses common to prairie and steppe areas. Mollisols have high contents of base nutrients throughout their profile due to mostly non-acid parent materials in environments (subhumid to semiarid) where the soil was not subject to intense leaching of nutrients.
- Vertisol – Very clayey soils that shrink and crack when dry and expand when wet. Vertisols are dominated by clay minerals (smectites) and tend to be very sticky and plastic when wet and very firm and hard when dry. Vertisols are commonly very dark in color and distinct soil horizons are often difficult to discern due to the deep mixing (churning) that results from the shrink-swell cycles. Vertisols form over a variety of parent materials, most of which are neutral or calcareous, over a wide range of climatic environments, but all Vertisols require seasonal drying.

Mollisols are the most prominent soil order within the BVGB occupying nearly 78 percent of the total area. Vertisols occupy over 16 percent and are found mostly on the southwestern side of BVGB within the floodplain of the Pit River. Small patches of Vertisols are scattered in the remainder of the Basin. Alfisols occupy over 5 percent of the Basin and are found mostly on the west side of the Basin and along Hot Spring Slough in the south-central portion of the Basin.

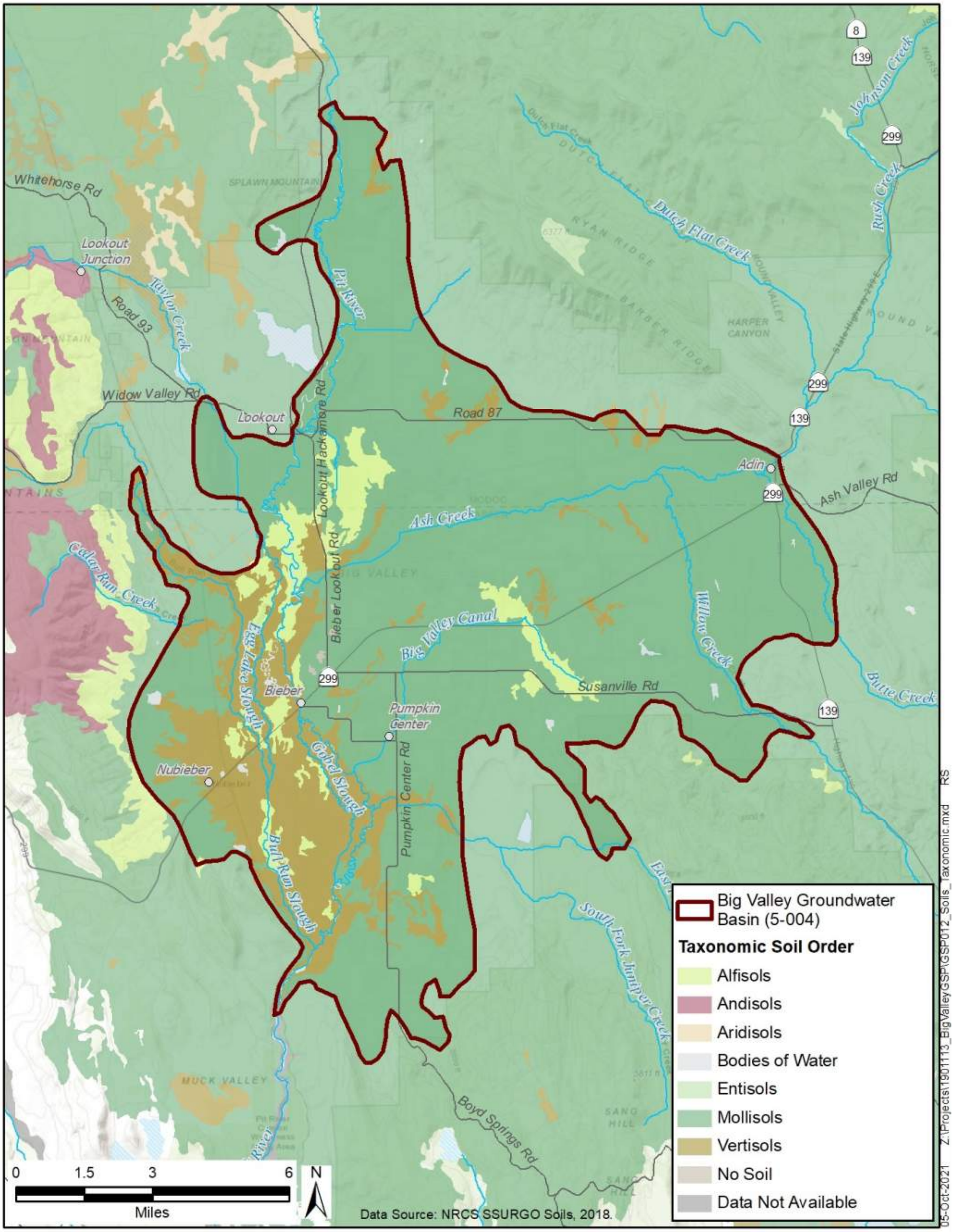


Figure 4-9 Taxonomic Soils Classifications

4.5.2 Hydrologic Soil Groups

The NRCS Hydrologic Soils Group (HSG) classifications provide an indication of soil infiltration potential and ability to transmit water under saturated conditions, based on hydraulic conductivities of shallow, surficial soils. **Figure 4-10** shows the distribution of the hydrologic soil groups, where higher conductivities (greater infiltration) are labeled as Group A and lowest conductivities (lower infiltration) as Group D. As defined by the NRCS (2012), the four HSGs are:

- Hydrologic Group A – "Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10% clay and more than 90% sand or gravel and have gravel or sand textures." Group A soils have the highest conductivity values (greater than 5.67 inches per hour [in/hr]) and therefore a high infiltration rate.

  Hydrologic Group B – "Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission is unimpeded. Group B soils typically have between 10 and 20% clay and 50 to 90% sand and have loamy sand or sandy loam textures." Group B soils have a wide range of conductivity values (1.42 in/hr to 5.67 in/hr), and a moderate infiltration rate.

- Hydrologic Group C – "Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 and 40% clay and less than 50% sand and have loam, silt loam, sandy clay loam, clay loam and silty clay loam textures." Group C soils have a relatively low range of conductivity values (0.14 to 1.42 in/hr), and a slow infiltration rate.

- Hydrologic Group D – "Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40% clay, less than 50% sand and have clayey textures. In some areas, [Group D soils]also have high shrink-swell potential." Group D soils have conductivity values less than 0.14 in/hr, a very slow infiltration rate.

A dual hydrologic group (C/D) is assigned to an area to characterize runoff potential under drained and undrained conditions, where the first letter represents drained conditions, and the second letter applies to undrained conditions.

According to this HSG dataset, BVGB does not show high infiltration rates (Group A) and only a tiny area (<0.1%) of Group B soil (moderate infiltration) are present, located on the western edge of the Basin at the top of Bull Run Slough near Kramer Reservoir. The remainder of the Basin is shown with hydrologic soils Groups C and D, slow to very slow infiltration rates (Group C at 30% and Group D at 58% of Basin area). Most of the ACWA is underlain by the dual hydrologic group C/D (11% of Basin area) and due to the wetland nature of this area contains primarily undrained soils corresponding to the very slow infiltration rates.

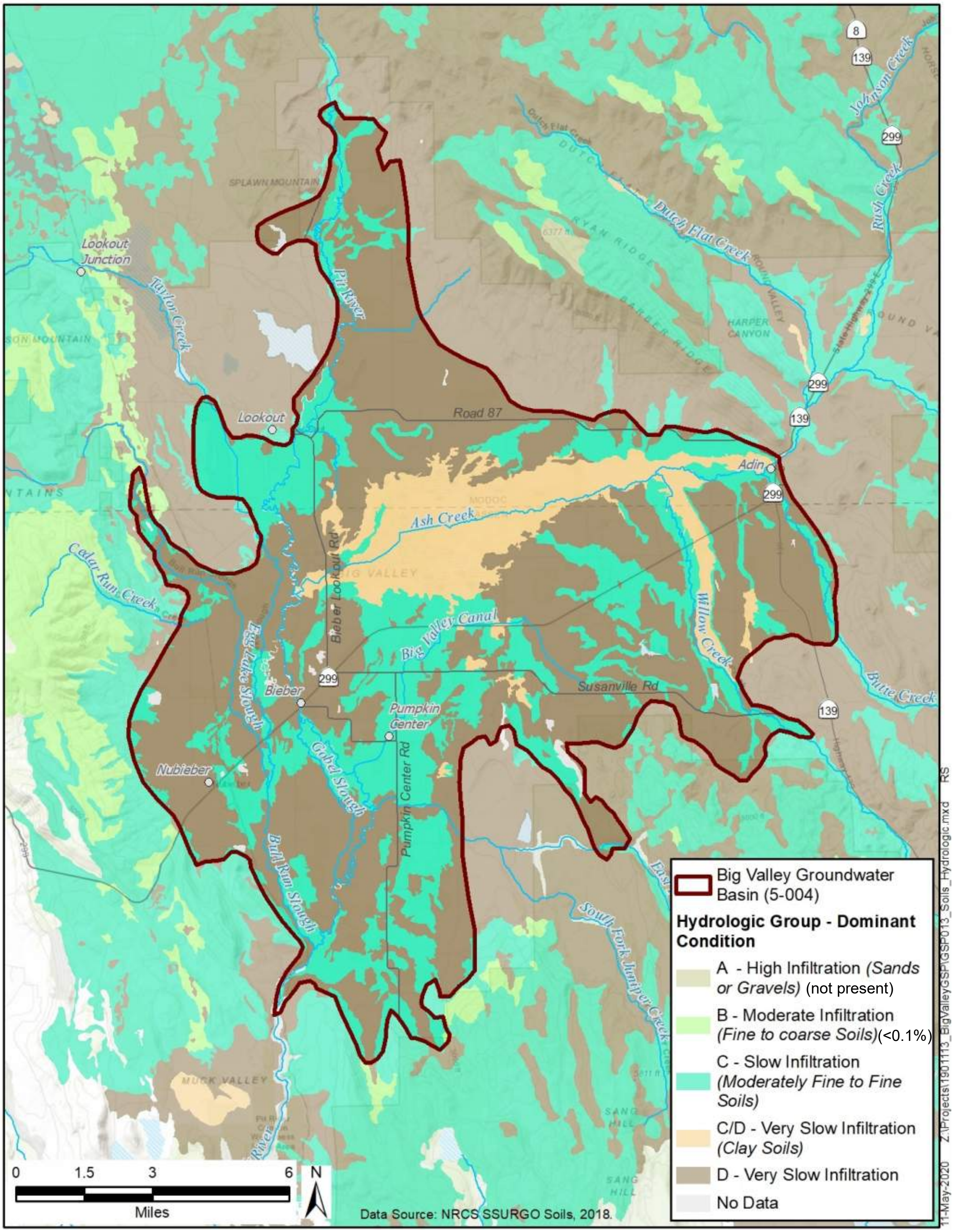


Figure 4-10 Hydrologic Soils Group Classifications

It should be noted that the NRCS develops these maps using a variety of information including remote sensing and some limited field data collection and does not always capture variations that may occur on a small scale. Historical experience from landowners and additional field data could identify areas of better infiltration. These soils groups do not necessarily preclude vertical movement of water and, while recharge may be slower than desired, recharge is still possible. Additionally, Group C and D soils may have slow infiltration rates due to shallow hardpan, and groundwater recharge could potentially be enhanced if this hardpan can be disrupted. Soil permeability has been identified as a data gap, particularly at the small scale.

4.5.3 Soil Agricultural Groundwater Banking Index

The University of California at Davis has established the Soil Agricultural Groundwater Banking Index (SAGBI) using data within the SSURGO database, which gives a rating of suitability of the soils for groundwater recharge. This index expands on the HSG to include topography, chemical limitations and soil surface condition. This effort has resulted in a mapping tool that illustrates six SAGBI classes (excellent-very poor) and has been completed for much of the state. This mapping tool is only available for the Modoc County portion of BVGB as shown on **Figure 4-11**, and the index varies mostly between moderately poor to very poor. Small areas of moderately good are present along the Pit River as it enters BVGB and to the west of Adin. It should be noted that the SAGBI is a large-scale, planning level tool and does not preclude local site conditions that are good for groundwater recharge.

4.6 Beneficial Uses of Principal Aquifer

Primary beneficial uses of groundwater in the BVGB include agricultural, environmental, municipal and domestic uses. A description of each is provided below.

Agricultural

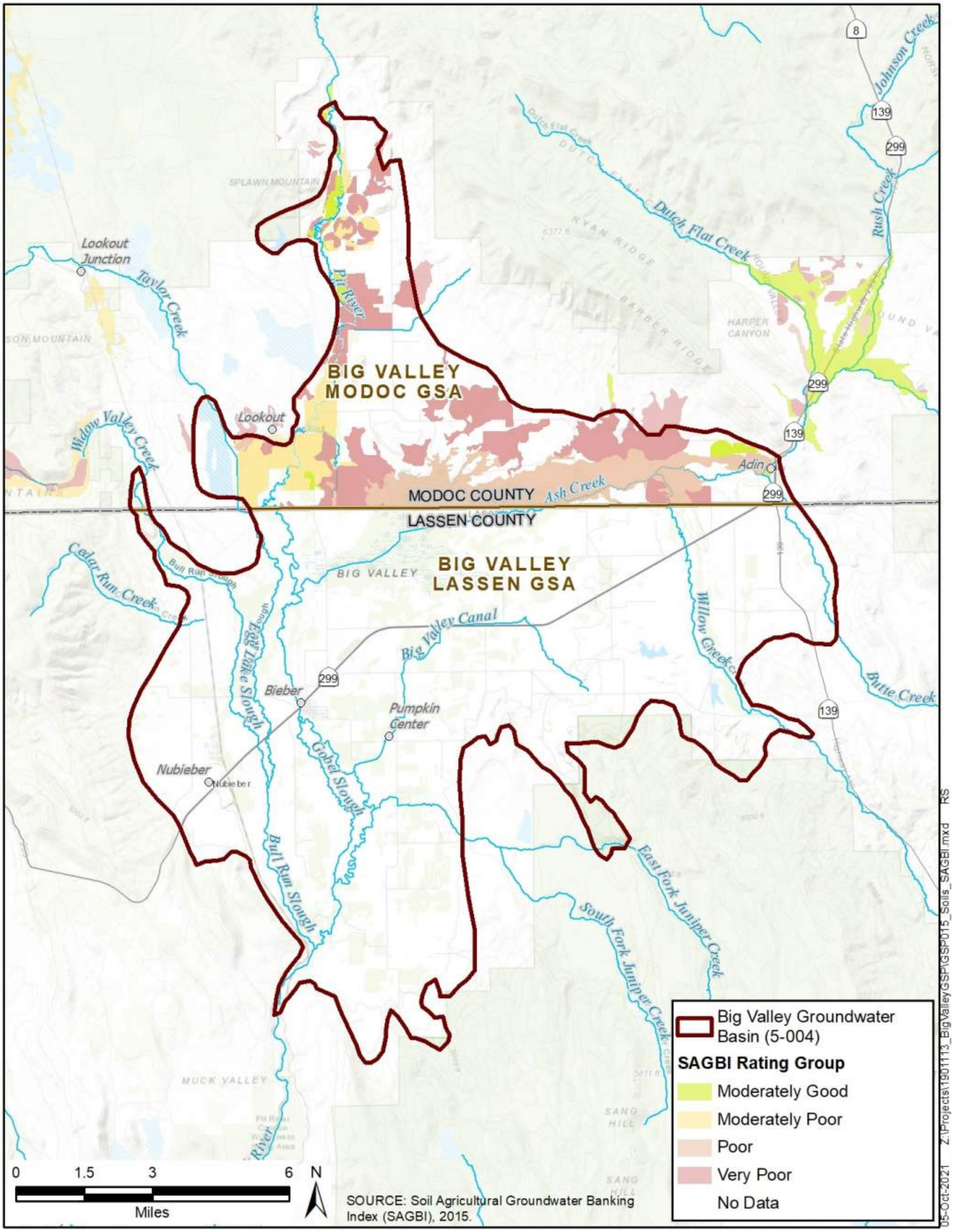
Agricultural users get their supply from surface water diversions, groundwater, or a combination of the two. **Figure 3-6** from the previous chapter illustrates DWR's estimate of the primary source being used around the Basin. The primary crops are grain and hay crops (primarily alfalfa) with some wild rice.

Industrial

Industrial groundwater use is limited in the BVGB. According to DWR well logs, six industrial wells have been drilled, all of them near Bieber at Big Valley Lumber, which is not currently in operation. **Figure 3-5** shows some areas of industrial use, but more use is likely present throughout the Basin as agricultural users have some associated industrial needs.

Environmental

Environmental uses for wetland and riparian botanical and wildlife habitat occur within the ACWA in the center of the Basin, near the overflow channels adjacent to the Pit River in the southern portion of the Basin and along the riparian corridors of some of the minor streams that flow into Big Valley. Additionally, private lands throughout the Basin provide for environmental uses, including those enrolled in the CRP and WRP programs discussed in Section 3.3.



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1550 **Figure 4-11 SAGBI Classifications**

Municipal

The State Water Board recognizes three public water systems that use groundwater under the purview of the DDW: LCWD #1 which serves the community of Bieber, the Forest Service Station in Adin which provides groundwater to a non-community, non-transient population and the CAL FIRE conservation camp west of the Basin whose well is located within the Basin boundary.

Domestic

Domestic users include residents that use their own well for household purposes. The BVGB has a population of about 1,046. With the 312 Bieber residents receiving water from municipal supply, the majority of the remaining 734 residents are domestic users.

4.7 General Water Quality

Previous reports have characterized the water quality as excellent (DWR 1963, Reclamation 1979). The central area of the Basin, where naturally occurring hot springs influence the chemistry, has elevated levels of sulfate, fluoride, boron and arsenic (Reclamation 1979). These localized areas with higher mineral content occur near the major faults that traverse the valley.

Figure 4-12 shows a Piper Diagram for water samples that were collected in late 2019 and early 2020, and characterizes the relative concentrations of the major cations (Ca, Mg, Na, K) and anions (SO_4, Cl, HCO_3). The dominant cations are derived from the minerals in the aquifer and range from sodium rich to mixed with higher amounts of calcium and magnesium which increases the water hardness. The major anion is strongly bicarbonate which is derived from carbon dioxide in the atmosphere and soil zone and indicates that the water is generally young in geologic terms.

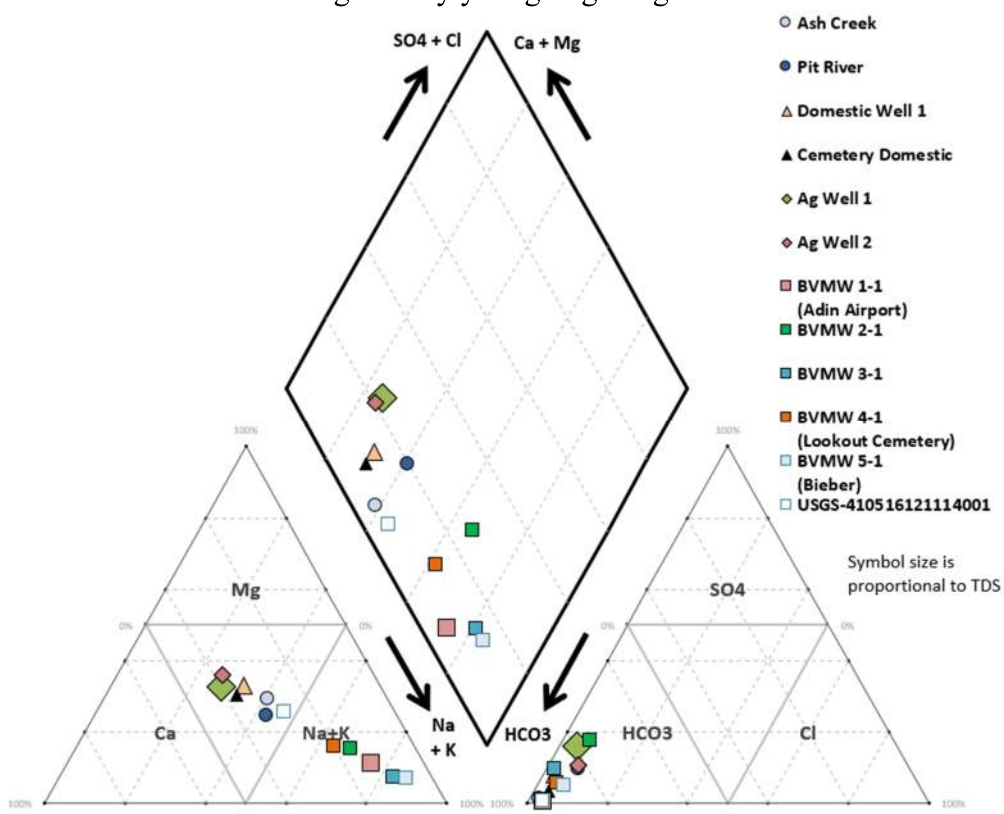


Figure 4-12 Piper Diagram showing major cations and anions

Some areas in the Basin have elevated levels of iron, manganese and/or arsenic, all of which are naturally occurring in volcanic terrains such as Big Valley. The nature and distribution of these constituents will be discussed further in Chapter 5 – Groundwater Conditions.

4.8 Groundwater Recharge and Discharge Areas

4.8.1 Recharge

Groundwater recharge in BVGB likely occurs *via* several mechanisms discussed below.

Underflow from adjacent upland areas and other areas outside the Basin

The upland areas consist of fractured basalt flows where the precipitation infiltrates vertically through joints and fractures until it reaches underlying aquifer material and then travels horizontally into the Basin. DWR has postulated that the areas shown in pink on **Figure 4-13** provide recharge in such a way. However, other areas adjacent to the Basin could provide some recharge in a similar fashion. In addition, underflow enters the Basin where the Pit River and Ash Creek enter the Basin. A Basin boundary modification is needed to encompass other important recharge areas outside the currently defined Basin boundary.

Infiltration of precipitation on the valley floor

Some direct infiltration of rain and snow on the valley floor occurs. However, because the aquifer materials in the Basin are largely lacustrine and much of the soils have slow infiltration rates, a high proportion of the precipitation likely runs off or is evapotranspirated. **Figure 4-13** shows the areas from the NRCS datasets that may have a slightly higher infiltration rate (HSG B and HSG C) than the other areas and therefore potentially more recharge.

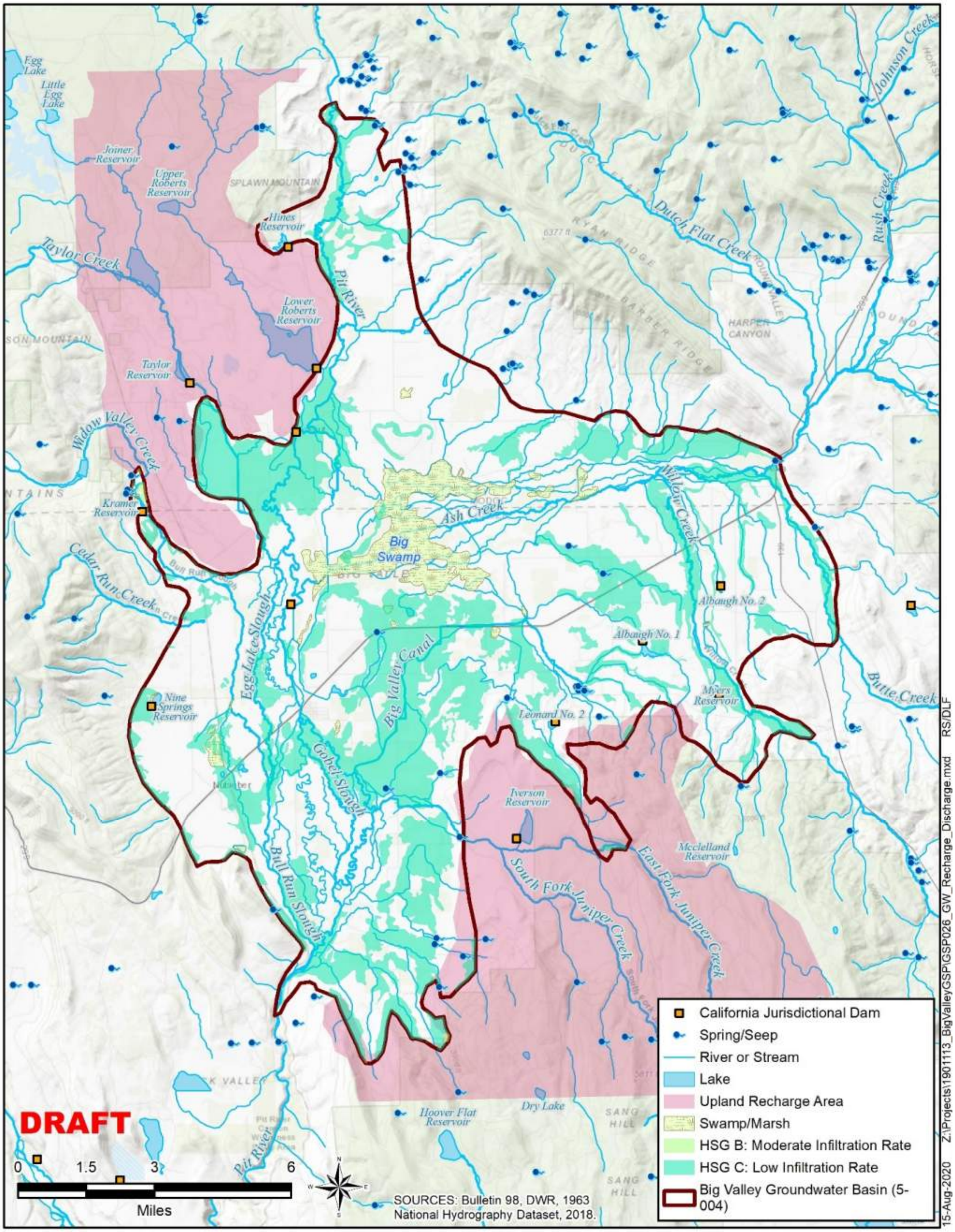
Rivers and streams that flow through the Basin

Streams that flow through the Basin lose water to the aquifer, particularly where they enter the Basin. Aquifer materials are typically coarser on the fringes of the Basin where the stream gradient begins to flatten. In general, recharge likely occurs in the eastern portions of the Basin along Ash Creek, Butte Creek and Willow Creek and then flows westerly through the subsurface. As Ash Creek flows to the center of the Basin and Big Swamp, the water slows and spreads out into a large marsh. The CDFW has recently enhanced this slowing and spreading of water through "pond and plug" projects which bring the water up out of the previously incised channel. Other pond and plug projects have been successfully implemented in the region. Even though the soils and aquifer materials in this portion of the Basin have slow infiltration rates, recharge is likely to occur from Big Swamp because of the long period of time that the shallow soils remain wet and saturated. Support from the public has been received at outreach meetings to conduct more pond and plug projects within and near the Basin.

Deep percolation of irrigation water

Depending on the irrigation method, particularly flood irrigation, deep percolation of irrigation water into the aquifer occurs. Flood irrigation is an active practice in the Basin and provides valuable recharge.

1609



1610 **Figure 4-13 Recharge, Discharge and Major Surface Water Bodies**

4.8.2 Discharge

Historically, flow out of the groundwater aquifer (and out of the Basin) most likely occurred at the southern portion of the Basin where the aquifer discharged to the Pit River. DWR (1963) indicates that artesian[36] conditions occurred in this southwestern area. The gaining river[37] then transported the water out of the Basin. However, based on currently documented water levels, this area is no longer artesian and likely hasn't been a gaining stream for decades. There are numerous springs throughout the Basin shown on **Figure 4-13** where groundwater is discharged, including several hot springs in the center of the Basin. Evapotranspiration may also be a significant discharge mechanism.

4.9 Surface Water Bodies

Figure 4-14 shows the numerous small streams that enter the Basin and flow towards the center where they connect with the two major streams: Pit River and Ash Creek. The figure also shows the many small ponds and several reservoirs that are in and around the perimeter of the Basin. The dams that are within the jurisdiction of the DWR Division of Safety of Dams are shown. While many of these impoundments are located outside of Basin boundaries, they represent supplies that hydrologically flow to/through the Basin. The reservoirs provide options for the timing of release of those waters, rather than importing supplies from sources external to the Basin.

4.10 Imported Water Supplies

BVGB users do not import surface water into the Basin because all surface water used in the Basin originates in the watershed of the Pit River or the watershed of a local BVGB stream.

4.11 Data Gaps in the Hydrogeologic Conceptual Model

As discussed in the introduction, hydrogeology has inherent uncertainties due to sparse data and in the case of Big Valley, a limited number of detailed studies on the groundwater resources in the Basin. Identified below are some of the uncertainties associated with the hydrogeology in the Basin. In some instances, this uncertainty can be reduced while other uncertainties will remain. The filling of the data gaps below is contingent on the needs that arise as the GSP is developed and implemented and the level of available outside funding.

Basin Boundary

The current, inaccurate Basin boundary was drawn by DWR with a regional scale map (CGS 1958) and was not drawn with as much precision as subsequent geologic maps. Additionally, the "uplands" areas outside the Basin boundary are postulated to be recharge areas interconnected to the Basin, which is contrary to DWR's definition of a lateral Basin boundary as being, "…features that significantly impede groundwater flow" (DWR 2016c). Further refinement of the Basin boundary is desired and necessary, particularly in the areas of, "upland recharge" mapped by DWR, the fingers in the southeastern portion of the Basin and in the northeastern portion of the Basin below Barber Ridge and Fox Mountain.

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[36] Artesian aquifers are under pressure and wells screened in them flow at the surface.
[37] Gaining rivers are where groundwater flows toward the river and contributes to surface water flow.

Confining Conditions

Confining conditions probably exist throughout much of the Basin. Often, the confinement is simply a result of depth and the fact that horizontal hydraulic conductivities are 10 times (or more) greater than vertical conductivities. However, in the southwest portion of the Basin, DWR (1963) documented an area of confined groundwater conditions. It is unknown whether that confinement is due to a single, coherent aquitard or is just a result of depth. It is also unknown whether the confinement is significant enough to warrant separate principal aquifers, which could have implications for the GSP. In addition, aquifer characteristics in the various areas of the Basin are not thoroughly understood as discussed in Section 4.4.5 and an assessment in needed on how aquifer characteristics vary throughout the Basin in shallow and deep portions of the aquifer.

Definable Bottom

This HCM has used the "practical" depth of 1,200 feet as the definable bottom. If stakeholders seek to develop groundwater deeper than this depth, newly constructed wells will demonstrate that the "physical bottom" and the base of fresh water ("effective bottom") extend deeper.

Faults as Barriers to Flow

It is unknown if the faults which traverse the Basin are barriers to flow. On the Lassen County side of the Basin, this condition has bearing on understanding whether the eastern portions of the Basin near Willow Creek are interconnected with the southwestern portions of the Basin near Pumpkin Center. Groundwater contours indicate that there is east to west flow, but this flow is uncertain due to a mapped fault between the two areas. This uncertainty could be reduced by conducting a pumping test with observation well(s) on the other side of the fault.

Soil Permeability

The NRCS mapping of soils indicates primarily low to very low permeability soils throughout the Basin. However, there is some variation of permeabilities indicated by the maps, which are drawn at a large scale with limited field verification. Further field investigation of soils and permeability tests could help identify more permeable areas where groundwater recharge could be enhanced.

Recharge

The recharge sources below have been identified, but the rate and amount of recharge is unknown. In the water budget (*see* Chapter 6 – Water Budget), the amount of recharge is roughly estimated. Below are the data gaps related to recharge.

- Effect of Ash Creek on recharge (including Big Swamp)
- Effect of Pit River on recharge (including overflow channels)
- Effect of smaller streams on recharge (including Willow Creek)
- Amount of recharge from direct precipitation
- Amount of recharge from deep percolation of applied water
- Amount of recharge from upland recharge areas
- Amount of recharge from seepage of ditches, canals and reservoirs

5. Groundwater Conditions §354.16

This chapter presents available information on groundwater conditions for the BVGB developed by GEI for the Lassen County and Modoc County GSAs. This chapter provides some of the information needed for the development of the monitoring network and the sustainable management criteria of this GSP. The content of this chapter is defined by the regulations of SGMA (Chapter 1.5, Article 5, Subarticle 2: 354.16). GEI Professional Geologists provided the content of this chapter and will affix their professional stamps (as required by the regulations) certifying that it was developed under their supervision once the chapter is finalized into the GSP.

5.1 Groundwater Elevations

Historic groundwater elevations are available from a total of 22 wells in Big Valley, six located in Modoc County and 16 in Lassen County as shown on **Figure 5-1** and listed in **Table 5-1**. Twenty of the wells are part of Lassen and Modoc counties' monitoring network, which was approved by the counties in 2011, in compliance with the CASGEM program. DWR staff measure water levels in these wells twice annually (spring and fall) on behalf of the counties. Some measurements from wells are missing, which is typically a result of access issues to the wells sites or occasionally a well owner who has removed their well from the monitoring program. These wells may or may not be used as part of the GSP monitoring network, which will be addressed in Chapter 8 – Monitoring Networks.

The first water level measurements in the BVGB began in the late 1950s at two wells near Bieber (17K1) and Nubieber (32A2). Regular monitoring of these two wells began in the mid-1960s and monitoring began in most of the other wells during the late 1970s or early 1980s. Three wells located on the ACWA were added to the CASGEM networks in 2016. Of the 22 historically monitored wells, one well (12G1) has not been monitored since 1992 and one well (06C1) has no measurements since 2015. Construction details are not available for one well (32R1) and could benefit from a 'downhole' video inspection of the well casing to determine the depth interval associated with the water levels.

In addition to these 22 wells, five well clusters were constructed in late 2019 and early 2020 to support the GSP. Their locations are also shown on **Figure 5-1**. Each cluster consists of a deep well (200-500 feet) and three shallow wells (60-100 feet). These wells were drilled to explore the geology, with the deep well giving water level information for the main portion of the aquifer at that location. The three shallow wells are screened shallow to determine the direction and magnitude of flow in the shallow subsurface and potentially to give an indication if groundwater interacts with surface water and possibly the location of groundwater recharge. Limited water level information is available from these five clusters.

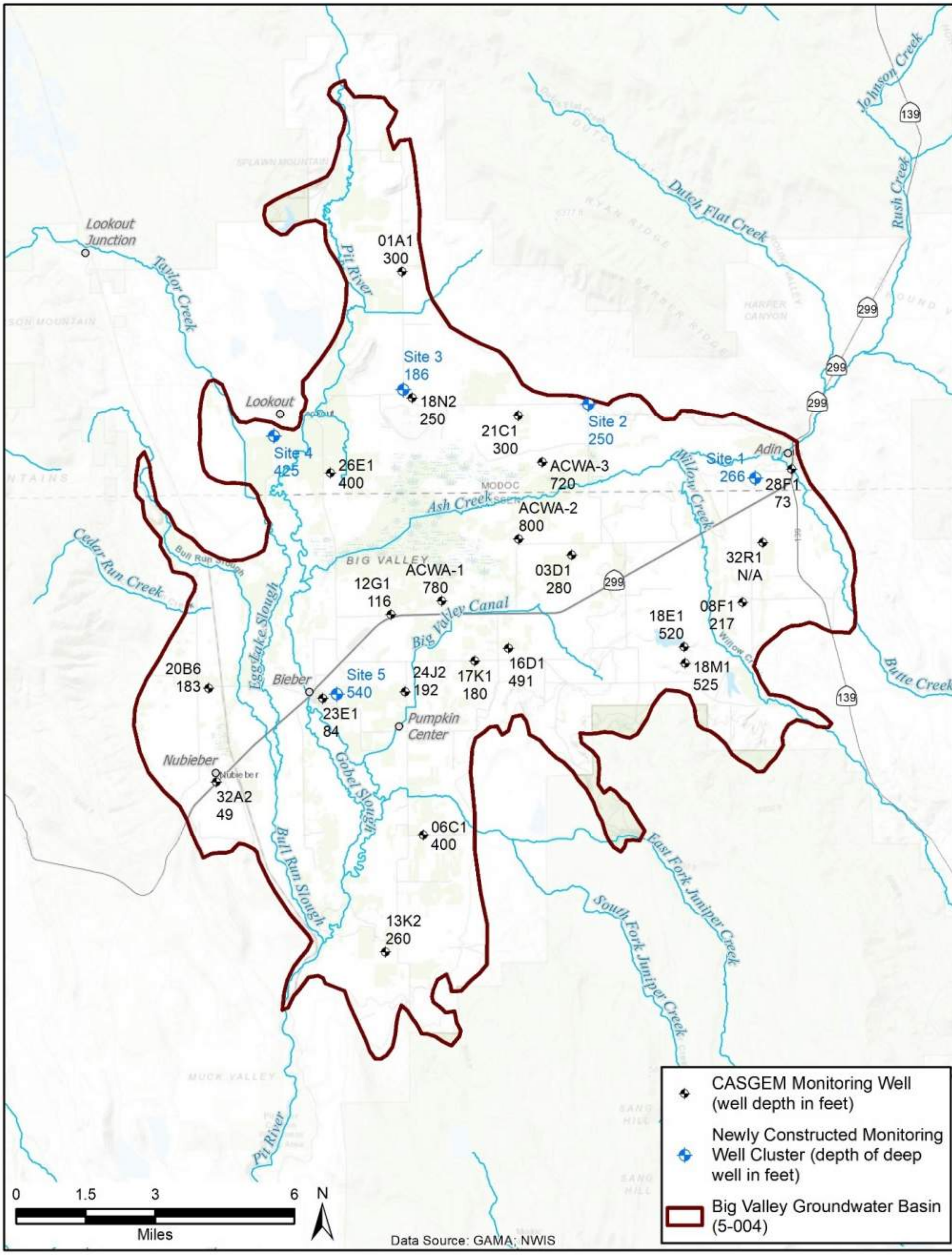


Figure 5-1 Water Level Monitoring

Table 5-1 Historic Water Level Monitoring Wells

Well Name	State Well Number	CASGEM ID	County	Well Use	Well Depth (feet bgs)	Ground Elevation (feet msl)	Reference Point Elevation (feet msl)	Period of Record Start Year	Period of Record End Year	Number of Measure-ments	Minimum Groundwater Elevation (feet msl)	Maximum Groundwater Elevation (feet msl)
18E1	38N09E18E001M	411356N1209900W001	Lassen	Irrigation	520	4248.40	4249.50	1981	2019	73	4198.20	4234.10
23E1	38N07E23E001M	411207N1211395W001	Lassen	Residential	84	4123.40	4123.40	1979	2020	81	4070.40	4109.10
260	39N07E26E001M	411911N1211354W001	Modoc	Irrigation	400	4133.40	4135.00	1979	2020	79	4088.90	4131.30
01A1	39N07E01A001M	412539N1211050W001	Modoc	Stockwatering	300	4183.40	4184.40	1979	2020	81	4035.40	4163.90
03D1	38N08E03D001M	411647N1210358W001	Lassen	Irrigation	280	4163.40	4163.40	1982	2020	71	4076.60	4148.60
06C1	37N08E06C001M	410777N1210986W001	Lassen	Irrigation	400	4133.40	4133.90	1982	2016	69	4066.20	4126.80
08F1	38N09E08F001M	411493N1209656W001	Lassen	Other	217	4253.40	4255.40	1979	2020	83	4167.90	4229.50
12G1	38N07E12G001M	411467N1211110W001	Lassen	Residential	116	4143.38	4144.38	1979	1993	28	4130.98	4138.68
13K2	37N07E13K002M	410413N1211147W001	Lassen	Irrigation	260	4127.40	4127.90	1982	2018	70	4061.90	4109.70
16D1	38N08E16D001M	411359N1210625W001	Lassen	Irrigation	491	4171.40	4171.60	1982	2020	74	4078.73	4162.40
17K1	38N08E17K001M	411320N1210766W001	Lassen	Residential	180	4153.30	4154.30	1957	2020	146	4115.08	4150.00
18M1	38N09E18M001M	411305N1209896W001	Lassen	Irrigation	525	4288.40	4288.90	1981	2020	74	4192.30	4232.70
18N2	39N08E18N002M	412144N1211013W001	Modoc	Residential	250	4163.40	4164.40	1979	2020	80	4136.60	4160.20
20B6	38N07E20B006M	411242N1211866W001	Lassen	Residential	183	4126.30	4127.30	1979	2019	80	4076.94	4116.60
21C1	39N08E21C001M	412086N1210574W001	Modoc	Irrigation	300	4161.40	4161.70	1979	2020	79	4082.10	4148.50
24J2	38N07E24J002M	411228N1211054W001	Lassen	Irrigation	192	4138.40	4139.40	1979	2019	77	4056.70	4137.70
28F1	39N09E28F001M	411907N1209447W001	Modoc	Residential	73	4206.60	4207.10	1982	2020	76	4194.57	4202.10
32A2	38N07E32A002M	410950N1211839W001	Lassen	Other	49	4118.80	4119.50	1959	2020	133	4106.70	4118.80
32R1	39N09E32R001M	411649N1209569W001	Lassen	Irrigation	unknown	4243.40	4243.60	1981	2020	64	4161.20	4205.50
ACWA-1	38N08E07A001M	411508N1210900W001	Lassen	Irrigation	780	4142.00	4142.75	2016	2020	8	4039.15	4126.35
ACWA-2	39N08E33P002M	411699N1210579W001	Lassen	Irrigation	800	4153.00	4153.20	2016	2020	8	4126.40	4139.35
ACWA-3	39N08E28A001M	411938N1210478W001	Modoc	Irrigation	720	4159.00	4159.83	2016	2020	7	4136.23	4150.58

Notes:
bgs = below ground surface
msl = above mean sea level
source: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

5.1.1 Groundwater Level Trends

Figure 5-2 and **Figure 5-3** show hydrographs for the two wells with the longest monitoring records along with background colors representing the Water Year (WY) type: wet, below normal, above normal, dry and critical dry. These WY types are developed from the Sacramento River Index (SRI), which is calculated from annual runoff of the Sacramento River Watershed, of which the Pit River is a tributary. The SRI (no units) has varied between 3.1 and 15.3 (average: 8.1) over its 115-year history (1906-2020) and is divided into the five WY categories. For 1983 to 2018, the average SRI is 7.9.

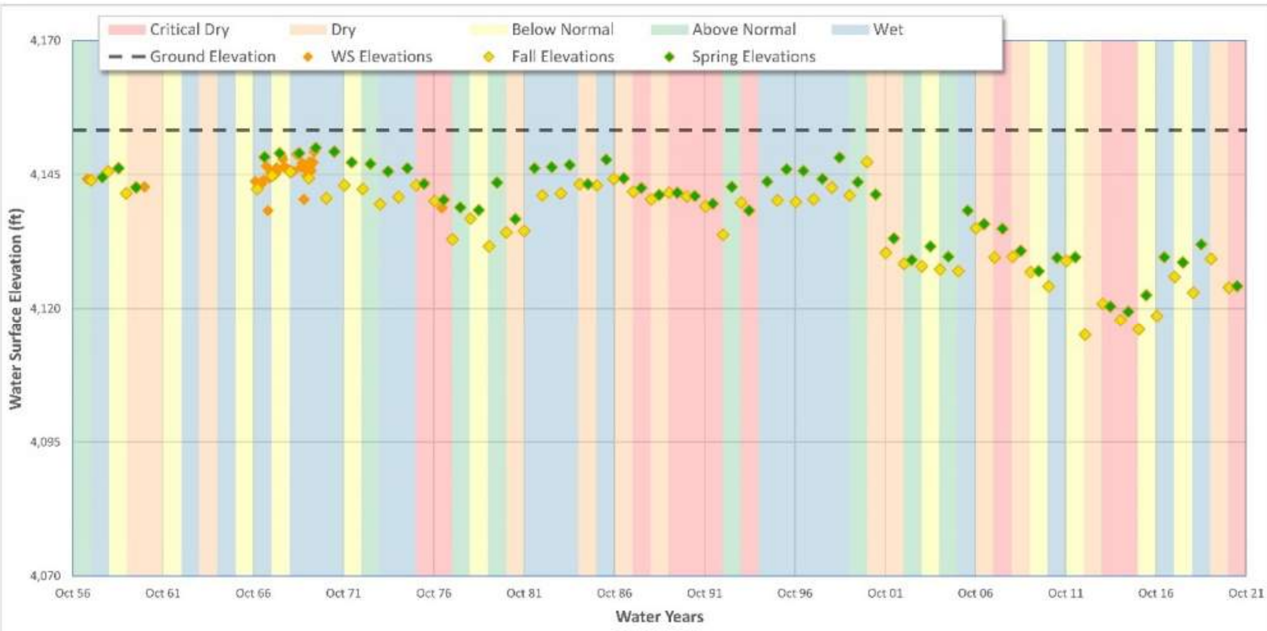


Figure 5-2 Hydrograph of Well 17K1

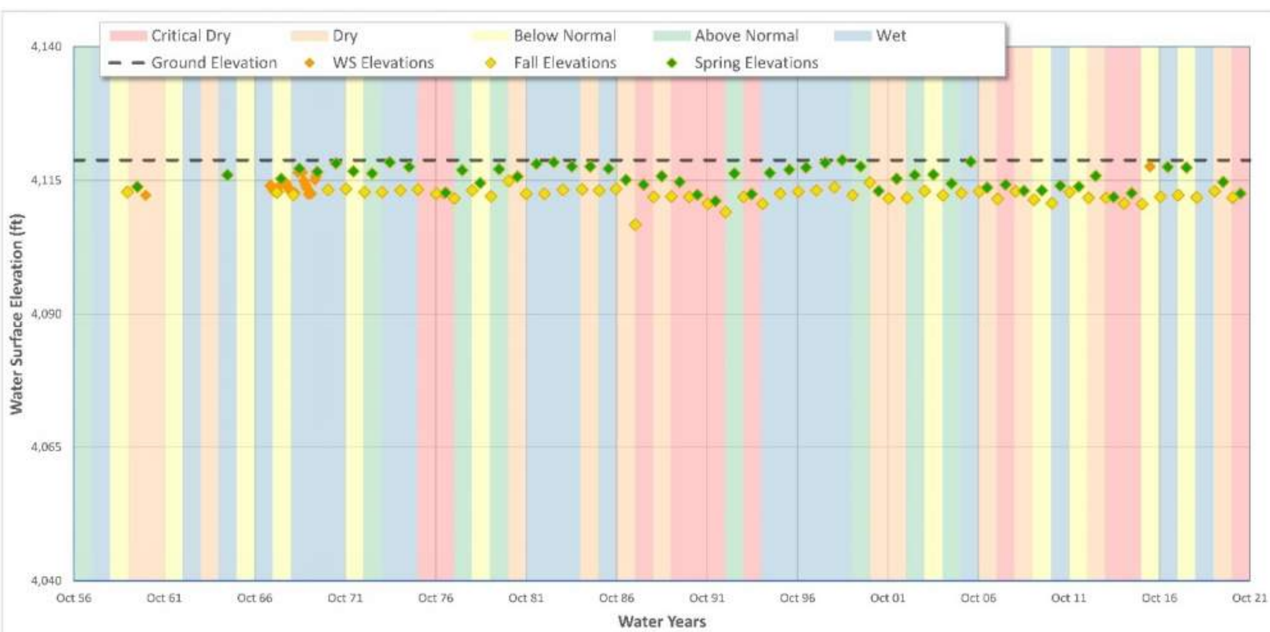


Figure 5-3 Hydrograph of Well 32A2

The water level record for these two wells illustrates that some areas of the Basin have experienced little to no change in water levels, while other areas have fluctuated and declined during the last 20 years. Declines during the drought period of the late 1980s and early 1990s were offset by recovery during the wet period of the late 1990s. Water levels in some wells have declined during the sustained dry period that has occurred since 2000. Hydrographs for all 22 wells are presented in **Appendix 5A**. On each of these hydrograph, an orange trend line is shown, which is determined from a line of best fit for the spring water level measurements between WY 1979 and 2021. The average water level change during that period, in feet per year, is also shown. Sixteen wells show relatively stable (less than -1.0 foot per year [ft/yr] of decline) or rising water levels and six wells show declining water from -1.0 ft/yr to -3.1 ft/yr. The locations of these water level changes are shown graphically on **Figure 5-4** with the stable or rising water levels shown in green and areas with declines in excess of -1.0 ft/yr in orange.

5.1.2 Vertical Groundwater Gradients

Vertical hydraulic gradients are apparent when groundwater levels in wells screened deep in the aquifer differ from water levels measured shallow in the aquifer at the same general location. Significant vertical gradients can indicate that the deep portion of the aquifer is separate from the shallow (e.g., by a very low permeability clay layer) and/or that pumping in one of the aquifers has occurred and the vertical flow between the aquifers is in progress of stabilizing. Chapter 4 – Hydrogeologic Conceptual Model defines a single principal aquifer in the BVGB. However, vertical gradients likely exist, and the five recently constructed well clusters will have data to describe these gradients once sufficient water level data are available from those wells. The locations of the clusters are shown on **Figure 5-1**.

5.1.3 Groundwater Contours

Spring and fall 2018 water level measurements from the 21 active CASGEM wells were used to illustrate current groundwater conditions. The 2018 data was used to illustrate current conditions because there were several wells without data for 2019 or 2020. **Figure 5-5** and **Figure 5-6** show the 2018 seasonal high and seasonal low groundwater elevation contours, respectively, which were interpolated from the locations of the 21 active wells. Each contour line shows equal groundwater elevation. Groundwater flows from higher elevations to lower elevations, perpendicular to the contour lines. The direction of flow is emphasized on the figures in certain areas with arrows. In general, groundwater is highest in the east, where Ash, Willow and Butte creeks enter the Basin. The general flow of water is to the west and south. The contours do indicate, however, northerly flow from the lower reaches of Ash Creek. In the southern portions of the BVGB, groundwater flows toward the east.

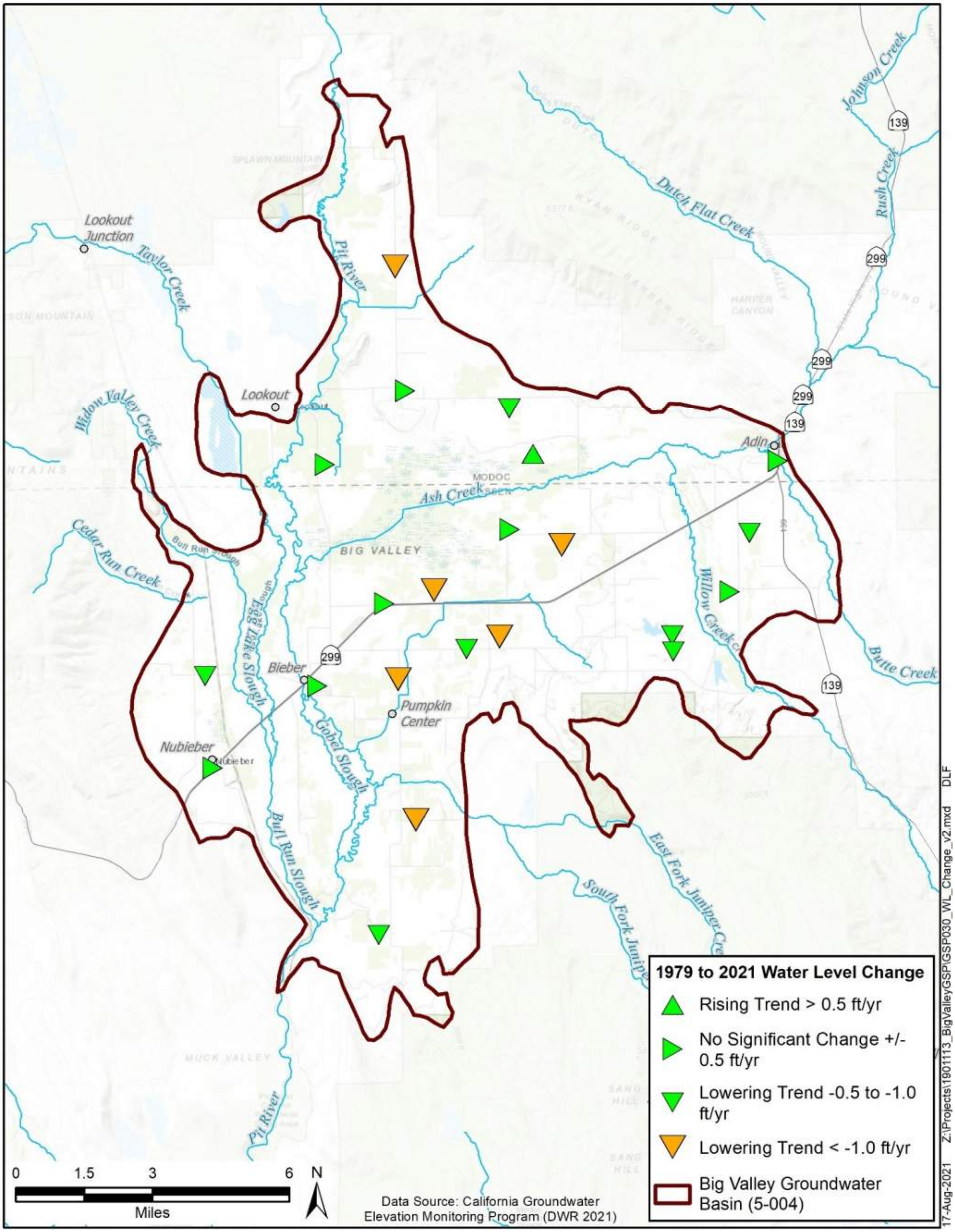
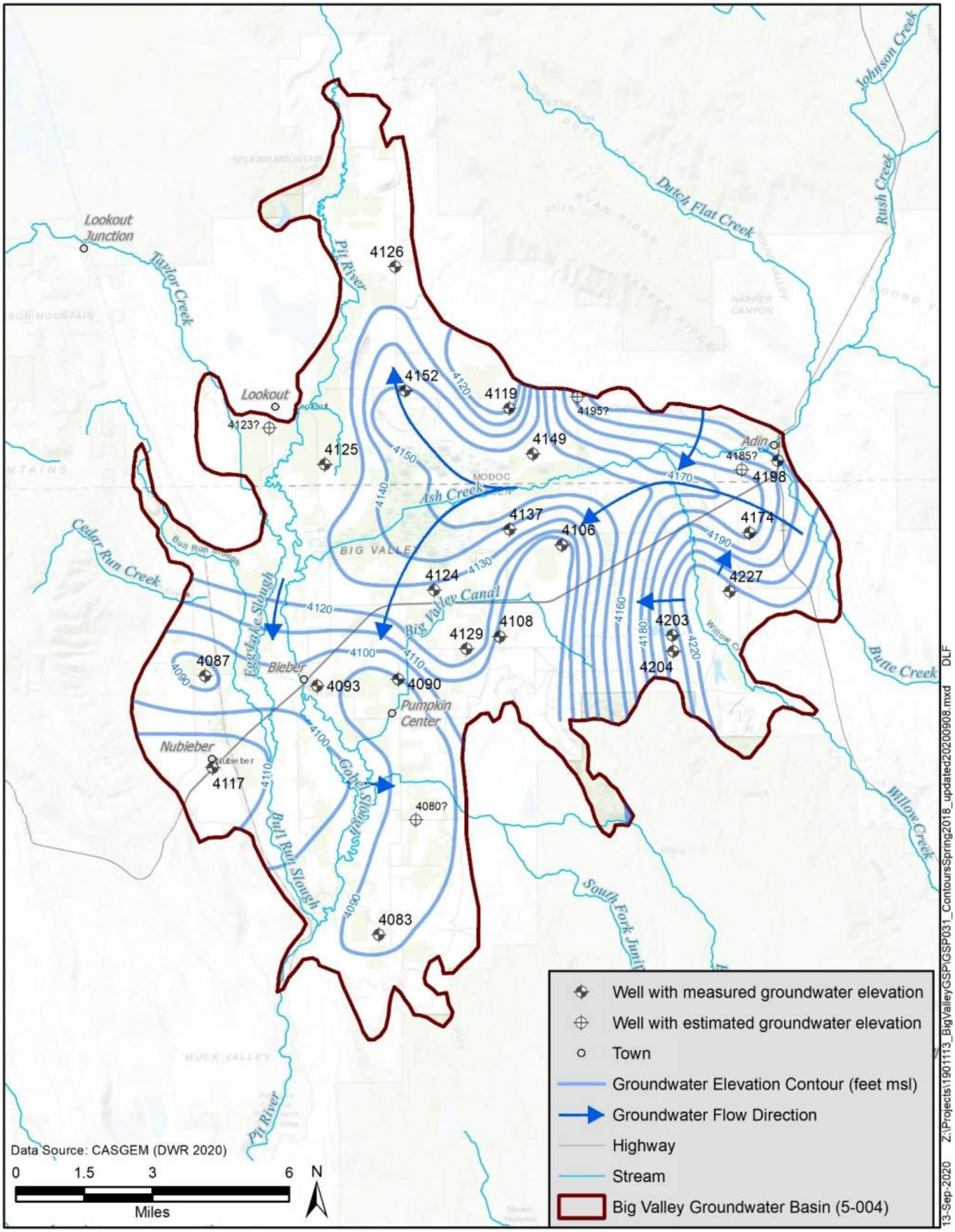


Figure 5-4 Average Water Level Change Since 2000 Using Spring Measurements

1762



1763 **Figure 5-5 Groundwater Elevation Contours and Flow Direction Spring 2018**

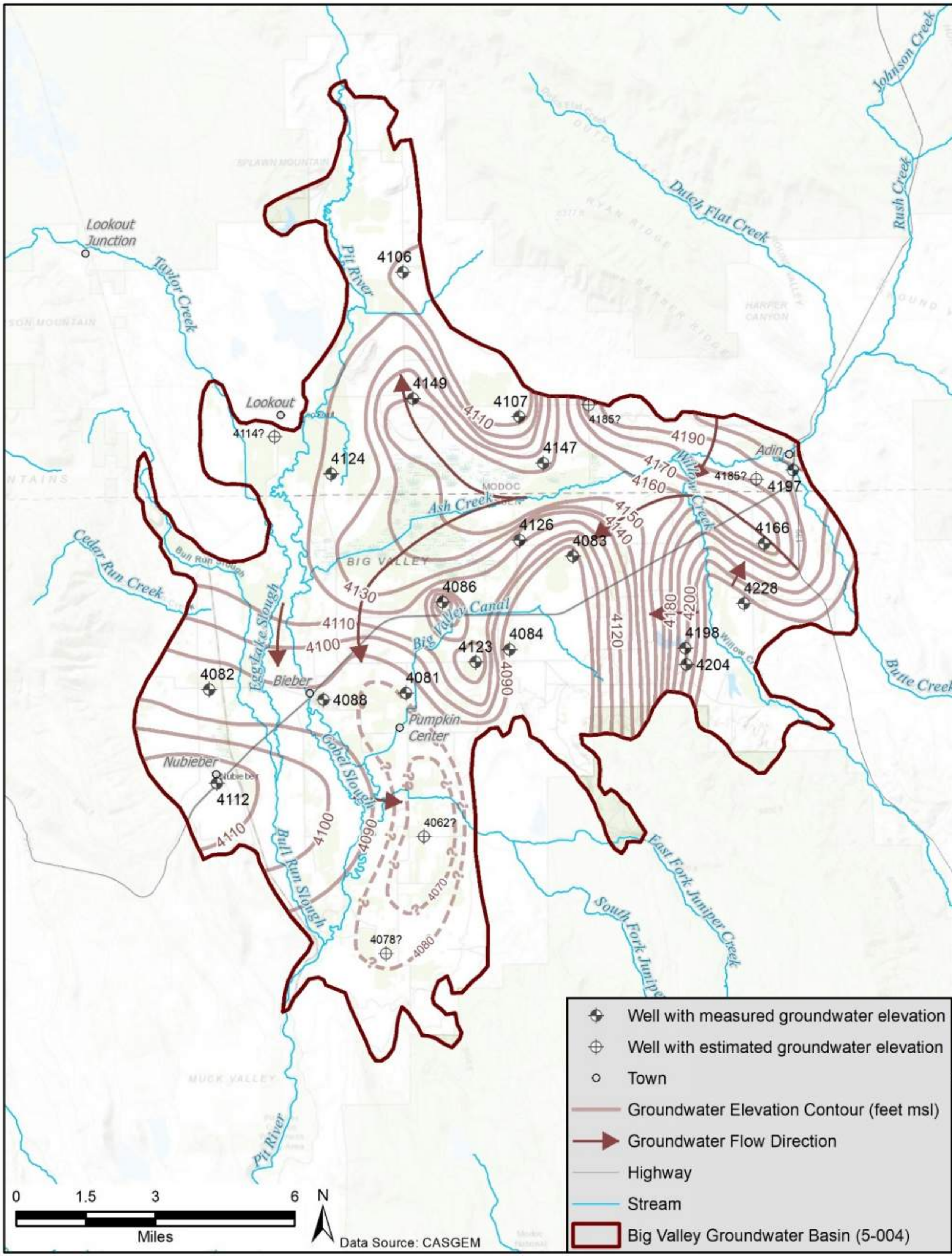


Figure 5-6 Groundwater Elevation Contours and Flow Direction Fall 2018

5.2 Change in Storage

To determine the annual and seasonal change in groundwater storage, groundwater elevation contoured surfaces[38] were developed for spring and fall for each year between 1983 and 2018. These surfaces are included in **Appendix 5B**. The amount of groundwater in storage for each set of contours was calculated using software which can subtract the groundwater elevation surface from the ground elevation surface (using a digital elevation model) at each grid cell (pixel) and calculate the average depth to water (DTW) for the entire Basin. This average DTW was then subtracted from the practical bottom of the Basin (1,200 feet), multiplied by the area of the Basin and multiplied by 5 percent, which is used as the specific yield[39].

Table 5-2 shows, from 1983 to 2018, the total groundwater in storage for each year and the cumulative change in storage. The highest SRI occurred in 1983 and the fourth lowest SRI occurred in 2015. Moreover, this 36-year period also include five of the lowest ten SRIs and five of the highest ten SRIs, which demonstrates the high degree of variability in climatic conditions.

Figure 5-7 shows this information graphically, along with the annual precipitation from the McArthur station. This graph shows that groundwater storage generally declines during dry years and stays stable or increases during normal or wet years. During the early portion of the 36-year period, groundwater levels dipped, then recovered to 1983 conditions by 1999 due to six consecutive years of above average precipitation. Since 2000, groundwater storage has generally declined by about 96,000 acre-feet (AF) (using spring measurements) which is a slight increase from the historic low of about 116,000 AF in spring 2015.

Annual groundwater use is not shown on **Figure 5-7** as required by SGMA regulations. Groundwater use will be addressed in Chapter 6 – Water Budget.

5.3 Seawater Intrusion

The BVGB is not located near the ocean, and therefore seawater intrusion is not applicable to this GSP.

5.4 Groundwater Quality Conditions

As noted in Chapter 4, previous reports have characterized the water quality in the BVGB as excellent (DWR 1963, Reclamation 1979). Groundwater is generally suitable for all beneficial uses and only localized contamination plumes have been identified in the BVGB. This section presents an analysis of recent groundwater quality conditions and the distribution of known groundwater contamination sites in compliance with GSP Regulation §354.16(d).

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[38] Groundwater elevation surfaces are developed using a kriging mathematically method and the known groundwater elevations at wells throughout the Basin. Kriging predicts (interpolates) what groundwater levels are between known points. The kriging surface consists of a grid (pixels) covering the entire basin that has interpolated groundwater elevation values for each node of the grid.

[39] The fraction of the aquifer material that contains recoverable water. Specific yield is described in more detail in Chapter 4 – Hydrologic Conceptual Model.

Table 5-2 Change in Storage 1983-2018

Year	Average Spring Depth to Water[1] (feet)	Spring Storage[2] (Acre-feet)	Spring Cumulative Change in Storage[3] (Acre-feet)
1983	29.3	5,390,192	-
1984	29.4	5,389,508	(684)
1985	31.4	5,380,526	(9,666)
1986	31.0	5,382,539	(7,653)
1987	32.6	5,375,135	(15,057)
1988	34.9	5,364,459	(25,733)
1989	35.2	5,363,150	(27,042)
1990	35.6	5,360,976	(29,216)
1991	36.8	5,355,677	(34,515)
1992	38.0	5,350,297	(39,895)
1993	36.9	5,355,293	(34,899)
1994	37.5	5,352,221	(37,971)
1995	35.3	5,362,737	(27,456)
1996	32.4	5,375,861	(14,332)
1997	31.8	5,378,600	(11,592)
1998	31.1	5,382,014	(8,179)
1999	29.5	5,389,070	(1,122)
2000	32.3	5,376,287	(13,905)
2001	38.0	5,350,015	(40,177)
2002	39.3	5,344,357	(45,835)
2003	39.4	5,343,881	(46,311)
2004	39.2	5,344,515	(45,677)
2005	41.5	5,334,164	(56,028)
2006	36.7	5,356,175	(34,017)
2007	38.8	5,346,641	(43,551)
2008	41.6	5,333,712	(56,480)
2009	42.5	5,329,337	(60,856)
2010	46.4	5,311,440	(78,752)
2011	45.9	5,313,710	(76,482)
2012	44.9	5,318,299	(71,893)
2013	49.3	5,298,013	(92,179)
2014	51.7	5,287,059	(103,133)
2015	54.4	5,274,644	(115,548)
2016	51.3	5,288,702	(101,490)
2017	49.7	5,296,127	(94,066)
2018	50.1	5,294,464	(95,728)

Note: Parentheses indicate negative numbers

[1] From water surface elevation contours - Appendix 5A

[2] Calculated from average depth to water, area of basin, 1,200 foot aquifer bottom, and specific yield of 5%

[3] This is the total change in storage since the baseline, defined as Spring 1983.

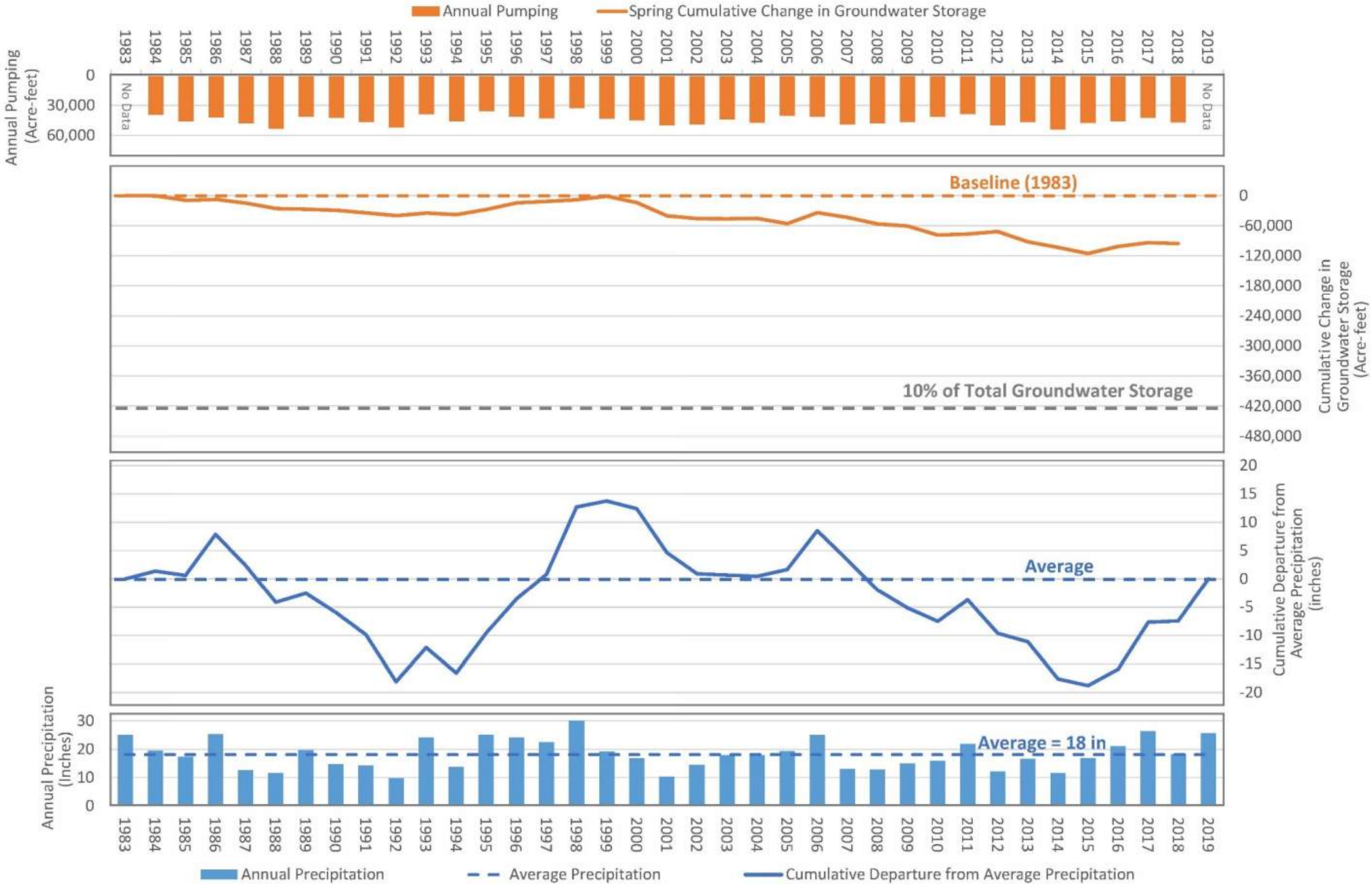

Figure 5-7 Precipitation, Pumping and Change in Groundwater Storage

5.4.1 Naturally Occurring Constituents

The concentration of naturally occurring constituents varies throughout the BVGB. Previous reports have noted the potential elevated concentrations of arsenic, boron, fluoride, iron, manganese and sulfate. (DWR 1963, Reclamation 1979) All of these constituents are naturally occurring and in these historic reports, they indicate that most of these constituents are associated with localized thermal waters found near hot springs in the center of the Basin.

More recent conditions were analyzed using a statistical approach on available data from the GAMA Groundwater Information System [GAMA GIS] (State Water Board 2020a). The GAMA GIS data provides the most comprehensive, readily available water quality dataset and contains results from numerous programs, including:

- Division of Drinking Water (public supply systems)
- Department of Pesticide Regulation
- Department of Water Resources (historic ambient monitoring)
- Environmental Monitoring Wells (regulated facilities and cleanup sites)
- U.S. Geological Survey (USGS) GAMA program
- USGS National Water Information System data

Water quality results in these datasets go back to the 1950s. Because conditions can change as groundwater is used over time, data prior to the WY 1983 were eliminated from the statistical analysis of the data. WY 1983 was chosen because the bulk of the historic water level wells (**Figure 5-1**) came online by 1983. Data from the Environmental Monitoring Wells programs were also eliminated since water quality issues associated with these regulated sites are typically highly localized, often are associated with isolated, perched groundwater and are already regulated. The nature and location of groundwater contamination sites are discussed in Section 5.4.2. – Groundwater Contamination Sites and Plumes.

Table 5-3 shows the statistical evaluation of the filtered GAMA water quality data along with the water quality results obtained from the five well clusters constructed to support the GSP. The constituents selected to assess the suitability in the Basin are based on thresholds for different beneficial uses. For domestic and municipal uses, the inorganic constituents that are regulated under state drinking water standards are shown. Boron and sodium are also shown because elevated concentrations can affect the suitability of the water for agricultural uses. The suitability threshold concentration for each constituent is shown, using either the MCL or agricultural threshold, whichever was lower. Iron and manganese were evaluated for both drinking water and agricultural thresholds. It is assumed that water suitable for domestic, municipal and agricultural purposes would also be suitable for environmental and industrial beneficial uses.

Table 5-3 Water Quality Statistics

Constituent Name	Suitability Threshold Concentration	Suitability Threshold Type	Total # of Meas	min	max	# Meas Above Threshold	% of Meas Above Threshold	# Wells With Meas	# Wells with Average Above Threshold	% of Wells with Average Above Threshold	# Wells with Most Recent Meas Above Threshold	% of Wells with Most Recent Meas Above Threshold	Comment
Aluminum	200	DW1	41	0	552	2	5%	18	1	6%	0	0%	Low concern due to only two threshold exceedances and zero recent measurements above MCL
Antimony	6	DW1	45	0	36	1	2%	20	1	5%	0	0%	Low concern due to only one threshold exceedance and zero recent measurements above MCL
Arsenic	10	DW1	53	0	12	4	8%	23	3	13%	3	13%	
Barium	1000	DW1	49	0	600	0	0%	23	0	0%	0	0%	
Beryllium	4	DW1	48	0	1	0	0%	23	0	0%	0	0%	
Cadmium	5	DW1	49	0	1	0	0%	23	0	0%	0	0%	
Chromium (Total)	50	DW1	36	0	20	0	0%	13	0	0%	0	0%	
Chromium (Hexavalent)	10	DW1*	13	0.05	3.29	0	0%	13	0	0%	0	0%	
Copper	1300	DW1	34	0	190	0	0%	21	0	0%	0	0%	
Fluoride	2000	DW1	42	0	500	0	0%	16	0	0%	0	0%	
Lead	15	DW1	28	0	6.2	0	0%	16	0	0%	0	0%	
Mercury	2	DW1	44	0	1	0	0%	19	0	0%	0	0%	
Nickel	100	DW1	46	0	10	0	0%	20	0	0%	0	0%	
Nitrate (as N)	10000	DW1	151	0	4610	0	0%	24	0	0%	0	0%	
Nitrite	1000	DW1	62	0	930	0	0%	20	0	0%	0	0%	
Nitrate + Nitrite (as N)	10000	DW1	2	40	2250	0	0%	2	0	0%	0	0%	
Selenium	50	DW1	49	0	5	0	0%	23	0	0%	0	0%	
Thallium	2	DW1	46	0	1	0	0%	20	0	0%	0	0%	
Chloride	250000	DW2	66	1400	79000	0	0%	43	0	0%	0	0%	
Iron	300	DW2	50	0	11900	26	52%	21	8	38%	9	43%	Low human health concern due to being a secondary MCL for aesthetics
Iron	5000	AG	50	0	11900	2	4%	21	2	10%	2	10%	
Manganese	50	DW2	45	0	807	28	62%	21	12	57%	11	52%	Low human health concern due to being a secondary MCL for aesthetics
Manganese	200	AG	45	0	807	22	49%	21	7	33%	7	33%	
Silver	100	DW2	36	0	20	0	0%	19	0	0%	0	0%	
Specific Conductance	900	DW2	66	125	1220	3	5%	42	1	2%	1	2%	
Sulfate	250000	DW2	60	500	1143000	1	2%	40	0	0%	0	0%	Low concern due to only one threshold exceedance and zero recent measurements above MCL
Total Dissolved Solids (TDS)	500000	DW2	57	131000	492000	0	0%	39	0	0%	0	0%	
Zinc	5000	DW2	34	0	500	0	0%	20	0	0%	0	0%	
Boron	700	AG	40	0	100	0	0%	34	0	0%	0	0%	
Sodium	69000	AG	33	11600	69000	0	0%	21	0	0%	0	0%	

Sources:

GAMA Groundwater Information System, accessed June 5, 2020 (SWRCB 2020)

University of California Cooperative Extension Farm Advisor (UCCE 2020)

Notes:

GAMA data was filtered to remove all measurements before Oct 1, 1982 and all GeoTracker cleanup sites

Constituents listed are all inorganic naturally occurring elements and compounds that have a SWRCB drinking water maximum contaminant limit (MCL), plus Boron, which has a threshold for agricultural use.

All measurements in micrograms per liter, except specific conductance which is measured in microsiemens per centimeter.

Green indicates less than 1%

Yellow indicates between 1% and 10%

Red indicates greater than 10%

Threshold Types:

DW1: Primary drinking water MCL

DW2: Secondary drinking water MCL (for aesthetics such as taste, color, and odor)

AG: Agricultural threshold based on guidelines by the Food and Agricultural Organization of the United Nations (Ayers and Westcot 1985)

* Hexavalent chromium was regulated under a primary drinking water MCL until the MCL was invalidated in 2017. The SWRCB is working to re-establish the MCL.

The subset of water quality data was analyzed to determine which constituents to investigate further. **Table 5-3** shows that most constituents have not had concentrations measured above their corresponding threshold since 1983 and were not investigated further. Sulfate, aluminum and antimony only had one or two detections above their threshold, and none of these values were recent so these constituents were not investigated further. Arsenic (As), iron (Fe), manganese (Mn), specific conductance (SC) and total dissolved solids (TDS) were investigated further. All of these constituents are naturally occurring.

Arsenic, Iron and Manganese

As, Fe, and Mn show elevated concentrations in over 10 percent of the wells. Although iron and manganese are regulated under secondary drinking water standards (for aesthetics such as color, taste, and odor) and are not of concern for human health as drinking water, these constituents were still chosen for further investigation because they also have multiple detections above the agricultural suitability threshold (Ayers and Westcot 1985). **Figure 5-8** through **Figure 5-10** show the trends over time. Wells with single measurements are shown as dots, where wells that had multiple measurements shown as lines. These figures indicate that the number of wells with highly elevated concentrations of arsenic and manganese concentrations may have decreased over the last 40 years of groundwater use. Iron concentrations are generally below the agricultural suitability threshold (Ayers and Westcot, 1985), with two recent elevated measurements from the monitoring wells constructed in support of the GSP.

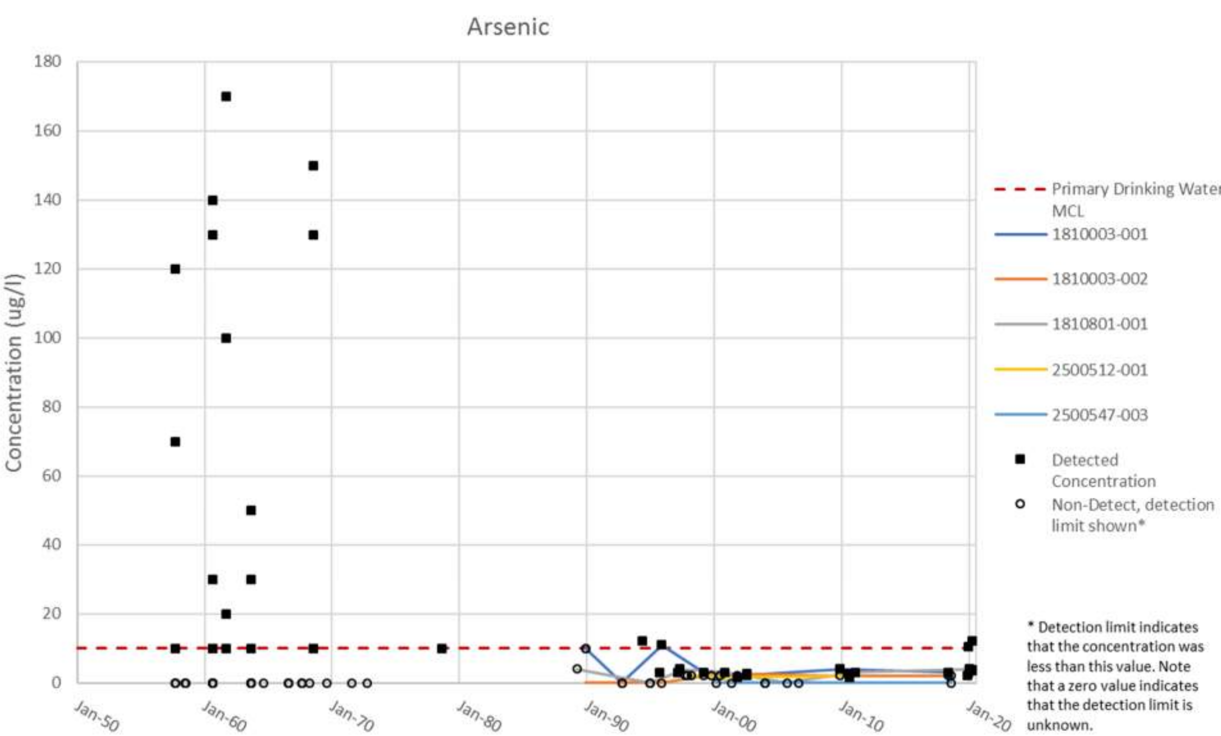

Figure 5-8 Arsenic Trends

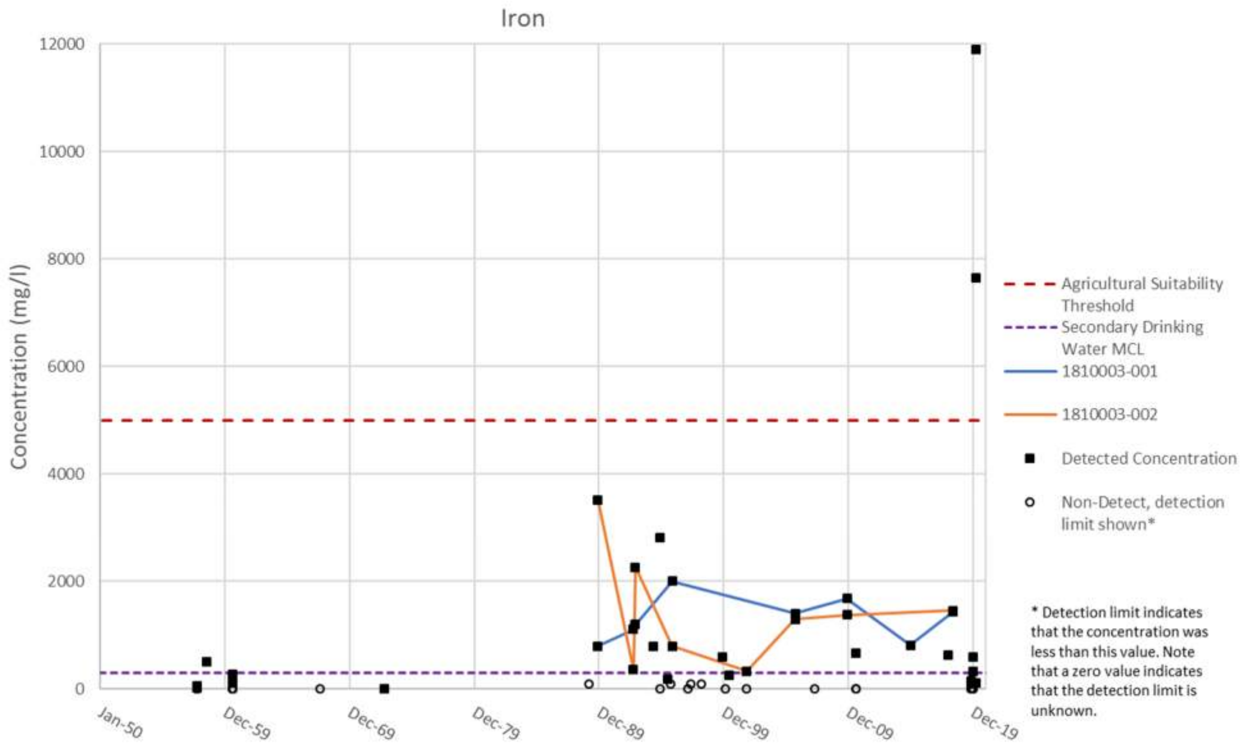

Figure 5-9 Iron Trends

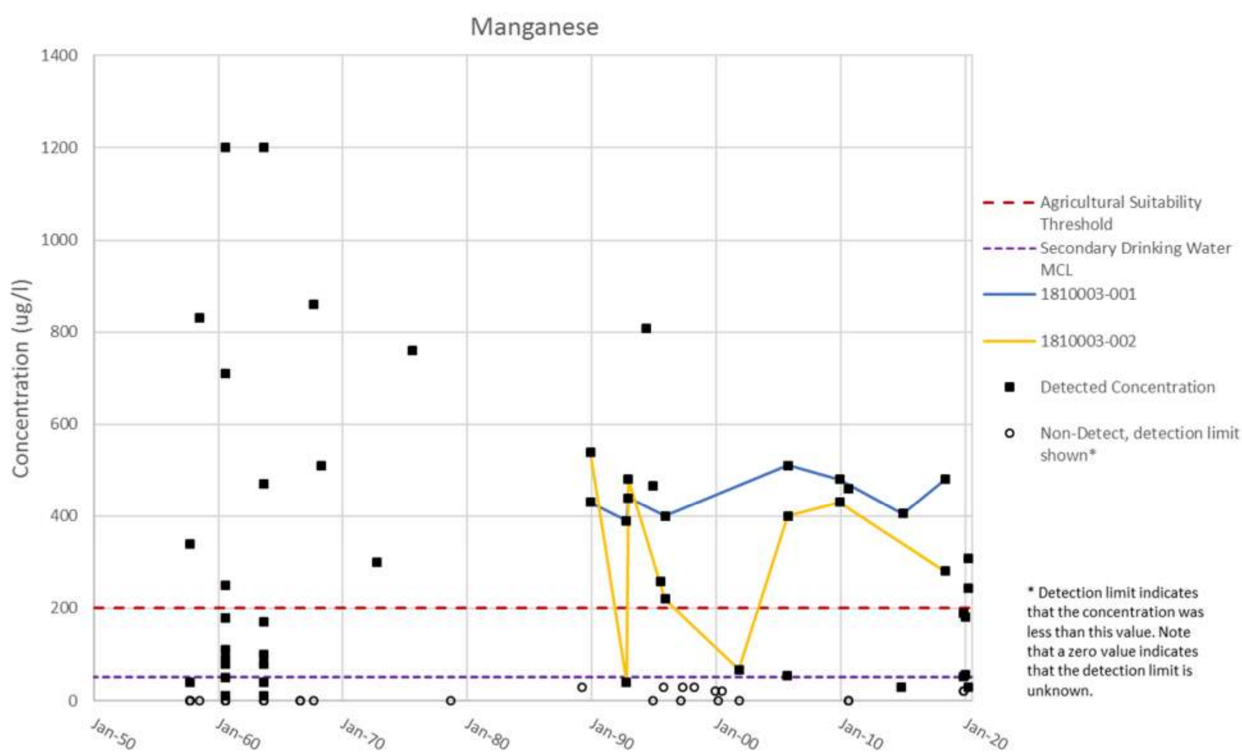

Figure 5-10 Manganese Trends

Specific Conductance and Total Dissolved Solids

SC is a measure of the water's ability to conduct electricity. TDS is a measure of the total amount of dissolved materials (i.e., salts) in water. SC and TDS are related to one another (higher TDS results in higher SC) and SC is often used as a proxy for TDS. Although there was only one recent measurement over the MCL for SC, both SC and TDS were investigated further because they are important indicators of general water quality conditions.

Figure 5-11 and **Figure 5-12** show the trends over time. Wells with single measurements are shown as dots, where wells that had multiple measurements shown as lines. These figures indicate that the number of wells with highly elevated concentrations of SC and TDS may have decreased over the last 40 years. **Figure 5-13** and **Figure 5-14** show the distribution of elevated levels of SC and TDS around the Basin.

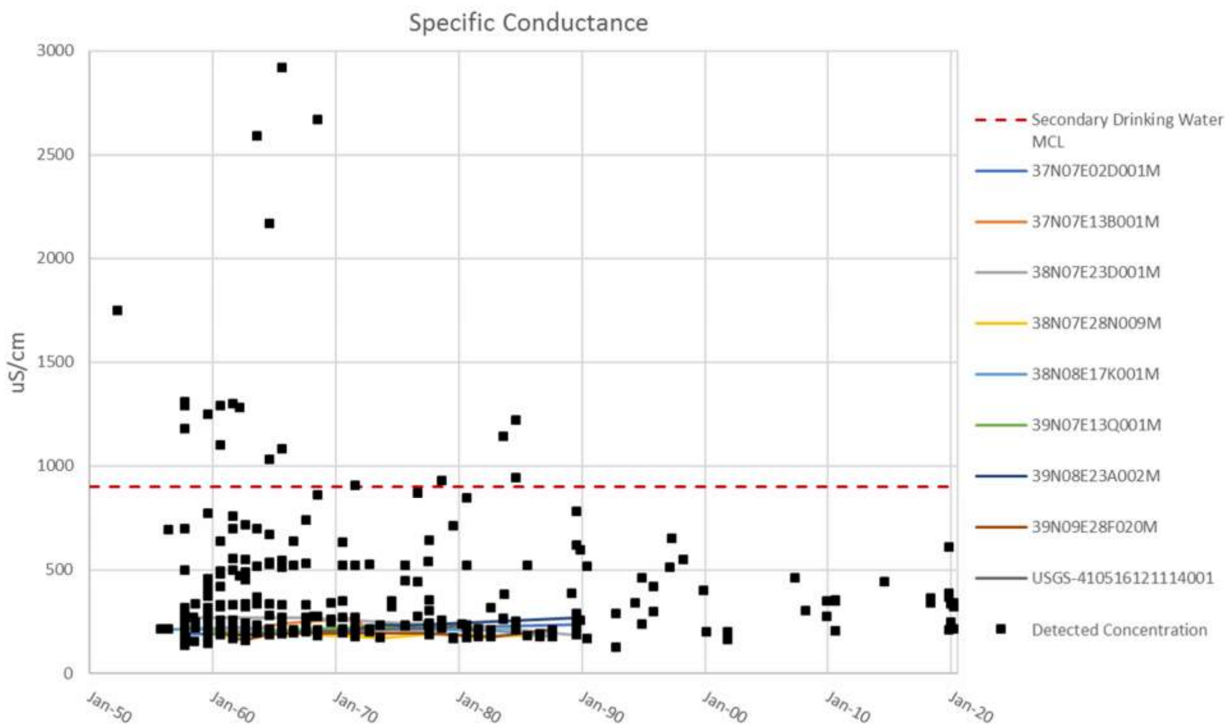

Figure 5-11 Specific Conductance Trends

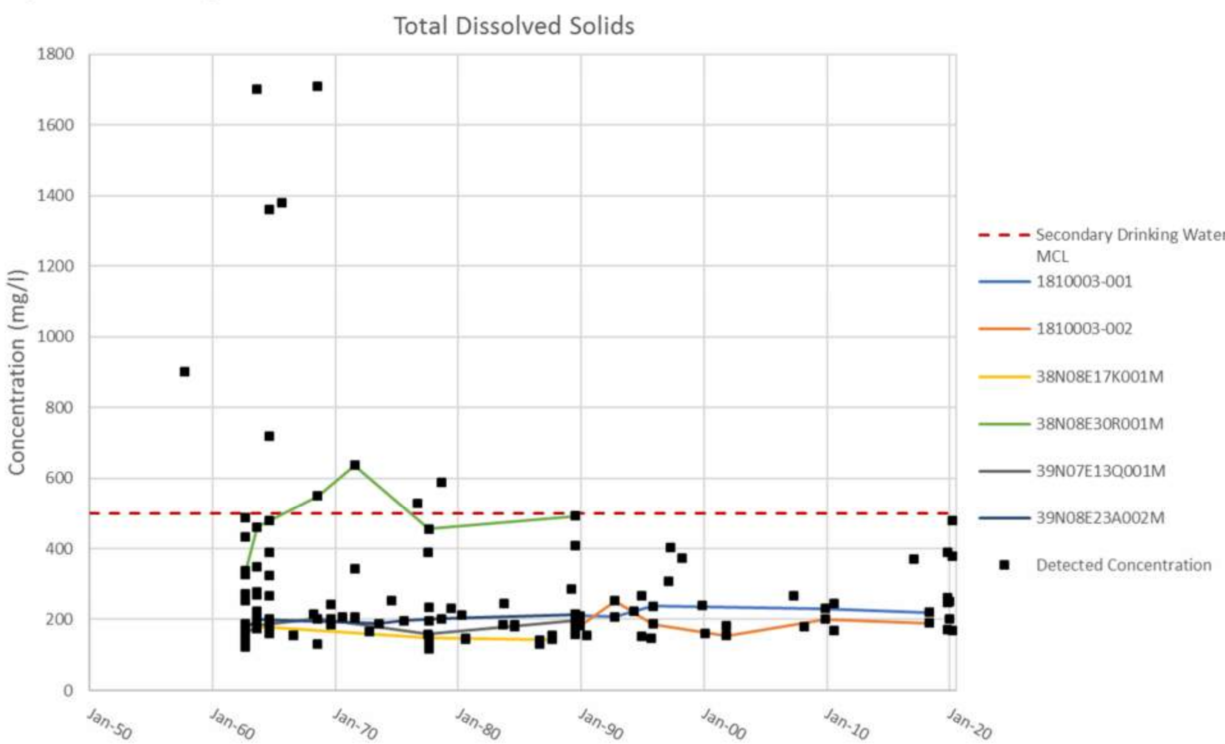

Figure 5-12 TDS Trends

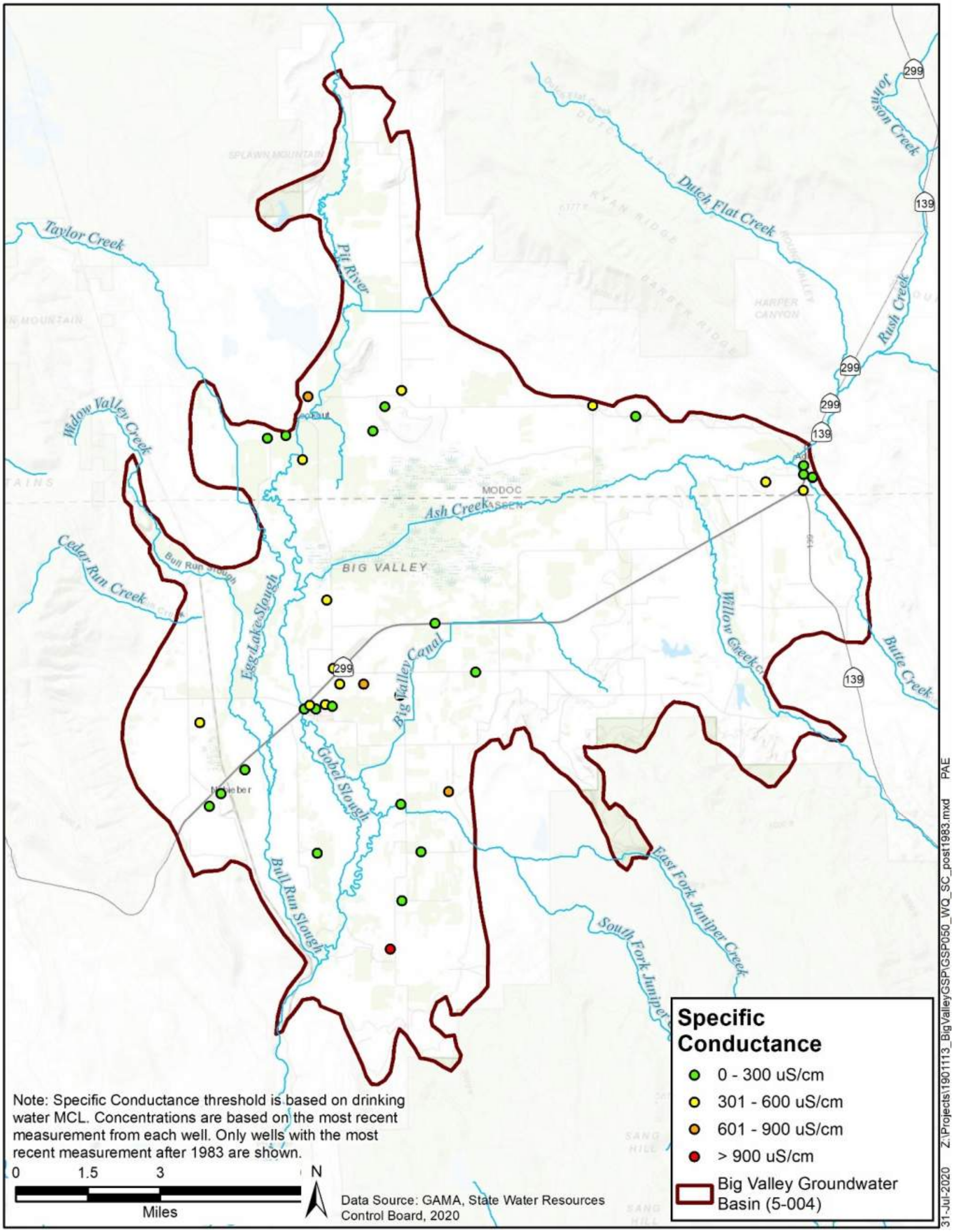

Figure 5-13 Distribution of Elevated Specific Conductance

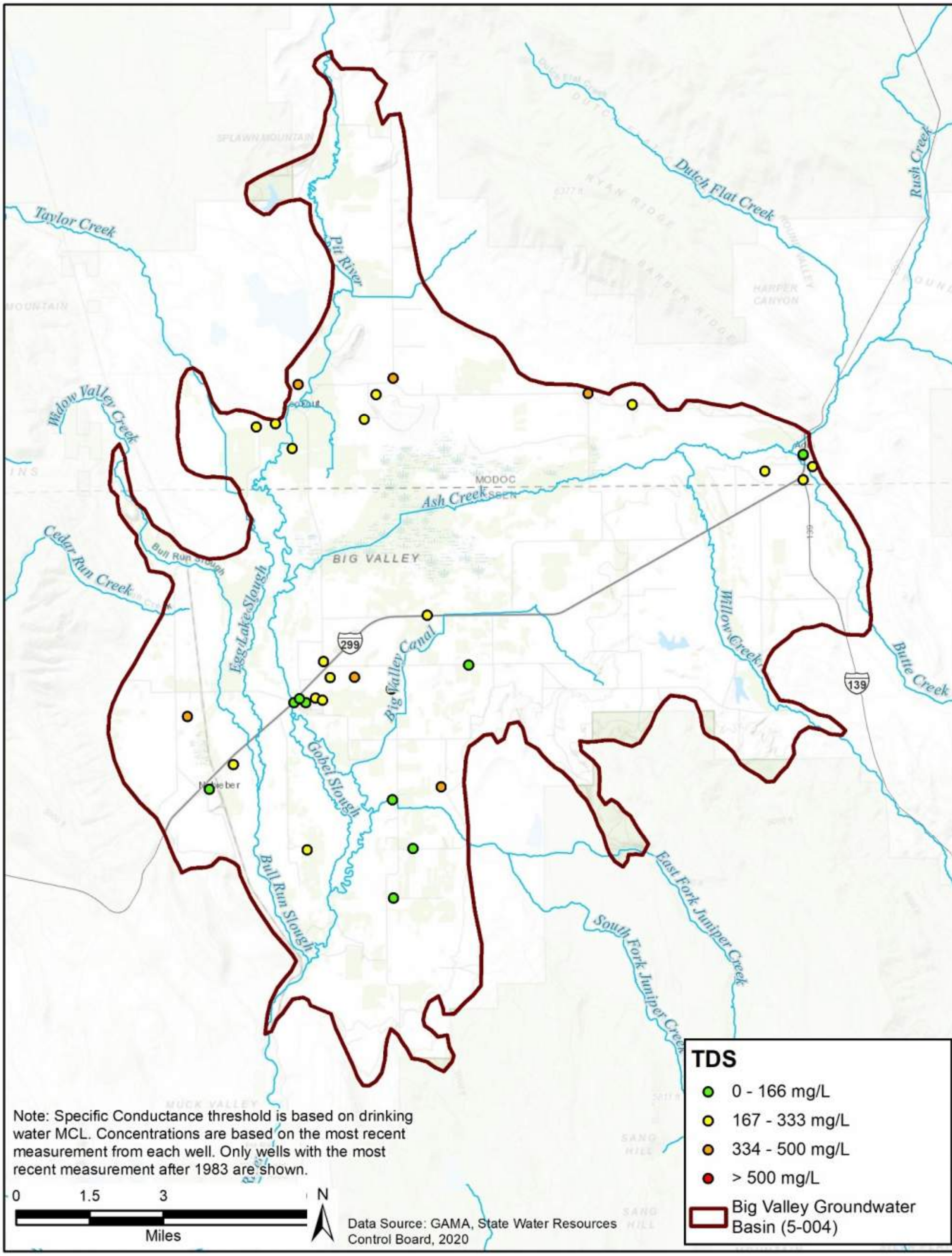

Figure 5-14 Distribution of Elevated TDS Concentrations

5.4.2 Groundwater Contamination Sites and Plumes

To determine the location of potential groundwater contamination sites and plumes, the State Water Board's GeoTracker website was consulted. GeoTracker catalogs known groundwater contamination sites and waste disposal sites (State Water Board 2020b). A search of GeoTracker identified ten sites where groundwater could potentially be contaminated. These sites are in the vicinity of Bieber and Nubieber as listed in **Table 5-4** and shown on **Figure 5-15**. The sites include leaking underground storage tanks (LUSTs), cleanup program sites and a land disposal site. Half of the sites are open and subject to on-going regulatory requirements. The contaminants are listed in **Table 5-4**, which also gives a summary of the case history.

Most of the contaminants originated at LUST sites leaking petroleum hydrocarbons which are light non-aqueous phase liquids (LNAPLs). LNAPLs are less dense than water and their solubility is quite low, meaning that if they reach groundwater, they float on top and generally do not migrate into the deeper portions of the aquifer. Moreover, many of the constituents can be degraded by naturally occurring bacteria in soil and groundwater so the hydrocarbons do not migrate far from the LUST sites. However, MTBE[40], TBA[41] and fuel oxygenates are more soluble in water. Two LUST sites and the landfill site are subject to long-term monitoring while a fourth site is ready for case closure.

The Bieber Landfill is subject to on-going semi-annual monitoring of groundwater levels and groundwater quality at four shallow wells. This monitoring is required by the RWQCB (Order No. R5-2007-0175), after the formal closure of the landfill in the early 2000s. Trace concentrations of several organic constituents[42] have been detected at MW-1, the closest downgradient well to the site, but rarely at the other three wells. Higher concentrations of inorganic constituents (e.g., TDS, SC, others) are also present at MW-1. During 2019, the landfill was also required to analyze groundwater samples from MW-1, MW-2 and MW-4 for per/polyfluoroalkyl substances (PFAS), which are an emerging group of contaminants that are being studied for their effect on human health and may be subject to very low regulatory criteria (parts per trillion). Fifteen of 28 PFASs were detected at MW-1 and nine of 28 PFASs were detected at MW-4 (none at MW-2). The State Water Board/RWQCB evaluation of these data is still pending.

[40] Methyl tert-butyl ether (MTBE) is a fuel additive that was used starting in 1979 and was banned in California after 2002. MTBE is sparingly soluble in water and has a primary MCL of 13 ug/l for human health and a secondary MCL of 5 ug/l for aesthetics.

[41] tert-Butyl alcohol (TBA) is also a fuel additive and is used to produce MTBE. TBA does not have a drinking water MCL in California.

[42] 1,1-dichoroethane, 1,4-dichlorobenzene, cis-1,2-dichloroethylene, benzene, chlorobenzene, MTBE, 2,4,5-trichlorophenoxyacetic acid

Table 5-4 Known Potential Groundwater Contamination Sites in the BVGB

GeoTracker ID	Latitude	Longitude	Case Type	Status	Last Regulatory Acitivity	Case Begin Date	Potential Contaminants of Concern	Site Summary
T10000003882	41.12050	-121.14605	LUST Cleanup Site	Open - Assessment & Interim Remedial Action	04/16/20	10/17/11	Benzene, Diesel, Ethylbenzene, Total Petroleum Hydrocarbons (TPH), Xylene	The case was opened following an unauthorized release from an UST(s). Tank removal and further site assessment, including installation of 8 monitoring wells, led to remedial actions. Periodic groundwater monitoring started in October 2013 and has been ongoing though March 2020.
T0603593601	41.13230	-121.13070	LUST Cleanup Site	Open - Remediation	07/29/20	03/22/00	Gasoline	Active gas station with groundwater impacts. Full-scale remediation *via* groundwater extraction and treatment began in September 2013 and was shut down in April 2017 because it was determined that it was no longer an effective remedy to treat soil and groundwater. At the time of system shutdown, the influent MTBE concentration was 5,650 micrograms per liter which exceeds the Low-Threat Closure Policy criteria. Additionally, high levels of TPHg and sheen/free product are present. A soil vapor extraction system operated for a limited time in 2016/2017 but was not effective. In April 2018, it was determined that active remediation is not a cost-effective path to closure given low permeability of site soils. Staff suggested incorporating institutional controls (IC) and risk-based cleanup objectives instead of active remediation of soil and groundwater. The IC approach was dependent on the submittal of several documents related to soil management, deed restriction and risk modeling plus annual groundwater sampling. This information has not been provided and the RWQCB sent an Order for this information.
T0603500006	41.12241	-121.14128	LUST Cleanup Site	Completed - Case Closed	01/04/00	06/28/99	Diesel	A 2000-gallon UST was removed, and limited contaminated soil was present in the excavation. Petroleum hydrocarbons were not found in the uppermost groundwater. These findings led to the closure of the case.
L10005078943	41.12941	-121.14169	Land Disposal Site	Open - Closed facility with Monitoring*	06/26/20	06/30/08	Higher levels of Inorganic constituents, organic chemicals (synthetic), per/polyfluoroalkyl substances	Disposal activities at Bieber Landfill occurred from the early 1950s until 1994. The landfill was closed during the early 2000s. While active, the site received residential, commercial and industrial non-hazardous solid waste. Formerly an unlined burn dump, the site was converted to cut-and-cover landfill operation in 1974. Landfill refuse is estimated to occupy less than 13 acres of the 20-acre site. Wastes are estimated to be approximately 10-15 feet thick. The Class III landfill was closed in accordance with Title 27 of the California Code of Regulations. A transfer station was established at the site for the transportation of waste to another landfill. Groundwater levels and quality are monitored twice per year at 4 wells.
T0603500003	41.12124	-121.14061	LUST Cleanup Site	Completed - Case Closed	09/13/94	07/31/91	Heating Oil / Fuel Oil	A 1000-gallon UST was removed, and contaminated soil was present beneath the tank, which led to installation of nine soils borings and 3 monitoring wells. Contaminated soil was removed but an adjacent building limited the extent of the excavation so contaminated soil remains under the building. Hydrocarbons were initially found in 1 well but not in subsequent sampling. The RWQCB concurred with a request to close the investigation.
T10000003101	41.13151	-121.13658	Cleanup Program Site	Open - Assessment & Interim Remedial Action	07/22/20	04/03/07	Benzene, Toluene, Xylene, MTBE / TBA / Other Fuel Oxygenates, Gasoline, Other Petroleum	A diesel leak was found in association with an industrial chipper. Corrective action included excavation of diesel-impacted soil, removing contaminated water and groundwater monitoring. Results of soil and groundwater sampling indicate low concentrations of TPHg and BTEX and that there is no offsite migration. Staff have determined that the case is ready for closure, pending decommissioning of the site monitoring wells.
SL0603581829	41.09251	-121.17904	Cleanup Program Site	Completed - Case Closed	09/01/05	01/08/05	Petroleum - Diesel fuels, Petroleum - Other	Contaminated soil excavated and transported to Forward Landfill for disposal. Contaminated groundwater (7,000 gallons) extracted with vacuum truck for disposal.
T0603500002	41.12188	-121.13546	LUST Cleanup Site	Completed - Case Closed	07/17/06	10/20/86	Gasoline / diesel	Three USTs were removed, and contaminated soil was present beneath the tank, which led to installation of nine monitoring wells and three remediation wells. Natural attenuation of the hydrocarbon impact was acceptable to the RWQCB due to the limited, well-defined extent of the impact and the limited and declining impact to groundwater. The RWQCB concurred with a request to close the site.
T0603500004	41.12134	-121.13547	LUST Cleanup Site	Completed - Case Closed	03/12/99	06/12/97	Diesel	A 5000-gallon UST was removed and very low levels of petroluem hydrocarbons were detected in the soil, which was allowed to be spread onsite and the case was closed.
T10000002713	41.11993	-121.14271	Cleanup Program Site	Open - Site Assessment	12/30/16	03/10/10	Other Petroleum	The site is an old bulk plant which was built in the 1930's and handled gasoline and diesel. During a routine inspection in March 2010, evidence of petroleum spills were identified at the loading dock area. A follow-up inspection was conducted in April 2010. The ASTs and loading dock were removed but additional contamination was noted under the removed structures. Furthermore, a shallow excavation contained standing water with a sheen. Due to the potential impacts to shallow groundwater, the Regional Water Board became the lead agency in December 2010. Additional information was requested in December 2016. A response is not evident.

*This terminology indicates that the landfill is closed (no new material being disposed), but the site is open with regard to ongoing groundwater monitoring.
Source: GeoTracker (State Water Board 2020b)
MTBE = Methyl tert-butyl ether; TBA = tert-Butyl alcohol

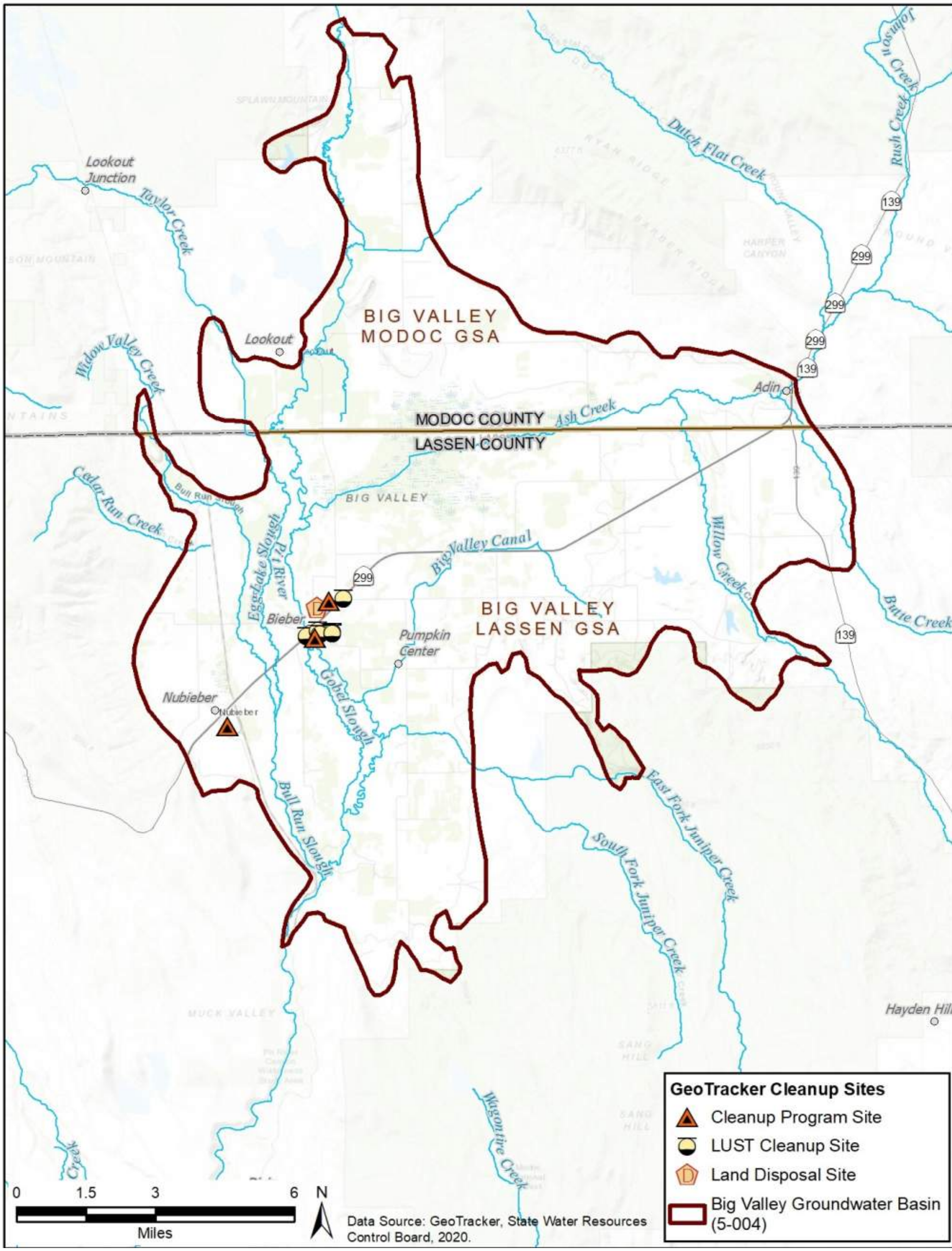

Figure 5-15 Location of Known Potential Groundwater Contamination Sites

5.5 Subsidence

Vertical displacement of the land surface (subsidence) is comprised of two components: 1) elastic displacement which fluctuates according to various cycles (daily, seasonally and annually) due to temporary changes in hydrostatic pressure (e.g., atmospheric pressure and changes in groundwater levels) and 2) inelastic displacement or permanent subsidence which can occur from a variety of natural and human-caused phenomena. Lowering of groundwater levels can cause prolonged and/or extreme decrease in the hydrostatic pressure of the aquifer. This decrease in pressure can allow the aquifer to compress, primarily within fine-grained beds (clays). Inelastic subsidence cannot be restored after the hydrostatic pressure increases. Other causes of inelastic subsidence include natural geologic processes (e.g., faulting) and the oxidation of organic rich (peat) soils as well as human activities such as mining and grading of land surfaces.

Subsidence can be measured by a variety of methods, including:

- Regular measurements of any vertical space between the ground surface and the concrete pad surrounding a well. If space is present and increasing over time, subsidence may be occurring at that location. If a space is not present, subsidence may not be occurring, or the well is not deep enough to show that subsidence is occurring because the well and ground are subsiding together.
- Terrestrial (ground-based) surveys of paved roads and benchmarks.
- Global Positioning Survey (GPS) of benchmarks. GPS uses a constellation of satellites to measure the 3-dimensional position of a benchmark. The longer the time that the GPS is left to collect measurements, the higher the precision. Big Valley has one continuously operating GPS (CGPS) station near Adin.
- Monitoring of specially constructed “extensometer” wells. There are no extensometers in the BVGB.
- Use of InSAR, which is microwave-based satellite technology that has been used to evaluate ground surface elevation and deformation since the early 1990s. InSAR can document changes in ground elevation between successive passes of the satellite. Between 2015 and 2019, InSAR was used to evaluate subsidence throughout California, including Big Valley.

Subsidence was recognized as an important consideration in the 2007 LCGMP (Brown and Caldwell 2007) but was not identified as an issue for Big Valley specifically. The analysis in the LCGMP was based on indirect observations (groundwater levels) and anecdotal information. This section presents additional data that has become available since the development of the LCGMP.

5.5.1 Continuous GPS Station P347

A CGPS station (P347) was installed at the CalTrans yard near Adin in September 2007. The station is part of the Plate Boundary Observatory which is measuring 3-dimensional changes in the Earth surface due to the movement of tectonic plates (e.g., Pacific and North American plates).

Figure 5-16 is a plot of the vertical displacement at P347 and shows a slight decline (0.6 inch) over the first 11 years of operation, based on the annual mean values (large black open circles). Daily values (blue dots) show substantial variation, as much as an inch, but more typically only 0.1 inch on average. This scattering of daily values around the annual mean provides an indication of the elastic nature of the displacement. The overall decline of 0.6 inch is an indication of inelastic displacement has occurred over an 11-year period, which equates to a rate of -0.05 inch per year at this location near Adin.

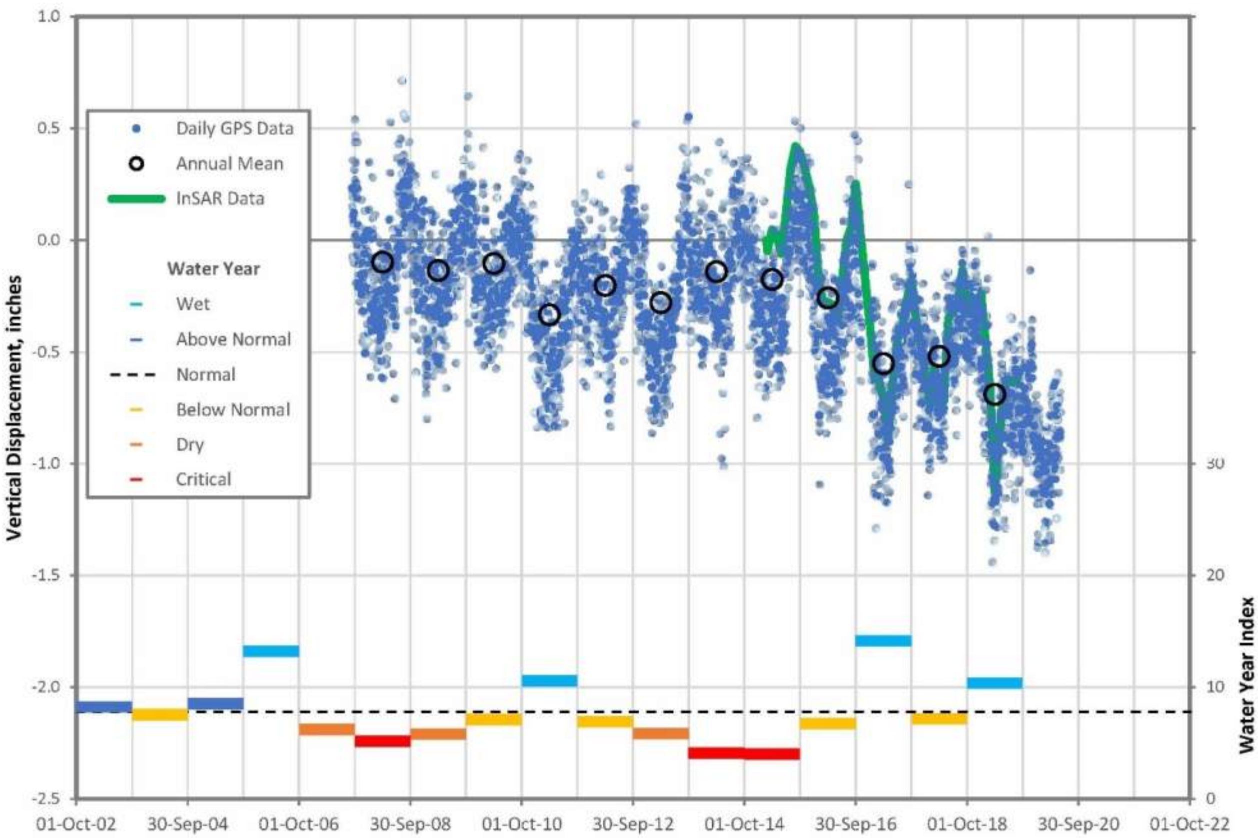

Figure 5-16 Vertical Displacement at CGPS P347

5.5.2 Interferometric Synthetic Aperture Radar

Figure 5-17 is a map of InSAR data made available by DWR for the 4.3-year period between June 2015 and September 2019. The majority of Big Valley was addressed by this InSAR survey although the survey excludes some areas (shown in white on **Figure 5-17**) including much of the Big Swamp (ACWA), areas along the Pit River near Lookout and south of Bieber. The accuracy of this type of InSAR data in California has been calculated at 18mm (0.7 inches) at a 95% confidence level (Towill 2021). Most of the survey shows downward displacement between 0 and -1 inch throughout Big Valley. This small displacement is close to the level of accuracy of the data, but if true is likely due to natural geologic activities due to its widespread nature.

Two localized areas of subsidence exceeding -1.5 inches are apparent from this data, one in the east-central portion of the Basin north of Highway 299 and one in the southern portion of the Basin between the Pit River and Bull Run Slough. Maximum downward displacement in the Basin is -3.3 inches, over the 4.3-year period. Some of the downward displacement in the Basin may be due to laser leveling of fields, particularly for production of wild rice.

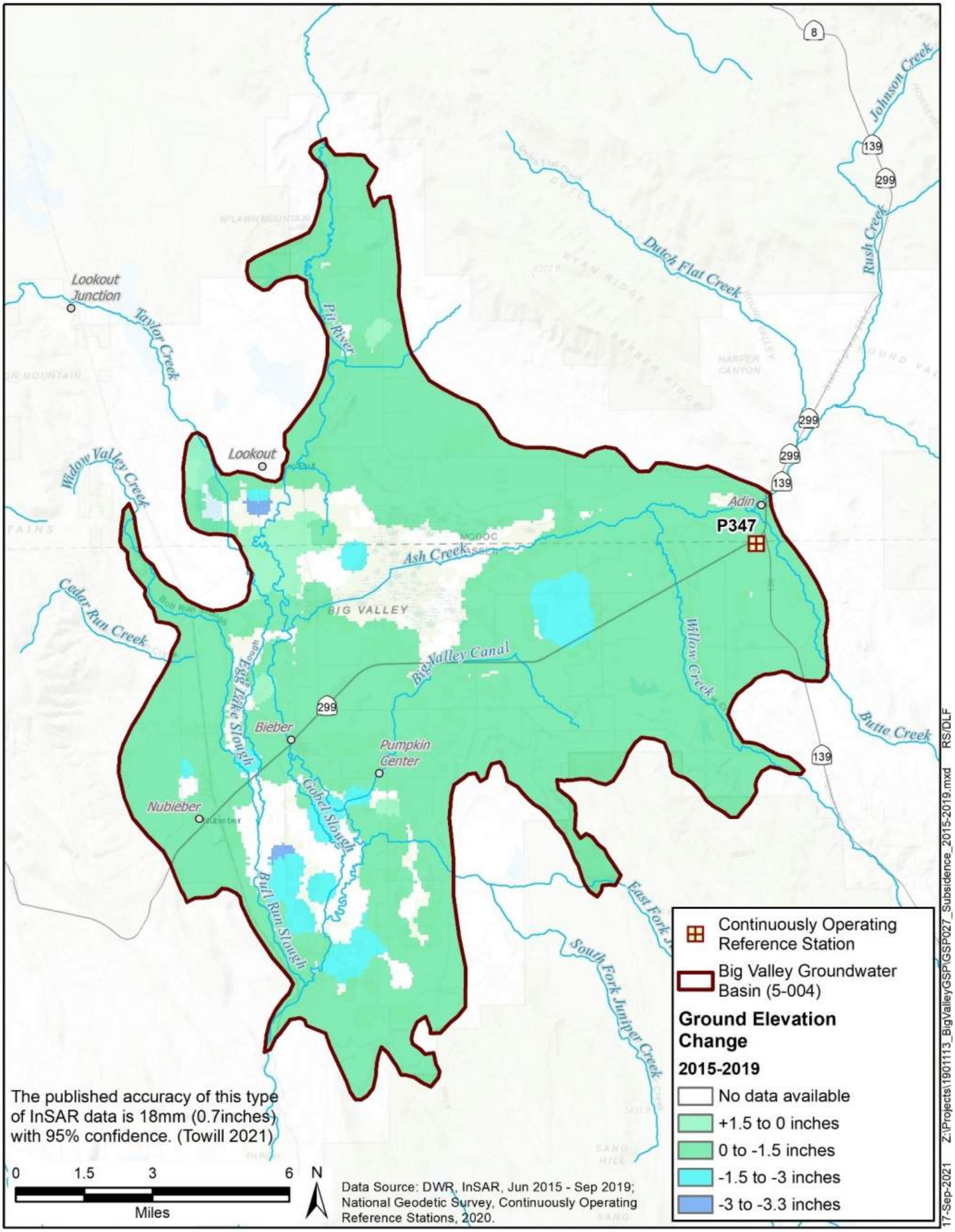

Figure 5-17 InSAR Change in Ground Elevation 2015 to 2019

5.6 Interconnected Surface Water

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" (DWR 2016c). For the principal aquifer to be interconnected to surface water streams, groundwater levels need to be near ground surface. As a first determination of where surface water *may* be interconnected, **Figure 5-18** shows the major[43] streams in the Basin which have groundwater levels near ground surface, depth to water less than 15 feet based on spring 2015 groundwater contours. These areas *may* have the potential to be interconnected with surface water.

Interconnected streams can be gaining (groundwater flowing toward the stream) or losing (groundwater flowing away from the stream). Preliminary data from the shallow monitoring well clusters[45] give an indication the direction of shallow groundwater flow adjacent to streams in two locations in the Basin as shown by the black arrows on **Figure 5-18**.

Section §354.16(f) of the regulations require an estimate of the "quantity and timing of depletions of [interconnected surface water] systems, utilizing…best available information". The existence and quantity cannot be determined with any reasonable level of accuracy using empirical data, so the best available information is presented in Chapter 6 – Water Budget. The timing of depletions also cannot be determined with existing data.

5.7 Groundwater-Dependent Ecosystems

SGMA requires GSPs to identify Groundwater Dependent Ecosystems (GDEs) but does not explicitly state the requirements that warrant a GDE designation. SGMA defines a GDE as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (DWR 2016c). GDEs are considered a beneficial use of groundwater.

The most comprehensive and readily accessible data to identify GDEs is referred to as the NCCAG[46] dataset. Upon inspection of the data[47], many inaccuracies were noted. The abstract of the dataset documentation reads:

> The Natural Communities dataset is a compilation of 48 publicly available State and federal agency datasets that map vegetation, wetlands, springs, and seeps in California. A working group comprised of DWR, the California Department of Fish and Wildlife (CDFW), and The Nature Conservancy (TNC) reviewed the compiled dataset and conducted a screening process to exclude vegetation and wetland types less likely to be associated with

[43] Named streams from the National Hydrography Dataset [NHD] (USGS 2020a)

[45] The clusters are sets of 3 wells drilled in close proximity to each other for the purpose of determining shallow groundwater flow direction and gradient. At the time of writing this draft chapter, 2 clusters have enough data to determine flow direction, one cluster near Adin and one cluster near Lookout. **Appendix 5C** contains data collected at the two clusters and their flow directions

[46] Natural communities commonly associated with groundwater

[47] By local landowners and local experts familiar with the Basin and its ecological communities.

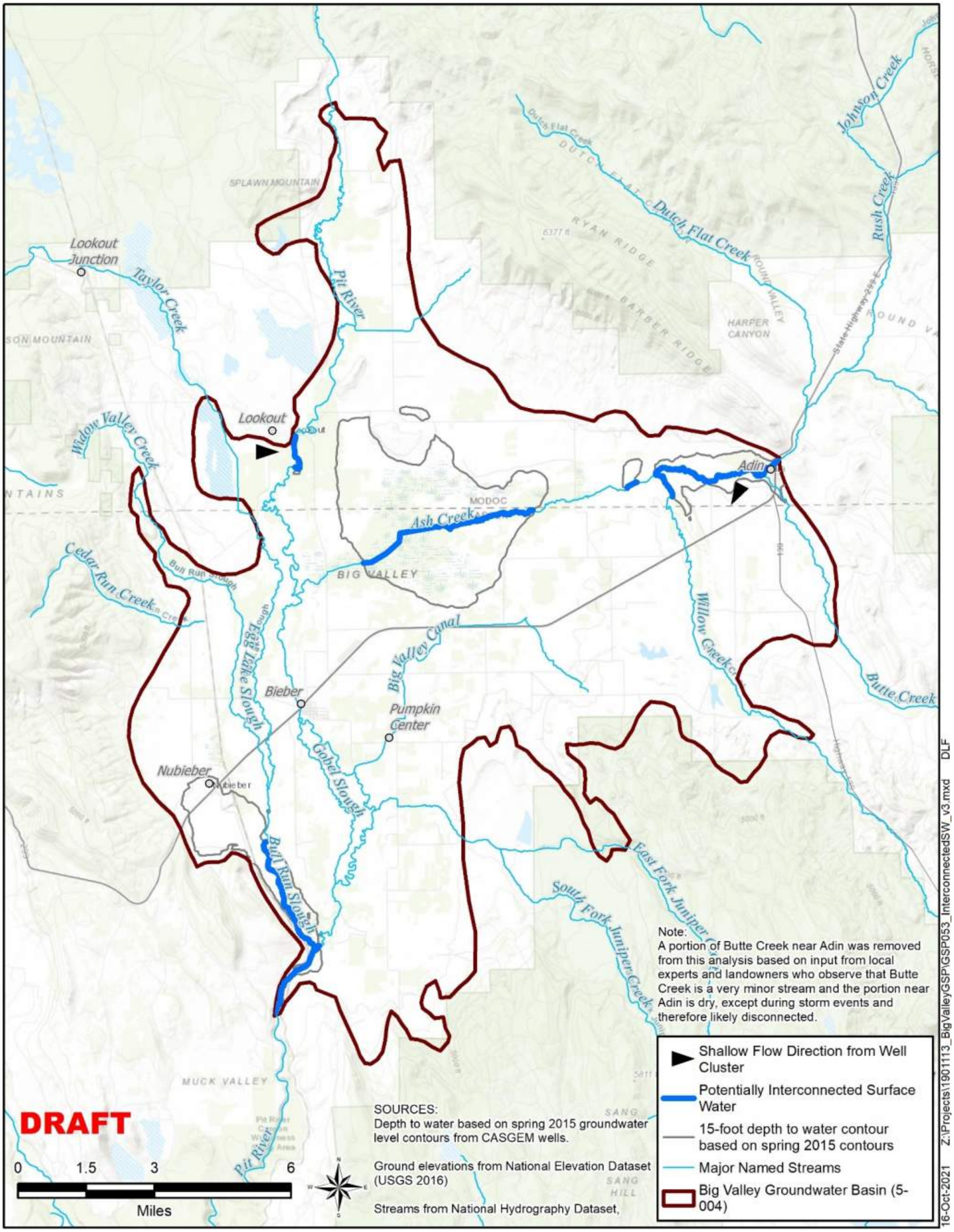

Figure 5-18 Potentially Interconnected Surface Water

> groundwater and retain types commonly associated with groundwater, based on criteria described in Klausmeyer et al. (2018).
>
> Two habitat classes are included in the Natural Communities dataset: (1) wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions; and (2) vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes).
>
> The data included in the Natural Communities dataset do not represent DWRs determination of a GDE. However, the Natural Communities dataset can be used by GSAs as a starting point when approaching the task of identifying GDEs within a groundwater basin. (DWR 2018a)

The NCCAG geospatial data (DWR 2018a) is separated into two categories: wetlands and vegetation, respectively.

The Wetlands area is subdivided into two primary habitats present in Big Valley: palustrine[48] and riverine[49]. Palustrine is the dominant habitat at 96 percent of the total wetland area while riverine is present at 4 percent and occurs along river courses. Sixteen springs account for a very small area. Most of the springs are in Lassen County (13) although numerous springs are located outside the BVGB boundary.

The Vegetation area is subdivided into two primary habitats, based on the plant species. Wet Meadows was the largest primary habitat at 59 percent of the vegetation area but did not include a dominant species. Willow was the second largest habitat at 41 percent of the vegetation area.

For the NCCAG areas to be designated as actual GDEs, the groundwater level needs to be close enough to the ground surface that it would support the vegetation. For determining potential GDEs, *fall* 2015[50] depth to water is used, because mid-summer months are the critical limiting factor for plant communities. Furthermore, if groundwater moisture isn't available later in the summer, then the groundwater dependent communities don't have an advantage over communities that are typically not associated with groundwater such as sagebrush, juniper and bunchgrass (Lile 2021).

The depth to water that could potentially be accessed by GDEs depends on the rooting depth of the vegetation. An assessment of native plants in the BVGB found that maximum rooting depths of species present is 10 feet as shown in **Table 5-5**. Access to groundwater by plant roots extends above the water table because the groundwater is drawn upward to fill soil pores, and this zone is known as the capillary fringe. The thickness of the capillary fringe extends upward several feet, depending on the soil type.

---

[48] Palustrine are freshwater wetlands, such as marshes, swamps and bogs, not associated with flowing water (Cowardin et al. 2013).

[49] Riverine are freshwater wetlands located in or near a flowing stream (Cowardin et al. 2013).

[50] 2015 is used because it is the baseline for SGMA.

Table 5-5 Big Valley Common Plant Species Rooting Depths

Species	Rooting Depth
Carex spp.	Up to 5 feet
Alfalfa	9 feet
Aspen	10 feet and less
Willow	2-10 feet
Elderberry	10 feet and less
Saltgrass	2 feet
Sources: CNPS 2020, TNC 2020, Snell 2020	

As a conservative estimate, a capillary fringe of 10 feet is used. In order for plants to access the water and thrive, not just barely touch, there needs to be significant overlap (of, say 5 feet) between the rooting depth and the capillary fringe (Lile 2021). Furthermore, while roots may extend to a deep level, documentation on maximum depth to water for some of the deep-rooting species in **Table 5-5** to thrive is on the order of 2-3 meters (6-9 feet) (Pezeshki and Shields 2006, Springer et. al. 1999). Therefore, as a conservative estimate for the purposes of delineating GDEs, only those areas in the NCCAG datasets that are in areas with fall 2015 groundwater less than 15 feet are classified as potential GDEs.

Figure 5-19 shows the area with potential GDEs, which is a preliminary assessment and needs to be ground-truthed. Moreover, the data are inaccurate in many places.

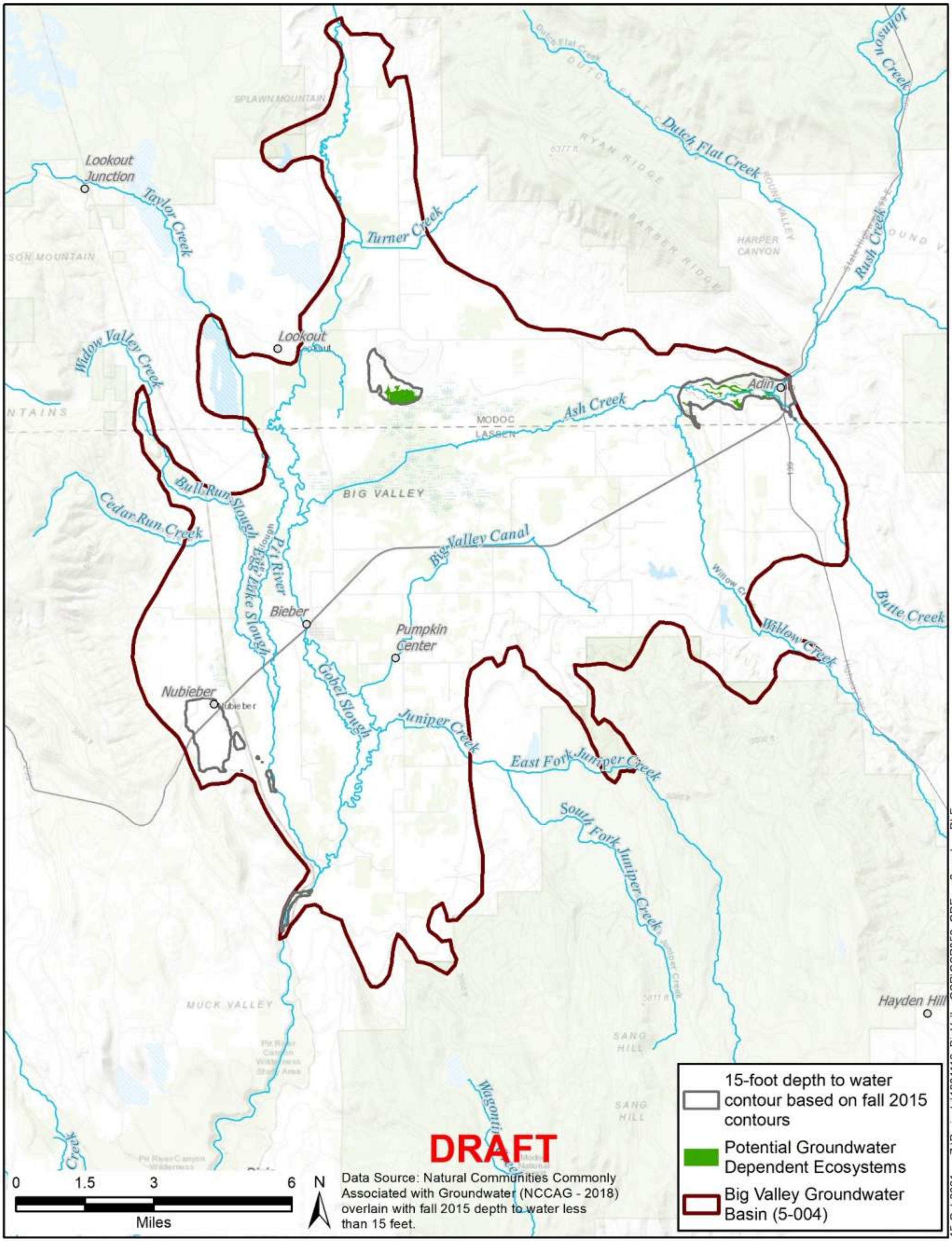

Figure 5-19 Potential Groundwater Dependent Ecosystems

6. Water Budget § 354.18

The hydrologic cycle describes how water is moved on the earth among the oceans, atmosphere, land, surface water bodies and groundwater bodies. **Figure 6-1** is a depiction of the hydrologic cycle.

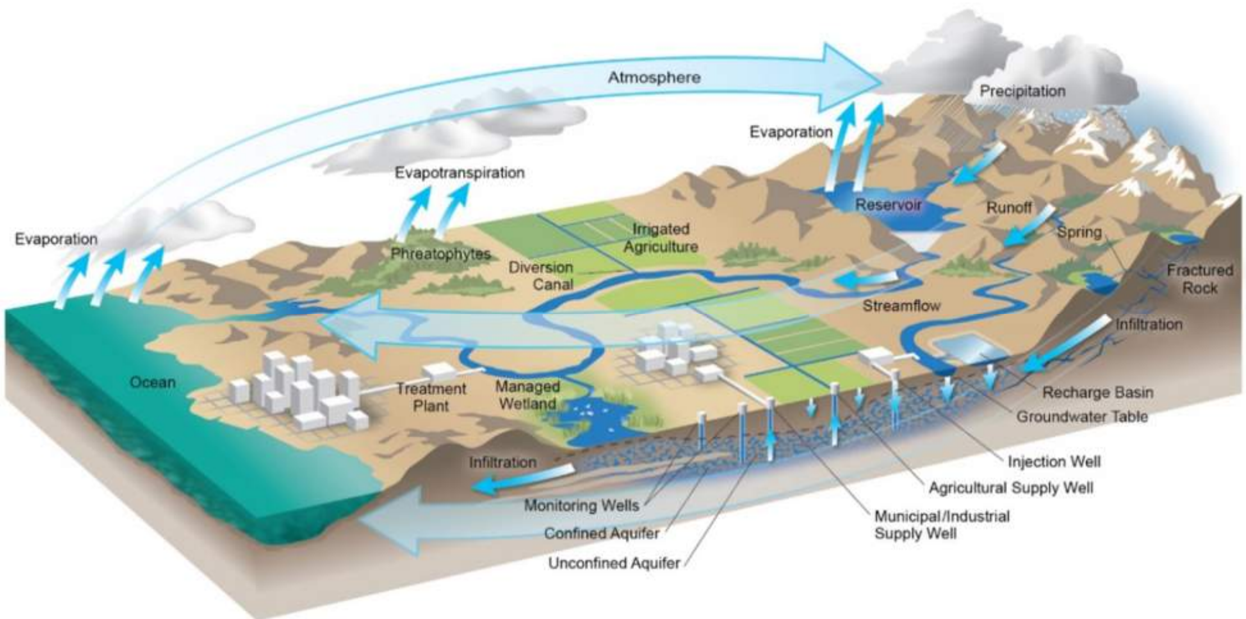

Figure 6-1 Hydrologic Cycle

A water budget accounts for the movement of water among the four major systems in Big Valley: atmospheric, land surface, surface water, and groundwater. The BVGB consists of the latter three systems (land surface, surface water and groundwater) as shown by the black outline on **Figure 6-2**. This figure shows the exchange between the systems and identifies the specific components of the water budget. The systems and the flow arrows are color coded. Inflows to the BVGB are shown with blue arrows and outflows from the BVGB are shown with orange arrows. Flows between the systems are shown with green arrows and flows within a system are shown in purple. The land system, surface water system and groundwater system are green, blue and brown respectively.

Like a checking account, a water budget helps the GSA and stakeholders better understand the deposits and withdrawals and identify what conditions result in positive and negative balances. It should be noted that, while the development of a water budget is required by the GSP regulations, the regulations don’t require actions based directly on the water budget. Actions are only required based on outcomes related to the six sustainability indicators: groundwater levels, groundwater storage, water quality, subsidence, seawater intrusion and surface water depletions. Therefore, a water budget should be viewed as a tool to develop a common understanding of the Basin and a basis for making decisions to achieve sustainability and avoid undesirable results with the sustainability indicators.

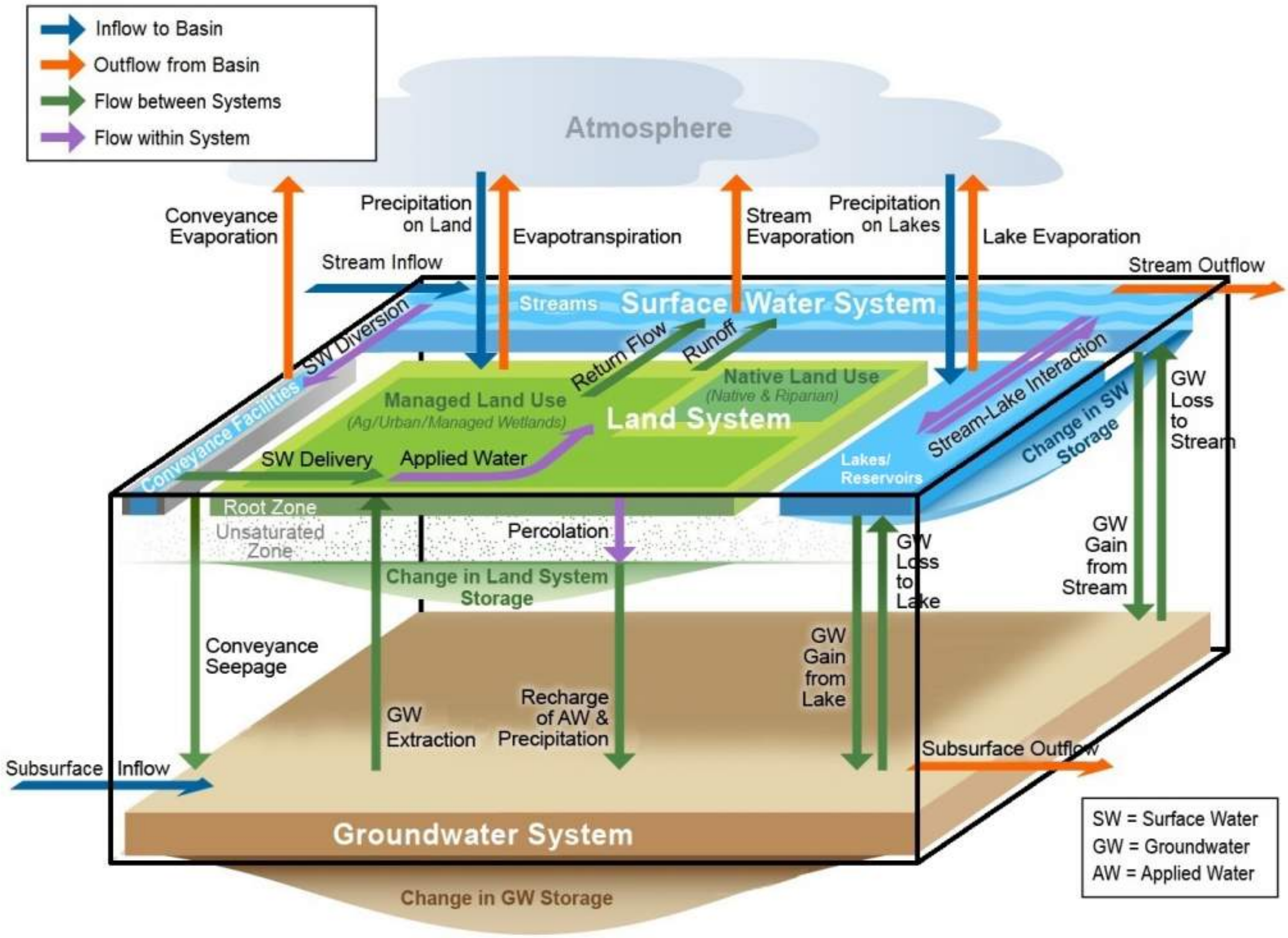

Figure 6-2 Water Budget Components and Systems

6.1 Water Budget Data Sources

Each component shown in **Figure 6-2** was estimated using readily available data and assembled into a budget spreadsheet. Many groundwater basins in California utilize a numerical groundwater model, such as MODFLOW[51] or IWFM[52] to calculate the water budget. These models require a specialized hydrogeologist to run them and the methodology by which the water budget is calculated is not readily apparent to the lay person. For the BVGB, a non-modeling (spreadsheet) approach was used so that future iterations of the water budget could be performed by a wider range of hydrology professionals (potentially reducing future GSP implementation costs) and so that the calculations of the specific components could be understood by a broader range of people.

In concept, each component is quantified precisely and accurately, and the resultant budget is balanced. In practice, most of the components can only be roughly estimated and in many cases not at all. Therefore, much of the work to balance the water budget is adjusting some of the unknown or roughly

[51] Modular Finite-Difference Groundwater Flow model, developed by USGS.
[52] Integrated Water Flow Model, developed by DWR.

estimated parameters within acceptable ranges until the budget is balanced and all components are deemed reasonable.

As such, the water budget calculations presented herein are not unique and the precision of the component estimates are within an order of magnitude. Estimation of nearly all components involves assumptions and, with more Basin-specific data, the accuracy and precision of many of the components are improved. Additional and improved data will result in a budget that more closely reflects the Basin conditions and allows the GSAs to make more informed decisions to sustainably maintain groundwater resources. **Appendix 6A** show the components of the water budget, their data source(s), assumptions and relative level of precision.

Major data sources include the PRISM[53] model (NACSE 2020) for precipitation, CIMIS (DWR 2020c) for evapotranspiration data, the National Water Information System (USGS 2020b) for surface water flows and DWR land use surveys (DWR 2020d).

6.2 Historical Water Budget

The historic water budget presented in this section covers 1984 to 2018. This period was chosen because it represents an average set of climatic conditions. **Figure 6-3** shows the annual precipitation and year type for the period. The criteria for year types were critical dry below 70 percent of average precipitation, dry between 70 and 85 percent of average precipitation, normal between 85 and 115 percent of average precipitation and wet years greater than 115 percent of average precipitation.

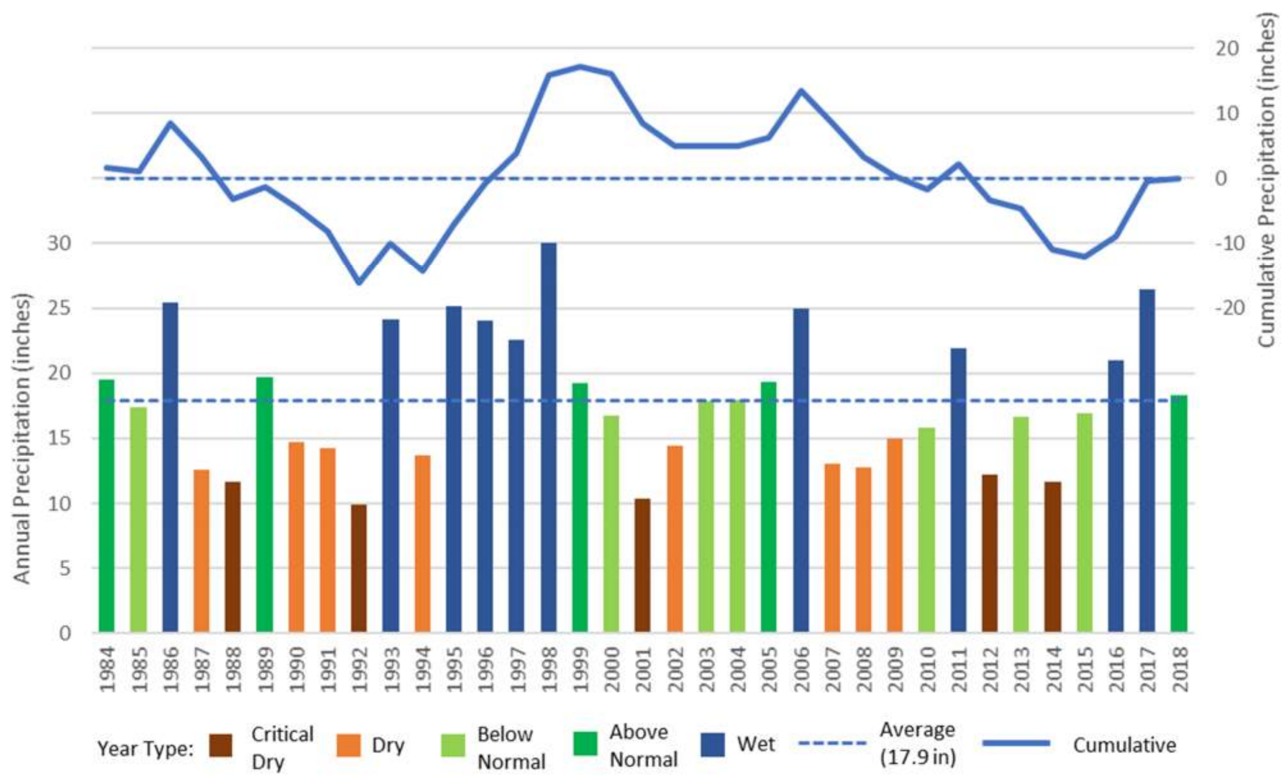

Figure 6-3 Annual and Cumulative Precipitation and Water Year Types 1984 to 2018

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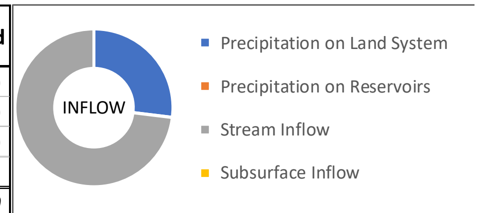
[53] PRISM stands for Parameter-elevation Regression on Independent Slopes Model and is provided by the Northwest Alliance for Computational Science and Engineering from Oregon State University. This model provides location-specific, historical precipitation values on monthly and annual time scales. Precipitation was evaluated at Bieber.

The budget was developed using this precipitation and other climate data (evapotranspiration) along with stream flow to estimate the inflows (credits) and outflows (debits) to the total BVGB. The budget was balanced by assuming that the land and surface water systems remain nearly in balance from year to year and allowing the groundwater system to vary. **Figure 6-4** shows the average annual values for the overall water budget. The detailed water budget for each year is included in **Appendix 6B**. **Appendix 6C** shows graphically how the water budget varies over time.

TOTAL BASIN WATER BUDGET — Acre-Feet

item	Flow Type	Origin/ Destination	Component	Estimated
(1)	Inflow	Into Basin	Precipitation on Land System	136,800
(14)	Inflow	Into Basin	Precipitation on Reservoirs	500
(13)	Inflow	Into Basin	Stream Inflow	371,100
(27)	Inflow	Into Basin	Subsurface Inflow	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*508,400*
(5)	Outflow	Out of Basin	Evapotranspiration	154,000
(24)	Outflow	Out of Basin	Stream Evaporation	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	700
(19)	Outflow	Out of Basin	Conveyance Evaporation	-
(18)	Outflow	Out of Basin	Stream Outflow	358,500
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*513,600*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(5,000)



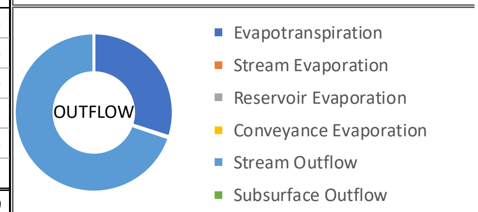


Figure 6-4 Average Total Basin Water Budget 1984-2018 (Historic)[54]

The evapotranspiration value was calculated using land use data (crop and wetland acreages) from DWR for 2014 and land use was assumed to be constant throughout the water budget period.

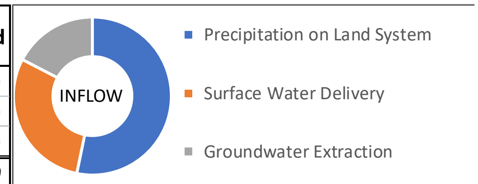
Using the evapotranspiration for irrigated lands, the amount of irrigation from surface water and groundwater was determined using 85 percent irrigation efficiency (NRCS 2020) and a respective 35 to 65 percent split between surface water and groundwater. This surface water – groundwater split was determined from input received from local landowners, an assessment of surface water rights (areas without surface water rights were assumed to use 100% groundwater), well drilling records (areas without wells drilled were assumed to use 100% surface water) and an assessment of aerial imagery to see if water source could be determined. For the evapotranspiration associated with the ACWA, the ecosystem largely relies on surface water and very shallow subsurface[55] water. This surface water delivery[56] was enhanced by implementation of a "pond and plug" project in 2012 to keep the water table higher and broader throughout ACWA. The ACWA also has three wells that extract groundwater from the deeper aquifers which is applied in portions of the habitat during dry months (fall). These areas with groundwater use are indicated by the light blue areas within ACWA. Based on the limited area and time groundwater is used to support the habitat, 98 percent of the evapotranspiration for ACWA is estimated to come from surface water and 2 percent from groundwater. **Figure 3-6** shows the lands with applied water and their water source based on this assessment.

[54] To re-emphasize, these are rough estimates and better and more accurate data are needed.
[55] Within about the top 10 feet that plant roots can access.
[56] For the purposes of the water budget, water from Ash Creek is considered "delivered" to the wetland areas.

Stakeholders have noted that despite the efforts to improve estimates of water source and some input from local residents, **Figure 3-6** still contains significant inaccuracies and further refinement of this dataset is needed.

The average annual water budgets for the three systems (land, surface water and groundwater) are shown on **Figure 6-5**, **Figure 6-6** and **Figure 6-7**. The detailed water budget for each year is included in **Appendix 6B**. **Appendix 6C** shows graphically how the system water budgets vary over time.

item	LAND SYSTEM			Acre-Feet
	Flow Type	Origin/ Destination	Component	Estimated
(1)	Inflow	Into Basin	Precipitation on Land System	136,800
(2)	Inflow	Between Systems	Surface Water Delivery	75,800
(3)	Inflow	Between Systems	Groundwater Extraction	44,600
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*257,000*
(5)	Outflow	Out of Basin	Evapotranspiration	154,000
(6)	Outflow	Between Systems	Runoff	83,400
(7)	Outflow	Between Systems	Return Flow	5,000
(8)	Outflow	Between Systems	Recharge of Applied Water	13,100
(9)	Outflow	Between Systems	Recharge of Precipitation	1,600
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*257,000*
(12)	Storage Change	(4)-(11)	Change in Land System Storage	-



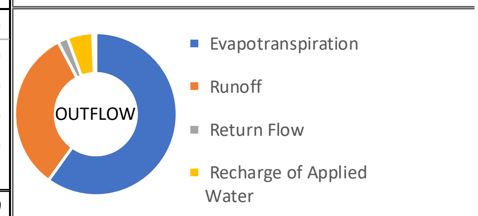
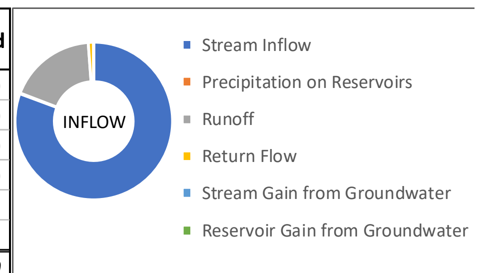


Figure 6-5 Average Land System Water Budget 1984-2018 (Historic)

item	SURFACE WATER SYSTEM			Acre-Feet
	Flow Type	Origin/ Destination	Component	Estimated
(13)	Inflow	Into Basin	Stream Inflow	371,100
(14)	Inflow	Into Basin	Precipitation on Reservoirs	500
(6)	Inflow	Between Systems	Runoff	83,400
(7)	Inflow	Between Systems	Return Flow	5,000
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*460,000*
(18)	Outflow	Out of Basin	Stream Outflow	358,500
(19)	Outflow	Out of Basin	Conveyance Evaporation	50
(20)	Outflow	Between Systems	Conveyance Seepage	30
(2)	Outflow	Between Systems	Surface Water Delivery	75,800
(21)	Outflow	Between Systems	Stream Loss to Groundwater	24,000
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	600
(23)	Outflow	Out of Basin	Reservoir Evaporation	700
(24)	Outflow	Out of Basin	Stream Evaporation	400
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*460,000*
(26)	Storage Change	(17)-(25)	Change in Surface Water Storage	-



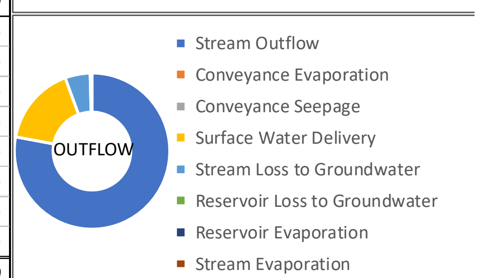
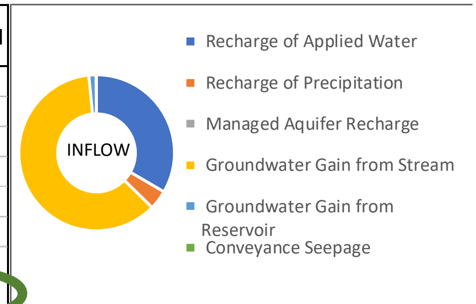


Figure 6-6 Average Surface Water System Water Budget 1984-2018 (Historic)

item	Flow Type	Origin/ Destination	Component	Estimated
	GROUNDWATER SYSTEM			**Acre-Feet**
(8)	Inflow	Between Systems	Recharge of Applied Water	13,100
(9)	Inflow	Between Systems	Recharge of Precipitation	1,600
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	24,000
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	600
(20)	Inflow	Between Systems	Conveyance Seepage	30
(27)	Inflow	Into Basin	Subsurface Inflow	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*39,300*
(3)	Outflow	Between Systems	Groundwater Extraction	44,600
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*44,600*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(5,000)



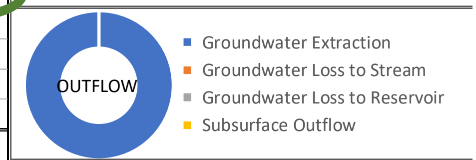


Figure 6-7 Average Groundwater System Water Budget 1984 to 2018 (Historic)

With the land system and surface water system assumed to be in balance, the groundwater system varies and reflects the change in water stored in the Basin. This change in storage is shown in **Figure 6-8** and is analogous to the change in storage presented in Chapter 5 – Groundwater Conditions which used groundwater contours to calculate the change. These two approaches show similar trends, but the magnitude of the changes differs slightly, with the groundwater contours showing a maximum cumulative overdraft (2015) of about 116,000 AF and the water budget indicating about 183,000 AF. This difference may indicate that the water budget overdraft may be slightly over estimated or that the average specific yield of the Basin is higher.

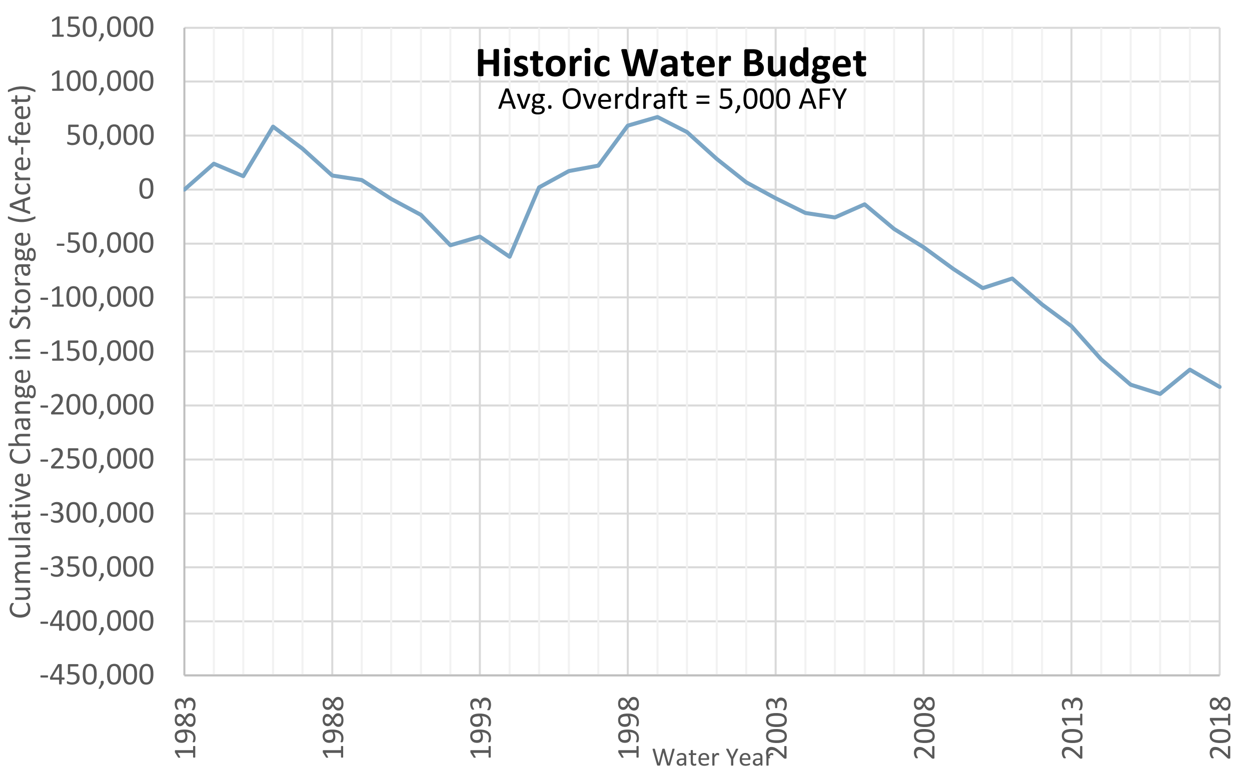


Figure 6-8 Cumulative Groundwater Change in Storage 1984 to 2018 (Historic)

The GSP regulations require an estimate of the sustainable yield[57] for the Basin (§354.18(b)(7)). This requirement is interpreted as the average annual inflow to the groundwater system, which for the 34-year period of the historic water budget is approximately 39,300 AF, as indicated on item 28 of **Figure 6-7** (circled in green) for the groundwater system. The estimate of annual average groundwater use is approximately 44,600 AFY.

The regulations also require a quantification of overdraft[58] (§354.18(b)(5)). For the water budget period of 1984 to 2018, overdraft is estimated at approximately 5,000 AFY, shown as the average annual groundwater system change in storage, circled in red on **Figure 6-7** (item 31).

6.3 Current Water Budget

The current water budget is demonstrated by estimating future water budget holding current conditions, land use and water use. The projection described in section 6.4.1 below holds these values constant and therefore represents both the current and projected..

6.4 Projected Water Budget

As required by the GSP Regulations, the projected water budget is developed using at least 50 years of historic climate data (precipitation, evapotranspiration and streamflow) along with estimates of future land and water use. The climate data from 1962 to 2011 was used as an estimate of future climate baseline conditions.

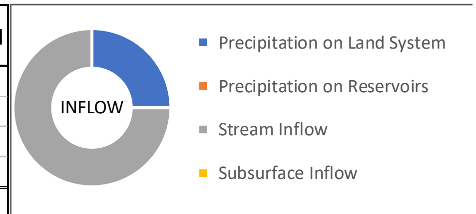
6.4.1 Projection Baseline

The baseline projected water budget uses the most recent estimates of population and land use and keeps them constant. **Figure 6-9** shows the average annual future water budget. Long-term overdraft is projected to be about 2,000 AFY, which is less than the overdraft for the historic water budget because it uses a longer, wetter time-period for its projections. **Figure 6-10** shows the projected cumulative change in groundwater storage.

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

[58] DWR defines overdraft as “the condition of a groundwater basin or Subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions.” (DWR 2016b)

item	TOTAL BASIN WATER BUDGET			Acre-Feet
item	Flow Type	Origin/ Destination	Component	Estimated
(1)	Inflow	Into Basin	Precipitation on Land System	143,200
(14)	Inflow	Into Basin	Precipitation on Reservoirs	500
(13)	Inflow	Into Basin	Stream Inflow	430,200
(27)	Inflow	Into Basin	Subsurface Inflow	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*574,000*
(5)	Outflow	Out of Basin	Evapotranspiration	156,900
(24)	Outflow	Out of Basin	Stream Evaporation	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	700
(19)	Outflow	Out of Basin	Conveyance Evaporation	50
(18)	Outflow	Out of Basin	Stream Outflow	418,000
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*576,000*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(2,000)



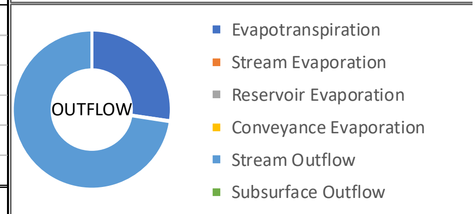


Figure 6-9 Average Projected Total Basin Water Budget 2019-2068 (Future Baseline)

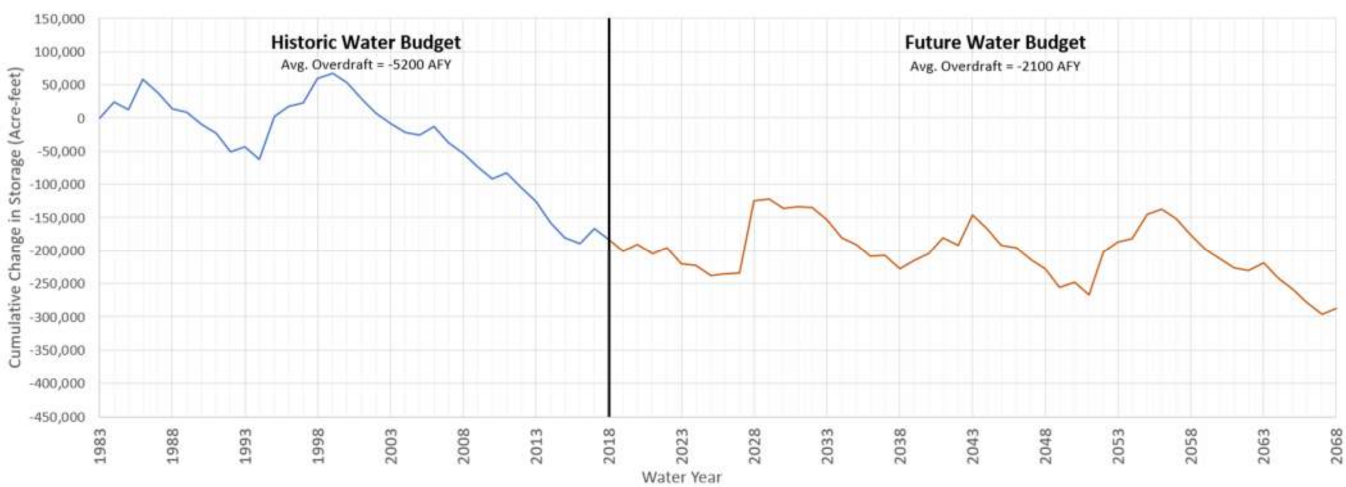


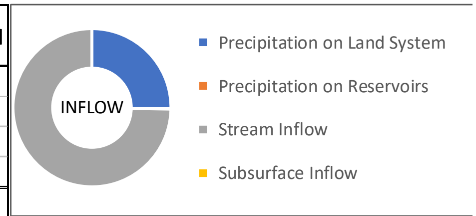
Figure 6-10 Cumulative Groundwater Change in Storage 1984 to 2068 (Future Baseline)

6.4.2 Projection with Climate Change

The SGMA regulations require an analysis of future conditions based on a potential change in climate. DWR provides location-specific change factors for precipitation, evapotranspiration and streamflow based on climate change models. While there is variability in the climate change models, if the models are correct, they indicate that the future climate in Big Valley will be wetter and warmer, resulting in more precipitation and more of that precipitation falling in the form of rain rather than snow. The change factors were applied to the baseline water budget and are shown in **Figure 6-11** and **Figure 6-12**. Land use was assumed to be constant, with conditions the same as DWR's 2014 land use survey. Future conditions with climate change projections indicate that the Basin may be nearly in balance, with overdraft of only about 1000 AFY.

TOTAL BASIN WATER BUDGET — Acre-Feet

item	Flow Type	Origin/ Destination	Component	Estimated
(1)	Inflow	Into Basin	Precipitation on Land System	152,200
(14)	Inflow	Into Basin	Precipitation on Reservoirs	600
(13)	Inflow	Into Basin	Stream Inflow	450,400
(27)	Inflow	Into Basin	Subsurface Inflow	-
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*603,000*
(5)	Outflow	Out of Basin	Evapotranspiration	165,800
(24)	Outflow	Out of Basin	Stream Evaporation	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	800
(19)	Outflow	Out of Basin	Conveyance Evaporation	-
(18)	Outflow	Out of Basin	Stream Outflow	436,700
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*604,000*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(1,000)



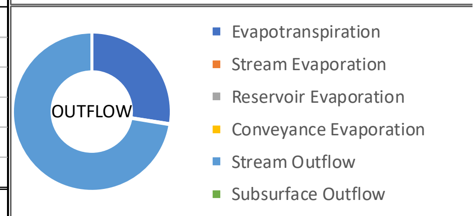


Figure 6-11 Projected Total Basin Water Budget 2019-2068 (Future with Climate Change)

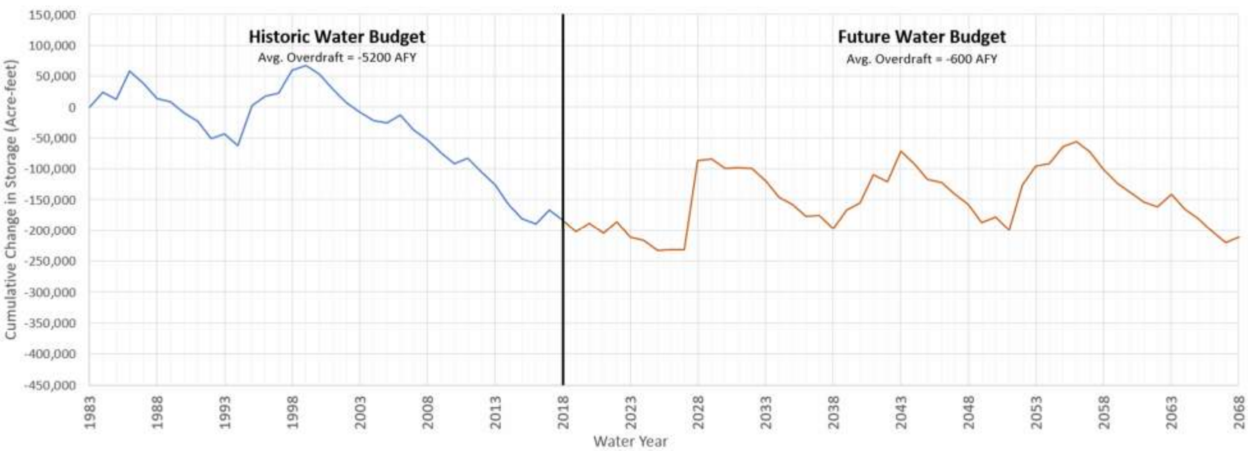


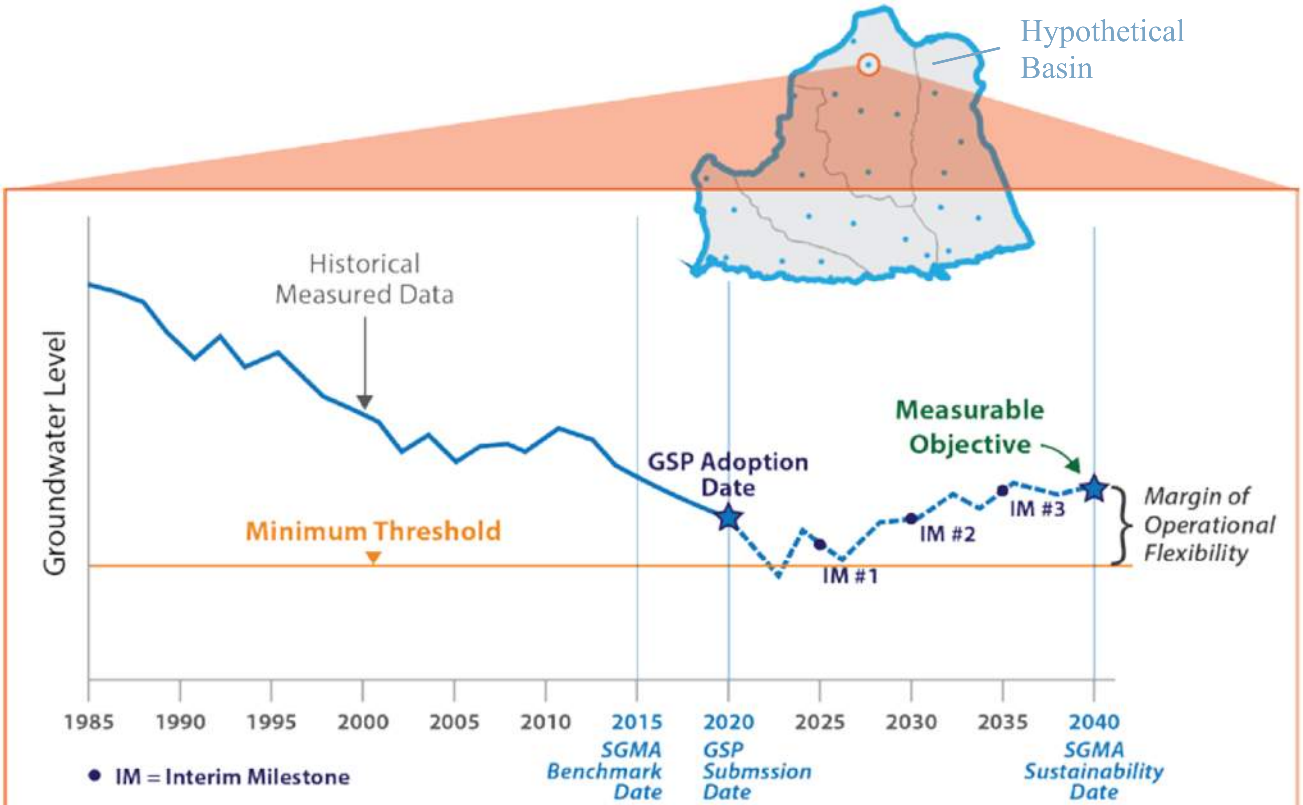
Figure 6-12 Cumulative Groundwater Change in Storage 1984 to 2068 (Future with Climate Change)

7. Sustainable Management Criteria § 354.20

This chapter describes criteria and conditions that constitute sustainable groundwater management for the BVGB, also known as Sustainable Management Criteria (or SMC). Below are descriptions of key terms used in the GSP Regulations and described in this chapter:

- **Sustainability goal:** This is a qualitative, narrative description of the GSP's objective and desired conditions for the BVGB and how these conditions will be achieved. The Regulations require that the goal should, "culminate in the absence of undesirable results within 20 years" (§ 354.22).
- **Undesirable result:** This is a description of the condition(s) that constitute "significant and unreasonable" effects (results) for each of the 6 sustainability indicators:
    - Chronic lowering of *groundwater levels*
    - Reduction in *groundwater storage*
    - *Seawater intrusion* – Not applicable to BVGB
    - Degraded *water quality*
    - Land *subsidence*
    - Depletion of *interconnected surface water*
- **Minimum threshold (MT):** Numeric values that define when conditions have become undesirable ("significant and unreasonable"). Minimum thresholds are established for representative monitoring sites. Undesirable results are defined by minimum threshold exceedance(s) and define when the Basin conditions are unsustainable (i.e., out of compliance with SGMA).
- **Measurable objective (MO):** Numeric values that reflect the desired groundwater conditions at a particular monitoring site. MOs must be set for the same monitoring sites as the MTs and are not subject to enforcement.
- **Interim milestones (IMs):** Numeric values for every 5 years between the GSP adoption and sustainability (20 years, 2042) that indicate how the Basin will reach the MO (if levels are below the MO). IMs are optional criteria and not subject to enforcement.

Figure 7-1 shows the relationship of the MT, MO and IMs. In addition to these regulatory requirements, some GSAs in other basins have developed "action levels", applicable when levels are above the MT but below the MO, for each well to indicate where and when to focus projects and management actions. This GSP also has action levels that are described in this chapter.



Source: DWR 2017

Figure 7-1 Relationship among the MTs, MOs and IMs for a hypothetical basin

7.1 Process for Establishing SMCs

The SMCs detailed in this chapter were developed by the GSAs through consultation with the BVAC. The sustainability goal was developed by an ad hoc committee and presented to the larger BVAC, GSA staff and the public for review and comment. The BVAC also formed ad hoc committees for each sustainability indicator and evaluated the data and information presented in Chapters 1-6. In consultation with GSA staff, each committee determined whether significant and unreasonable effects for each sustainability indicator have occurred historically and the likelihood of significant and unreasonable effects occurring in the future. The sections below reflect the guidance given to the GSAs and consultants by the ad hoc committees.

7.2 Sustainability Goal

The sustainability goal was presented in Chapter 1 and is reiterated here:

> The sustainability goal for the Big Valley Groundwater Basin is to maintain a locally governed, economically feasible, sustainable groundwater basin and surrounding watershed for existing and future legal beneficial uses with a concentration on agriculture. Sustainable management will be conducted in context with the unique culture of the basin, character of the community, quality of life of the Big Valley residents and the vested right of agricultural pursuits through the continued use of groundwater and surface water.

7.3 Undesirable Results

Undesirable results must be described for each sustainability indicator. To comply with §354.26 of the Regulations, the narrative for each applicable indicator includes:

- *Description* of the "significant and unreasonable" conditions that are undesirable
- Potential *causes* of the undesirable results
- *Criteria* used to define when and where the effects are undesirable
- Potential *effects* on the beneficial uses and users of groundwater, on land uses and property interests

Sustainability indicators that have not experienced undesirable results and are unlikely to do so in the future describe the justification for non-applicability of that Sustainability Indicator.

7.3.1 Groundwater levels

For this section, it is necessary to understand that it is natural (and expected) that groundwater levels will rise and fall during a particular year and over the course of many years. Chapters 4 through 6 describe the nature of groundwater levels throughout the Basin and how levels have changed over time. These chapters conclude that many areas of the Basin have seen no significant change. Other areas saw a lowering of levels in the late 1980's and early 1990's, recovery during the wet period of the late 1990's and lowering water levels since 2000. Groundwater usage has only seen minor increases since 2000, therefore the declines are more related to climatic conditions than to a lack of stewardship of the resource. As illustrated in **Figure 5-4**, water levels in 12 wells have shown stable (less than 1 foot of change) or rising water levels and 9 wells have shown declining trends with only three of those wells declining by more than 2 feet per year.

This context is given both to set the stage for discussion of undesirable results and to illustrate that water levels overall have not declined significantly. This re-emphasizes the point raised in Section 1.3 that the GSAs believe the Basin should be ranked as low priority. As mentioned previously, the GSAs also believe its ranking of medium priority is due in large part to the DWR's scoring of all basins with water level declines with a fixed number of points rather than considering the severity of declines. Big Valley has seen only minor declines in comparison to the widespread decline of hundreds of feet experienced elsewhere in the state. The Basin has demonstrated that it can recover during wet climatic cycles (e.g., late 1990's) as shown in **Figure 5-7**. There have not been widespread reports of issues or concerns regarding groundwater levels from the residents of the Basin (whether agricultural producers or domestic users or others). The GSAs contend that Big Valley's medium priority ranking is based on unscientific concerns raised by DWR based on isolated wells that experienced limited decline during a below average climatic cycle.

Therefore, undesirable results have not occurred in the past and the measurable objective established in this section is set at the fall 2015 groundwater level for each well in the monitoring network (*see* Chapter 8 – Monitoring Networks). Fall 2015 is the most recent measurement prior to the adoption of this GSP and is generally the lowest groundwater level throughout the period of record. Since these levels are economically feasible for agricultural uses, this level is a reasonable proxy for the desired conditions.

Description

This section describes undesirable results for groundwater levels by defining significant and unreasonable impacts on beneficial uses. As described in Section 1.1 and emphasized in the Sustainability Goal, agricultural production is of paramount importance due to its economic, cultural and environmental benefits. For agricultural pursuits to be viable, growers need a large margin of operational flexibility (*refer to* **Figure 7-1**) so that crops can be irrigated even during dry years. Accordingly, and consistent with the goal, 140 feet below the 2015 groundwater level was established as the minimum threshold.

Consistent with the Sustainability Goal, significant and unreasonable lowering of groundwater levels is defined as the level where the energy cost to lift groundwater exceeds the economic value of the water for agriculture[59]. Through discussions in BVAC ad hoc committee meetings among committee members, local well driller (Conner 2021) and the Lassen County Farm Advisor (Lile 2021) a depth of 140 feet below fall 2015 levels was determined to be the depth at which groundwater pumping becomes economically unfeasible for agricultural use.

The increase in horsepower required to pump from a well approaching the MT would result in an increased cost of $15 per acre foot of water using Surprise Valley Electric (SVE) rates and $30 per acre foot using Pacific Gas and Electric (PG&E) rates (Conner 2021). Calculated on a per ton basis, the increased cost of 140-foot water level decline translates to about $6.50 per ton using SVE power and $13 per ton with PG&E. (*see* **Appendix 7A**).

Total operating costs for a typical grass hay farm in the intermountain area are estimated to be $119 per ton. Total cash costs, not counting land and depreciation are estimated at $138 per ton of hay produced (Orloff et al 2016). Considering hay prices have been in the $200 per ton range (U.S. Department of Agriculture [USDA], Agricultural Marketing Service), the potential increase in required pumping power reduces return over cost by 10 to 20 percent.

To produce grain hay pumping costs are less because less water is required. Because the relative value of grain hay, approximately $120 per ton, is also much less, the overall impact to economic returns is equal if not greater. Thus, the agricultural production economic threshold for well levels is determined to be 140 feet below the fall 2015 baseline.

While the viability of agriculture is of paramount importance, it is acknowledged that if water levels approach the MT, some wells in the Basin may go dry. **Figure 7-2** shows an assessment of the depths of wells throughout the Basin based on DWR well logs[60]. While this dataset has inaccuracies, it gives a sense of the impact of lowering water levels on the different well types and indicates that lowering of water levels throughout the Basin to the MT could result in a significant percentage of wells going dry. Many of the shallower wells are likely the oldest wells in the Basin and may be unused or abandoned.

Figure 7-3 shows that domestic well density is not evenly distributed throughout the Basin and that representative wells are located near the areas of highest domestic well density.

It is also acknowledged that utilizing the margin of operational flexibility by agriculture could have impacts on users of surface water if it is determined to be interconnected. This potentially includes

[59] The Lassen County General Plan identifies this.
[60] This is an inaccurate dataset, but the best well data available to the GSAs.

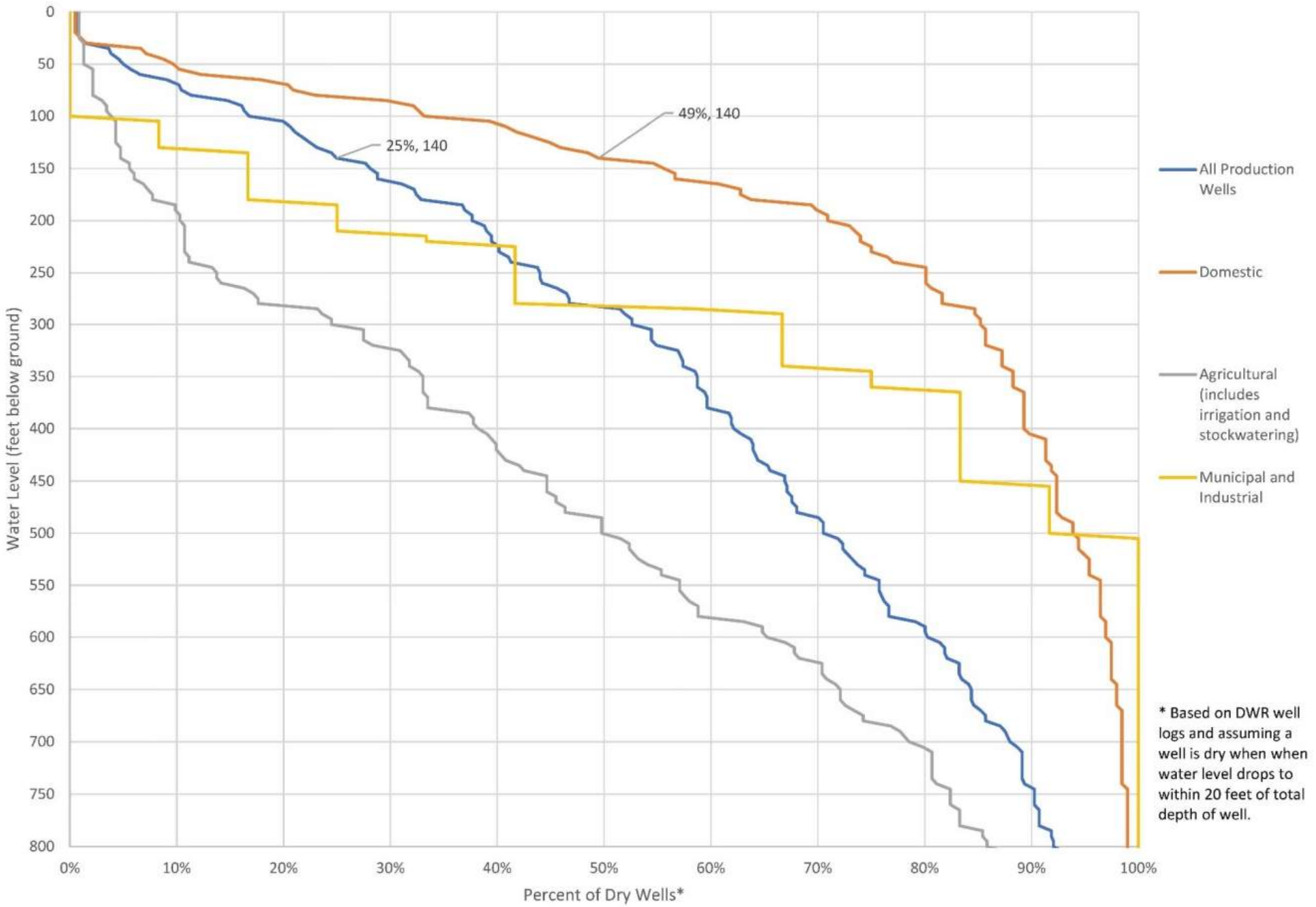


Figure 7-2 Analysis of Wells That Could Potentially Go Dry at Different Depths

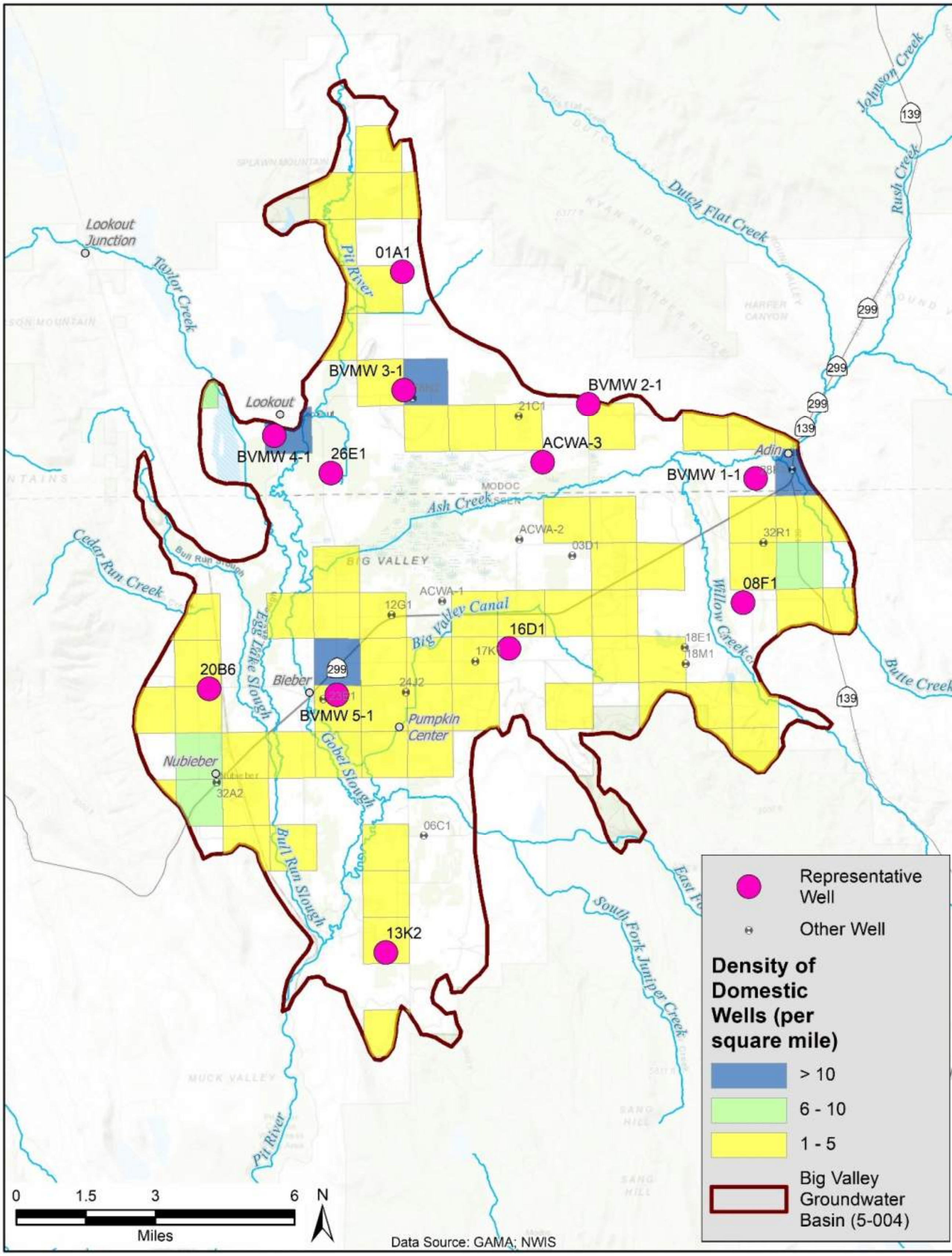


Figure 7-3 Domestic Well Density and Representative Groundwater Level Wells

groundwater dependent ecosystems and surface water rights holders. Discussion of this effect is discussed in Section 7.3.6 – Interconnected Surface Water, below.

Causes

Long term sustainability of groundwater is achieved when pumping and recharge are measured and balanced over multiple wet and dry cycles. When the groundwater pumping exceeds recharge, groundwater levels may decline. Similarly, when recharge exceeds pumping, groundwater levels may rise. Lower than average precipitation and snowpack over the last 20 years has resulted in declining groundwater levels in some parts of the Basin. A similar period of declining water levels occurred in the late 1980's through the middle of the 1990's. In the late 1990's, several years in a row of above average precipitation caused groundwater levels to fully recover. Future wet periods, enhanced recharge, increased storage and addressing data gaps will likely cause groundwater levels to experience a similar recovery and maintain balance within the Basin.

Criteria

The undesirable result criterion for the groundwater level sustainability indicator occurs when the groundwater level in one-third of the representative monitoring wells drop below their minimum threshold for 5 consecutive years.

In addition to the above definition of undesirable result it is recognized that, although groundwater levels naturally fluctuate, some actions may be justified even before levels fall below the minimum threshold at a particular representative well. Thus, the GSAs are defining an "action level" to identify areas within the Basin where management actions and projects are needed (*see* Chapter 9 – Projects and Management Actions). The definition of the term "Action Level" is also at the discretion of the GSAs. "Action Levels" and the associated protocol are defined as follows:

"Action Level": When monitoring within the established monitoring network identifies the following ground water level trends, targeted projects or management actions may be considered, at the discretion of the GSAs when any of the following occur:

- 1/3 of the representative monitoring wells in the Basin decline below the measurable objective (e.g., the fall 2015 baseline levels) for 5 consecutive years.
- Water levels at a 1/3 of the representative wells decline 3 times the average historic decline that well experienced between 2000 and 2018 as shown in **Appendix 5A**.
- Water levels at 1/3 of the representative wells decline more than 5 feet in 1 year.

Effects

As discussed above, if groundwater levels were to fall below the minimum threshold, pumping costs would render agricultural pursuits in the affected areas unviable. Without agriculture, the unique culture, character of the community and quality of life for Big Valley residents would be drastically changed. Reductions in agriculture would also affect wildlife who use irrigated lands as habitat, breeding grounds and feeding grounds.

Low water levels could cause wells to go dry, requiring deepening, redrilling, or developing a new water source. However, the long-term costs of agriculture becoming unviable causing reduced property values and tax revenue outweigh the short-term costs of investing in deeper wells or alternative water supplies. The potential effect would be offset by a shallow well mitigation program, which would apply to wells that have gone dry because water levels have fallen below the measurable objective. Substandard (e.g., hand-dug wells) would not qualify for mitigation. Mitigation would rely on a "good neighbor" practice already demonstrated in the Basin and would leverage any state or federal funding that may be secured. For example, the USDA Rural Development has offered low interest loans to drill new or replace existing wells. Additionally, prior to the first 5-year update, a program will be developed (*see* Chapter 9 – Projects and Management Actions) to cover a portion of the cost if new residential wells must be drilled because groundwater levels drop below the measurable objective. Any such program would apply to legally established wells and would be dependent on state and federal funding. Criteria will likely include well depth, screen interval, age of the well, distribution of declining wells (e.g., is it isolated) and other factors.

7.3.2 Groundwater Storage

The discussion and analysis regarding groundwater levels is directly related to groundwater storage. The groundwater levels for the fall 2015 measurement for each of the wells in the monitoring network (*see* Chapter 8 – Monitoring Network) is established as the measurable objective for groundwater storage (identical to the groundwater level measurable objective). The measurable objective is established at this level for storage for the same reasons discussed in the groundwater levels section. In summary, through public outreach, coordination with the BVAC and analysis of available data, the GSAs have determined that groundwater storage has not reached significant and unreasonable levels historically. Like the groundwater levels minimum threshold, the minimum threshold for groundwater storage is the same as for groundwater levels. The minimum threshold is set at this level for the same reasons discussed in the groundwater levels section.

Chapter 5 contains estimates of groundwater storage from 1983 to 2018 using groundwater contours from each year and an assumption that the definable bottom of the groundwater basin is 1,200 feet bgs. During this period, storage has fluctuated between a high of about 5,390,000 AF in fall 1983 (and 1999) to a low of 5,214,000 AF in fall 2015.

Description

Like groundwater levels, significant and unreasonable reduction in groundwater storage is defined as a level that results in the energy cost to lift the groundwater exceeding the economic value of the water for agriculture or a significant number of domestic wells are affected.

Justification of Groundwater Elevations as a Proxy

Again, the use of groundwater elevations as a substitute metric for groundwater storage is appropriate because change in storage is directly correlated to changes in groundwater elevation.

Causes

Long-term sustainability of groundwater is achieved when pumping and recharge are measured and balanced over multiple wet and dry cycles. When the groundwater pumping exceeds recharge, groundwater levels may decline. Similarly, when recharge exceeds pumping, groundwater levels may rise. Lower than average precipitation and snowpack over the last 20 years has resulted in declining groundwater levels in some parts of the Basin. A similar period of declining water levels occurred in the late 1980's through the middle of the 1990's. In the late 1990's, several years in a row of above average precipitation caused groundwater levels to fully recover. Future wet periods, enhanced recharge, increased storage and addressing data gaps will likely cause groundwater storage to experience a similar recovery and maintain balance within the Basin.

Criteria

As said, the measurable objective and the minimum threshold for groundwater levels and groundwater storage is the same. The monitoring network described in Chapter 8 – Monitoring Networks is also the same for both groundwater levels and storage. As such, the GSAs will use the voluntary and discretionary "Action Level" protocol described in the groundwater level section as a technique to improve management of groundwater when groundwater storage is below the measurable objective but above the minimum threshold.

Effects

Please *refer to* the "Effects" discussion in the groundwater levels section of this chapter, as the content in both sections is the same.

7.3.3 Seawater Intrusion

§354.26(d) of the GSP Regulations states that "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."

The BVGB is not located near an ocean and ground surface elevations are over 4000 feet above msl. Seawater intrusion is not present and is not likely to occur. Therefore, SMCs are not required for seawater intrusion as per §354.26(d) cited above.

7.3.4 Water Quality

As described in Chapter 5 – Groundwater Conditions, the groundwater quality conditions in the Basin are over all excellent (DWR 1963, Reclamation 1979). After a review of the best available data on water quality in the Basin, it was concluded that all the constituents which were elevated above suitable thresholds are naturally occurring. There has been no identifiable increase in the level of concentrations over time, and several constituents have indications of improvement in recent decades compared to concentrations in the 1950's and 1960's (e.g., Arsenic and Manganese **Figures 5-8** and **5-10**).

While the water quality is considered excellent in the Basin, water quality is an important issue to both agricultural and domestic users within the Basin and they are working in coordination to retain the existence of excellent water quality. The multitude of programs which regulate water quality is listed in Section 3.5.

In addition, Big Valley residents are voluntarily participating and coordinating in activities that will ensure continued excellent quality water in the Basin. Over the last 15 years, landowners have drilled stock watering wells as part of the EQIP program to protect water quality in streams. In 2018, the Upper Pit River Watershed IRWMP 2017 Update was completed. This document conducted a thorough analysis of the entire Pit River Watershed and found no water quality issues within the BVGB. Agricultural users are also proactively managing water quality *via* partnerships with agencies such as the NRCS to implement on site programs which are designed to improve water quality as detailed in Chapter 9 – Projects and Management Actions. As described in Section 1.1 – Introduction, agricultural users primarily grow low impact crops with no till methods and little application of fertilizer or pesticides. Domestic water users are also assisting in maintaining good water quality within the Basin through community action. Through the civic process, Big Valley residents were engaged in the development of the Modoc and Lassen County ordinances to deter unlicensed outdoor marijuana growers and the unpermitted use of pesticides and rodenticides which may make their way into the groundwater and surface water. The domestic water users are also actively seeking to assist in code enforcement and reduce the amount of harmful debris within the Big Valley communities that may cause water quality issues. Public outreach through the offices of Public Health, Environmental Health and the Regional Recycling Group Recycle Used Oil and Filter Campaign will assist in maintaining excellent water quality. These outreach efforts are further discussed in Chapter 9 – Projects and Management Actions.

Due to the existence of excellent water quality in the Basin, significant amount of existing water quality monitoring, generally low impact land uses and a robust effort to conduct conservation efforts by agricultural and domestic users, per §354.26(d), SMCs were not established for water quality because Undesirable Results are not present and not likely to occur. At the 5-year updates of this GSP, data from various existing programs, including the RWQCB sites, public supply wells (regulated by the Division of Drinking Water) and electrical conductivity transducers installed by the GSAs at three wells (BVMW 1-2, 4-1 and 5-1) will be assessed to determine if degradation trends are occurring in the principal aquifer. In addition, water quality impacts resulting from projects and management actions will be evaluated during their planning and implementation. At the 5-year update, SMCs will be considered only if the trends indicate that undesirable results are likely to occur in the subsequent 5 years.

7.3.5 Land Subsidence

As detailed in Section 5.5, little to no measurable subsidence is occurring in the Basin. Furthermore, causes of micro-subsidence identified by the InSAR data presented in Section 5.5 are likely due to either agricultural land leveling operations or natural geologic activity. The specific identified areas of subsidence are considered acceptable and necessary agricultural operations to promote efficient irrigation. Similar situations may occur throughout the Basin and if identified through InSAR will be investigated. As detailed in Chapter 5, very minor areas of land subsidence have been observed in the Basin by the Continuous Global Positioning System site near Adin (CGPS P347, -0.6 inch over 11 years) and by the InSAR data provided by DWR (maximum of -3.3 inches over 4 years). The cause of these downward displacements has not been determined conclusively, but due to the widespread nature is likely natural and unavoidable due to the movement of Tectonic plates.

Given the lack of significant subsidence and the fact that some subsidence is acceptable to stakeholders in the absence of impacts on infrastructure (roadways, railroads, conveyance canals and wells among others), no undesirable results have occurred and none are likely to occur. Therefore, per §354.26(d), SMCs were not established for subsidence. At the 5-year updates of this GSP, data from GPS P347 and InSAR data provided by DWR will be assessed for notable subsidence trends that can be correlated with groundwater pumping. SMCs and undesirable results for subsidence will be established at the 5-year update only if trends indicate significant and unreasonable subsidence is likely to occur in the subsequent 5 years.

7.3.6 Interconnected Surface Water

The rivers and streams of the Basin are an important and vital resource for all interested parties. The agricultural industry has an extensive history of surface water use in the Basin and has operated for over a century. Many of the surface water rights on farms and ranches are pre-1914 water rights. All surface water flowing in the Basin during irrigation season is fully allocated. For all interested parties, there is need for better tracking of surface water allocations.

Section 5.6 presents the available information related to interconnected surface water. It is nearly impossible to quantify surface water depletion impact based on flow alone, even in an area where there is good data, such as pumping quantity, deep aquifer groundwater elevation, precipitation and surface flow. Many of these criteria are current data gaps in the Basin, particularly the variation in precipitation and flow across the Basin. Uncertainty in the amount of surface water entering the Basin and the unpredictability of weather patterns has already been established and will continue to be a barrier. Pumping data in the Basin is also a data gap as there is no current monitoring system which annually measures the amount of water pumped. The connection between upland recharge areas and the unique volcanic geologic features surrounding the Basin are mostly unknown and make understanding the connectivity of surface and groundwater very difficult if not impossible.

Furthermore, the number of wells located next to streams and the river in the Basin are not quantified. While Chapter 5 – Groundwater Conditions details the streams in Big Valley which *may* be interconnected by a "…continuous saturated zone to the underlying aquifer and the overlying surface water…" (DWR 2016c), however, there is currently no evidence to support interconnected surface water. Therefore, there is a lack of evidence for interconnection of streams. **Figure 5-18** overlays the general direction(s) of groundwater flow around the Basin in relation to the major streams. Also shown is the general direction of flow determined from the newly constructed well clusters near Adin and Lookout. The remaining clusters were constructed later and do not yet have a sufficient period of data to determine flow directions with certainty. The newly constructed monitoring wells will continue to gather data on whether there is any evidence of interconnected surface water.

Chapter 4 – Hydrogeological Conceptual Model, identified data gaps related to the effect of Ash Creek, Pit River and smaller streams on recharge. These data gaps may partially be filled once adequate data from the five monitoring well clusters are collected. Scientific research related to groundwater and surface water will improve over time. As this science is made available, the GSAs will work to locate funding for improved data depending on available staffing and financial resources.

SMCs were not established for interconnected surface water because there is insufficient evidence to determine that Undesirable Results are present or likely to occur. At the 5-year updates of this GSP, data from newly established well clusters, new and historic stream gages and the monitoring network detailed in Chapter 9 – Projects and Management Actions, will be assessed to determine if undesirable trends are occurring in the principal aquifer. At the 5-year update, SMCs will be considered only if the trends indicate that undesirable results are likely to occur in the subsequent 5 years.

7.4 Management Areas

Management areas are not being established for this GSP.

8. Monitoring Networks § 354.34

8.1 Monitoring Objectives

This chapter describes the monitoring networks necessary to implement the BVGB GSP. The monitoring objectives under this GSP are twofold:

- to characterize groundwater and related conditions to evaluate the Basin's short-term, seasonal and long-term trends related to the six sustainability indicators
- to provide the information necessary for annual reports, including water levels and updates to the water budget[61]

The sections below describe the different types of monitoring required to meet the above objectives, including groundwater levels, groundwater quality, subsidence, streamflow, climate and land use. Each type of monitoring relies on existing programs not governed by the GSAs and therefore the monitoring networks described in this chapter are subject to change if the outside agencies modify or discontinue their monitoring. The monitoring networks will generally be adjusted to the availability of data collected and provided by the outside agencies.

8.2 Monitoring Network

8.2.1 Groundwater Levels

Monitoring of groundwater levels is necessary to meet several needs based on the above stated objectives of the monitoring networks, including:

- Representative monitoring for groundwater levels
- The groundwater contours required for annual reports
- Shallow groundwater monitoring to help define potential interconnection of groundwater aquifers with surface water bodies

Table 8-1 lists existing wells that have been used for groundwater monitoring along with the newly constructed dedicated monitoring wells. The table indicates which wells are used for each of the three groundwater level monitoring networks. A more detailed table with elements required under §352.4(c) is included in **Appendix 8A**. Further details for each well and water level hydrographs are included in **Appendix 5A**. **Appendix 8B** contains the As-Built Drawings for the dedicated monitoring wells, also required by §352.4(c). The locations of the wells are shown on **Figure 8-1**.

[61] Water levels are needed to generate hydrographs, contours and an estimate of change in storage as required for the annual report. Also required for the annual reports are estimates of groundwater pumping, surface water use, and total water use which can be estimated from the water budget.

Table 8-1 Big Valley Groundwater Basin Water Level Monitoring Network

					Depth to Water (feet bgs)		Groundwater Elevation (feet msl)				
Well Name	Well Use	Well Depth (feet bgs)	Screen[1] Interval (feet bgs)	Representative Well[2]	Measurable Objective[3]	Minimum Threshold[4]	Measurable Objective[3]	Minimum Threshold[4]	Contour Well	Shallow Well	Monitoring Frequency
01A1	Stockwatering	300	40 - 300	X	148	288	4035	3895	X		biannual
03D1	Irrigation	280	50 - 280						X		biannual
06C1	Irrigation	400	20 - 400						X		biannual
08F1	Other	217	26 - 217	X	32	172	4222	4082	X		biannual
12G1	Residential	116	--								biannual
13K2	Irrigation	260	20 - 260	X	66	206	4062	3922	X		biannual
16D1	Irrigation	491	100 - 491	X	93	233	4079	3939	X		biannual
17K1	Residential	180	30 - 180						X		biannual
18E1	Irrigation	520	21 - 520						X		biannual
18M1	Irrigation	525	40 - 525								biannual
18N2	Residential	250	40 - 250								biannual
20B6	Residential	183	41 - 183	X	41	181	4085	3945	X		biannual
21C1	Irrigation	300	30 - 300						X		biannual
22G1	Residential	260	115 - 260								biannual
23E1	Residential	84	28 - 84								biannual
24J2	Irrigation	192	1 - 192						X		biannual
26E1	Irrigation	400	20 - 400	X	20	160	4114	3974	X	X	biannual
28F1	Residential	73	--								biannual
32A2	Other	49	--						X		biannual
32R1	Irrigation	--	--						X		biannual
ACWA-1	Irrigation	780	60 - 780						X		biannual
ACWA-2	Irrigation	800	50 - 800						X		biannual
ACWA-3	Irrigation	720	60 - 720	X	23	163	4136	3996	X	X	biannual
BVMW 1-1	Observation	265	175 - 265	X	53	193	4162	4022	X		continuous[5]
BVMW 1-2	Observation	52	32 - 52							X	continuous[5]
BVMW 1-3	Observation	50	30 - 50							X	continuous[5]
BVMW 1-4	Observation	49	29 - 49							X	continuous[5]
BVMW 2-1	Observation	250	210 - 250	X	22	162	4194	4054	X		continuous[5]
BVMW 2-2	Observation	70	50 - 70							X	continuous[5]
BVMW 2-3	Observation	70	50 - 70							X	continuous[5]
BVMW 2-4	Observation	60	40 - 60							X	continuous[5]
BVMW 3-1	Observation	185	135 - 185	X	18	158	4146	4006	X		continuous[5]
BVMW 3-2	Observation	40	25 - 40							X	continuous[5]
BVMW 3-3	Observation	50	25 - 50							X	continuous[5]
BVMW 3-4	Observation	50	25 - 50							X	continuous[5]
BVMW 4-1	Observation	425	385 - 415	X	65	205	4088	3948	X		continuous[5]
BVMW 4-2	Observation	74	54 - 74							X	continuous[5]
BVMW 4-3	Observation	80	60 - 80							X	continuous[5]
BVMW 4-4	Observation	93	73 - 93							X	continuous[5]
BVMW 5-1	Observation	540	485 - 535	X	47	187	4082	3942	X		continuous[5]
BVMW 5-2	Observation	115	65 - 115							X	continuous[5]
BVMW 5-3	Observation	85	65 - 85							X	continuous[5]
BVMW 5-4	Observation	90	70 - 90							X	continuous[5]

Notes:

-- = information not available
feet bgs = feet below ground surface (depth to water)
feet msl = feet above mean sea level (groundwater elevation NAVD88)
water year = October 1 to September 30

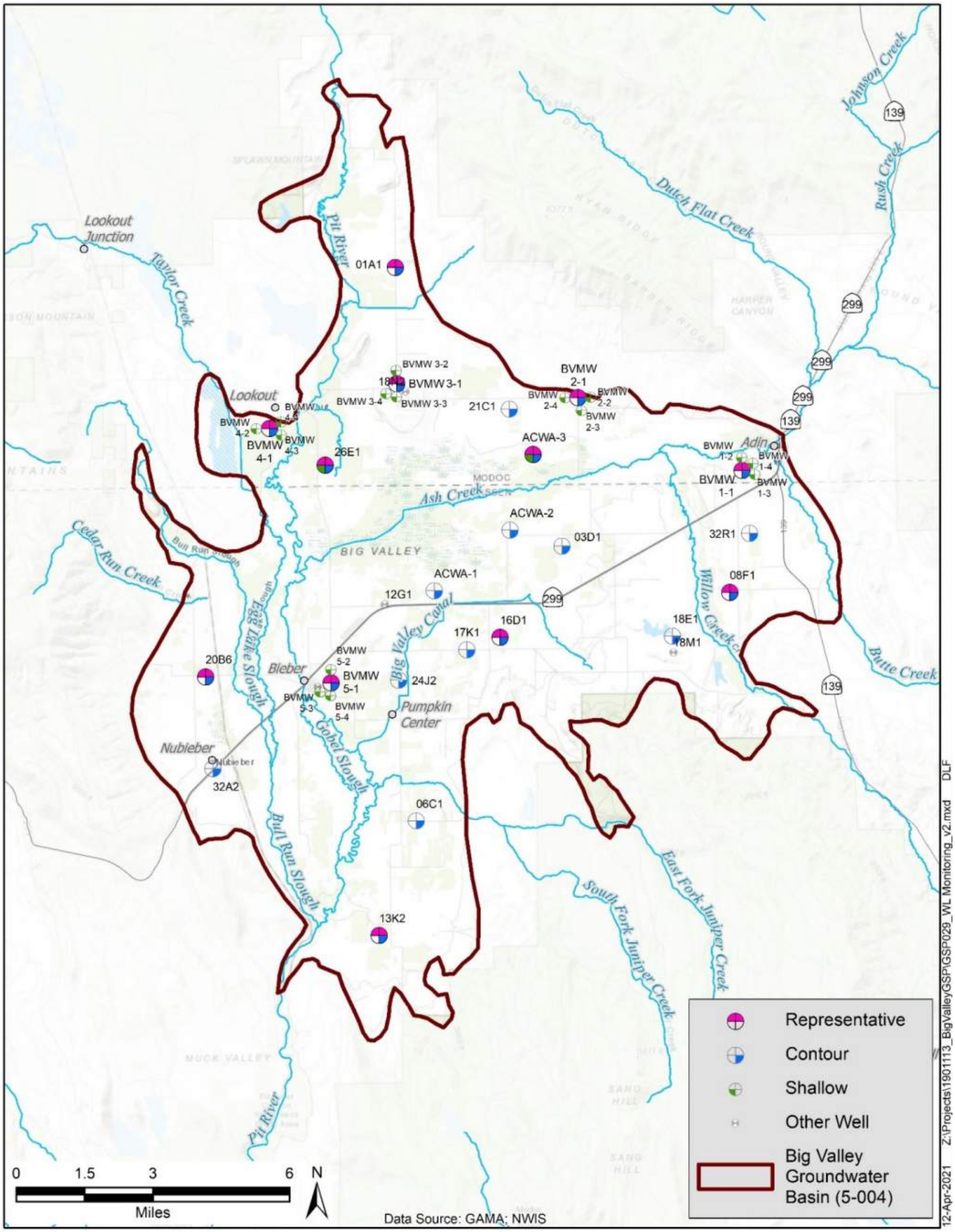
[1] For the purposes of this GSP, the terms "screen" or "perforation" encompases any interval that allows water to enter the well from the aquifer, including casing perforations, well screens, or open hole.

[2] Respresentative wells for Water Levels and Groundwater Storage

[3] Measurable objective is set at the Fall 2015 water level or at the lowest water level measured for wells that don't have a Fall 2015 measurement

[4] Minimum threshold is set at 140 feet below the measurable objective

[5] Continuous measurements are currently available due to the water level transducers installed in the wells. Less frequent monitoring may be appropriate in the future once the period of record of these wells is longer and interconnection of surface and groundwater is better understood.



2570
2571 **Figure 8-1 Water Level Monitoring Networks**
2572

GSP Regulation §352.4 states that monitoring sites that do not conform to DWR BMPs, "…shall be identified and the nature of the divergence from [BMPs] described." DWR's BMP (DWR 2016e) states that wells should be dedicated to groundwater monitoring. In addition, §354.34 indicates that wells in the monitoring network should have "depth-discrete[62] perforated intervals." Many of the historic wells listed in **Table 8-1** diverge from these standards and the explanation of their suitability for monitoring is described below.

Previous groundwater level monitoring in the Basin has relied on existing domestic and irrigation wells that often have pumps in them used for irrigation, stockwatering, or domestic uses. The intent of groundwater level monitoring is to capture static (non-pumping) water levels. However, historic monitoring is performed before and after the irrigation season, March or April for spring measurements and October for fall measurements[63]. Since these measurements are taken at a time when large-scale groundwater use is typically not active, using production wells is acceptable in the absence of dedicated monitoring wells. DWR staff who monitor the wells will indicate if the well (or a nearby well) is pumping in order to be considered when assessing water level measurements.

In addition to the well use considerations, most of the historic wells do not have depth-discrete screen intervals[64], as the typical well construction practice in the Basin has been to use long (100 feet up to 800 feet) screens, perforations, or open hole below about 30 to 40 feet of blank well casing. This construction practice is designed to maximize well yield. The use of such long-screen wells is acceptable for monitoring in Big Valley because multiple principal aquifers have not been defined in the Basin and therefore these long intervals do not cross defined principal aquifers. Since most wells are constructed with this practice, water levels in these long-screen wells should be indicative of the aquifer as a whole and less likely to be affected by perched water or isolated portions of the aquifer that may not be interconnected over large areas.

8.2.1.1 Representative Groundwater Levels and Storage Monitoring Network

The representative monitoring network includes all wells that have been assigned sustainable management criteria (minimum thresholds and measurable objectives). DWR does not give strict guidance on the number or density of wells appropriate for representative monitoring. DWR's BMP document cites sources that recommend well densities ranging from 0.2 to 10 wells per 100 square miles (DWR 2016e). Through consultation with the BVAC, 12 wells were selected for representative monitoring of the Basin (which has an area of about 144 square miles), a density of 8.3 wells per 100 square miles.

Extensive discussion and consideration were performed by the GSAs and local stakeholders to determine an appropriate water level monitoring network. Based on the comprehensive review of the wells, the network was selected based on:

[62] "Depth-discrete" means that the screens, perforations, or open hole is relatively short (typically less than about 20 feet).

[63] Local stakeholders have advocated for future measurements to occur in mid-March and late-October to ensure they are taken before and after the irrigation season.

[64] Screens in this context includes perforated casing, well screens, or open hole, all of which allow water to flow into the well.

- Spatial distribution throughout the Basin to represent agricultural pumping areas
- Areas with a high density of domestic wells
- An existing monitoring record (where available) to track long-term trends
- Access for long-term future monitoring
- Well depth (greater than the MT)
- Wells dedicated to monitoring where available

Table 8-1 shows the MOs and MTs for the 12 representative wells. As stated in Chapter 7 – Sustainable Management Criteria, MOs are set at the fall 2015 water level. MTs are shown in **Table 8-1** to protect agricultural beneficial use

8.2.1.2 Groundwater Contour Monitoring Network.

The GSP Regulations (§356.2) require that annual reports include groundwater contours for the previous year (spring and fall) as well as an estimate of change in groundwater storage. Historic groundwater storage changes were estimated in Chapter 5 – Groundwater Conditions, using groundwater contours contained in **Appendix 5B**. Therefore, for annual reports to be comparable to historic conditions, the wells used for groundwater contouring should be the same, or nearly the same as those used for the historic contours. Five wells that were used in the historic contours are not included in the groundwater contour monitoring network (18M1, 18N2, 22G1, 23E1 and 28F1), because they were either replaced by a new dedicated monitoring well or there was another well close by that makes the measurement unnecessary. **Table 8-1** lists the groundwater contour monitoring network and **Figure 8-1** shows their locations.

8.2.1.3 Shallow Groundwater Monitoring Network

Chapter 5 – Groundwater Conditions, discusses interconnected surface water and describes the perennial streams in the BVGB. As described in Chapter 7 – Sustainable Management Criteria, there is currently no conclusive evidence for interconnection of streams with the groundwater aquifer and all summer flows are 100 percent allocated based on existing surface water rights. Therefore, measurable objectives, minimum thresholds and a representative monitoring network for interconnected surface water have not been established. Monitoring will be assessed at the 5-year update. Through consultation with the BVAC, a shallow monitoring network has been established that includes the shallow wells from each of the five monitoring well clusters. These clusters were designed to measure the magnitude and direction of shallow groundwater flow and are equipped with water level transducers that collect continuous (15-minute interval) water level measurements so that potential correlations with streamflow gages can be assessed. Well 26E1 was also added to the shallow network due to its position between the two major streams (Pit River and Ash Creek), its shallow screen depth (20 feet bgs) and its lack of a pump. Well number ACWA-3 was also selected for the shallow network due to its location on the ACWA within the northern portion of the Ash Creek wetlands associated with Big Swamp and the possible groundwater dependent ecosystems shown in **Figure 5-19**. **Table 8-1** lists the shallow groundwater monitoring network and **Figure 8-1** shows the well locations.

8.2.1.4 Monitoring Protocols and Data Reporting Standards

Currently, DWR measures groundwater levels at 21 wells in Big Valley. The expectation of the GSAs is that DWR will also monitor levels at the dedicated monitoring wells and download the transducer data from these wells. Transducer data will be corrected for barometric fluctuations using data from two barometric probes installed at two of the clusters. Water level data will be made available on the state's SGMA Data Viewer website for use by the GSAs in their annual reports and GSP updates. DWR's water level monitoring protocols are documented in their Monitoring Protocols, Standards and Sites BMP. (DWR 2016b). Portions of the BMP relevant to water levels are included in **Appendix 8C**.

8.2.1.5 Data Gaps in the Water Level Monitoring Network

Data gaps are identified in this section using guidelines in SGMA Regulations and BMP published by DWR on monitoring networks (DWR, 2016e). **Table 8-2** summarizes the suggested attributes of a groundwater level monitoring network from the BMP in comparison to the current network and identifies data gaps. No data gaps exist except the area near well 06C1, shown on **Figure 8-1**.

8.2.2 Groundwater Quality

Chapter 5 describes water quality conditions as overall excellent, and the few constituents that are infrequently elevated in Big Valley are all naturally occurring. Therefore, measurable objectives, minimum thresholds and a representative monitoring network have not been established. Monitoring will be assessed at the 5-year update. To make such an assessment, the GSAs will rely on existing programs, described in Chapter 7. Focus will be on the water quality reported for wells regulated by the State Water Board's DDW. DDW wells are shown on **Figure 8-2** and are in Bieber and Adin, with one well in the western portion of the Basin. In addition to data from DDW, the GSAs have installed three transducers to measure electrical conductivity (EC) at wells BVMW 1-1, 4-1 and 5-1, shown on **Figure 8-2**. These transducers increase the distribution of the monitoring network around the Basin and with increased frequency of measurement will allow the GSAs to better understand temporal trends that may not be apparent from infrequent DDW measurements. The EC transducers may be able to put anomalous[65] measurements from DDW into better context. **Table 8-3** lists the groundwater quality monitoring sites and their details.

[65] Anomalous measurements are those that are out of the norm or deviate from what would be expected. The source of the deviation from the norm should be noted and if errors are identified, the measurement(s) removed from the dataset based on professional judgment. At a minimum, anomalous measurements are marked as questionable, and the potential source(s) of the deviation documented.

Table 8-2 Summary of Best Management Practices, Groundwater Level Monitoring Well Network and Data Gaps

Best Management Practice (DWR, 2016d)	Current Monitoring Network	Data Gap
Groundwater level data will be collected from each principal aquifer in the Basin.	12 representative wells	None. There is a single principal aquifer and therefore all wells monitor the aquifer.
Groundwater level data must be sufficient to produce seasonal maps of groundwater elevations throughout the Basin that clearly identify changes in groundwater flow direction and gradient (Spatial Density).	22 contour wells	21 of the 22 proposed contour wells are currently monitored. Well 06C1 was monitored up until WY 2016. This well fills an important spatial area in the southern part of the Basin. To fill the data gap, the well could be re-activated, a new willing well owner found, or a dedicated monitoring well constructed in the area.
Groundwater levels will be collected during the middle of October and March for comparative reporting purposes, although more frequent monitoring may be required (Frequency).	All proposed monitoring network wells, except 06C1 are measured biannually, with the dedicated monitoring wells collecting continuous (15-minute) measurements	None. Current DWR monitoring occurs in March or April and in October for seasonal high (spring) and low (fall) respectively.
Data must be sufficient for mapping groundwater depressions, recharge areas and along margins of basins where groundwater flow is known to enter or leave a basin.	Groundwater depressions are present in the east-central part of the Basin near 03D1 and in the southern portion of the Basin near Well 06D1 and Well 13K2	03D1 defines the east-central depression. To ensure adequate definition of the southern depression, well 06C1 could be re-activated, a new, willing well owner found, or a dedicated monitoring well constructed in the area.
Well density must be adequate to determine changes in storage.	22 contour wells	Filling of data gap near 06C1.
Data must be able to demonstrate the interconnectivity between shallow groundwater and surface water bodies, where appropriate.	17 shallow wells, including 5 clusters of 3 shallow wells each	None.
Data must be able to map the effects of management actions, i.e., managed aquifer recharge.	22 contour wells and 17 shallow wells	None. Once projects and management actions are defined, monitoring specific to those projects and management actions will be identified.
Data must be able to demonstrate conditions near Basin boundaries; agencies may consider coordinating monitoring efforts with adjacent basins to provide consistent data across Basin boundaries. Agencies may consider characterization and continued impacts of internal hydraulic boundary conditions, such as faults, disconformities, or other internal boundary types.	22 contour wells and 17 shallow wells	None. There are no direct boundaries with adjacent Basins. Inflow/outflow from Basin addressed above.
Data must be able to characterize conditions and monitor adverse impacts to beneficial uses and users identified within the Basin.	12 representative wells	None

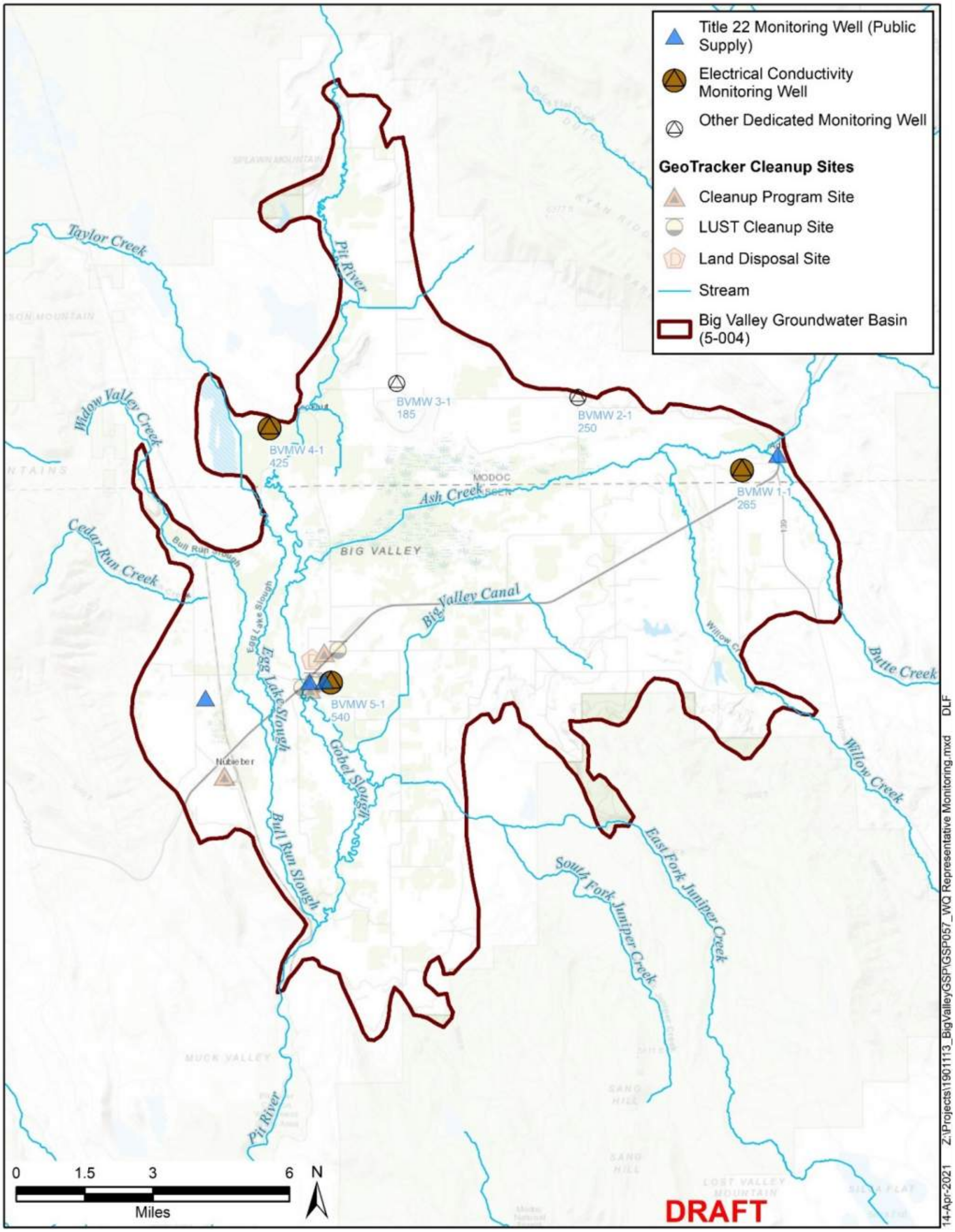


Figure 8-2 Water Quality Monitoring Network

Table 8-3 Big Valley Groundwater Basin Water Quality Monitoring Network

Well Name	SWRCB Public Source Code	DWR Site Code	Well Use	Well Depth (feet bgs)	Open Hole	Screen[1] Interval (feet bgs)	Constituents
Bieber Town Well 1	1810003-001		Public Supply	200	yes	62 - 200	Title 22
Bieber Town Well 2	1810003-002		Public Supply	240	no	60 - 240	Title 22
Adin Ranger Station Well 3	2500547-003		Public Supply	--	--	--	Title 22
Intermountain Conservation Camp Well 1	1810801-001		Public Supply	--	--	--	Title 22
BVMW 1-1		411880N1209599W001	Observation	265	no	175 - 265	Electrical conductivity
BVMW 3-1		412029N1211587W001	Observation	185	no	135 - 185	Electrical conductivity
BVMW 5-1		411219N1211339W001	Observation	540	no	485 - 535	Electrical conductivity

Notes:
-- = information not available
feet bgs = feet below ground surface (depth to water)
[1] For the purposes of this GSP, the terms "screen" or "perforation" encompases any interval that allows water to enter the well from the aquifer, including casing perforations, well screens, or open hole.

8.2.2.1 Monitoring Protocols and Data Reporting Standards

While DWR provides guidance on protocols and standards for water quality in their BMP (DWR 2016f), these don't generally apply to the Big Valley water quality monitoring network. For the DDW wells, monitoring protocols used by the parties responsible for collecting and analyzing samples will be relied upon. DDW and other data regulated by the State Water Board is made available on their GAMA GIS website. At the 5-year update, the GSAs will obtain and analyze the available data. The measurements for EC transducers are made in situ with no samples collected or analyzed in a laboratory.

8.2.2.2 Data Gaps in the Water Quality Monitoring Network

Table 8-4 summarizes the recommendations for groundwater quality monitoring from DWR's BMPs, the current network and data gaps. There are no data gaps in the water quality monitoring network.

8.2.3 Land Subsidence

As described in Chapter 5 - Groundwater Conditions and Chapter 7 – Sustainable Management Criteria, no significant land subsidence has occurred in the BVGB and no significant subsidence is likely to occur. Therefore, MOs, MTs and a representative monitoring network have not been established. This assessment was made based on a CGPS station near Adin (P347) and InSAR data provided by DWR. Future assessment of subsidence at the 5-year GSP update will rely on data provided by NOAA who operates Well P347 and updated InSAR data provided by DWR. The data will be assessed to determine if significant subsidence is occurring and the source of that subsidence.

Table 8-4 Summary of Groundwater Quality Monitoring, Best Management Practices and Data Gaps

Best Management Practices (DWR, 2016a)	Current Network	Data Gap
Monitor groundwater quality data from each principal aquifer in the Basin that is currently, or may be in the future, impacted by degraded water quality. The spatial distribution must be adequate to map or supplement mapping of known contaminants. Monitoring should occur based upon professional opinion, but generally correlate to the seasonal high and low groundwater level, or more frequent as appropriate.	4 public supply wells and 3 monitoring wells with EC transducers.	None. Most known contaminants are located in Bieber and Nubieber. Monitoring at wells in Bieber and in BVMW 5-1 have not shown contaminants but monitoring there would indicate if they become present.
Collect groundwater quality data from each principal aquifer in the Basin that is currently, or may be in the future, impacted by degraded water quality. Agencies should use existing water quality monitoring data to the greatest degree possible. For example, these could include ILRP, GAMA, existing RWQCB monitoring and remediation programs and drinking water source assessment programs.	4 public supply wells and 3 monitoring wells with EC transducers.	None.
Define the three-dimensional extent of any existing degraded water quality impact.	No degraded water quality impacts are present.	None.
Data should be sufficient for mapping movement of degraded water quality.	No degraded water quality impacts are present.	None.
Data should be sufficient to assess groundwater quality impacts to beneficial uses and users.	No degraded water quality impacts are present.	None.
Data should be adequate to evaluate whether management activities are contributing to water quality degradation.	None. Projects and management activities that are implemented will assess potential water quality impacts.	None.

8.2.3.1 Monitoring Protocols and Data Reporting Standards

Since the monitoring network relies on NOAA and DWR-provided data, the monitoring protocols and reporting standards for those organizations apply.

8.2.3.2 Data Gaps in the Subsidence Monitoring Network

Since InSAR data is contiguous across the Basin, there are no spatial data gaps. If subsidence is indicated by future InSAR datasets, there may be a need to field verify those areas to determine if field leveling has occurred or there is another reason or cause for the subsidence. Additional field validation could potentially be made by re-surveying monuments in the Basin, including those installed at the new monitoring wells.

8.2.4 Monitoring to Support Water Budget

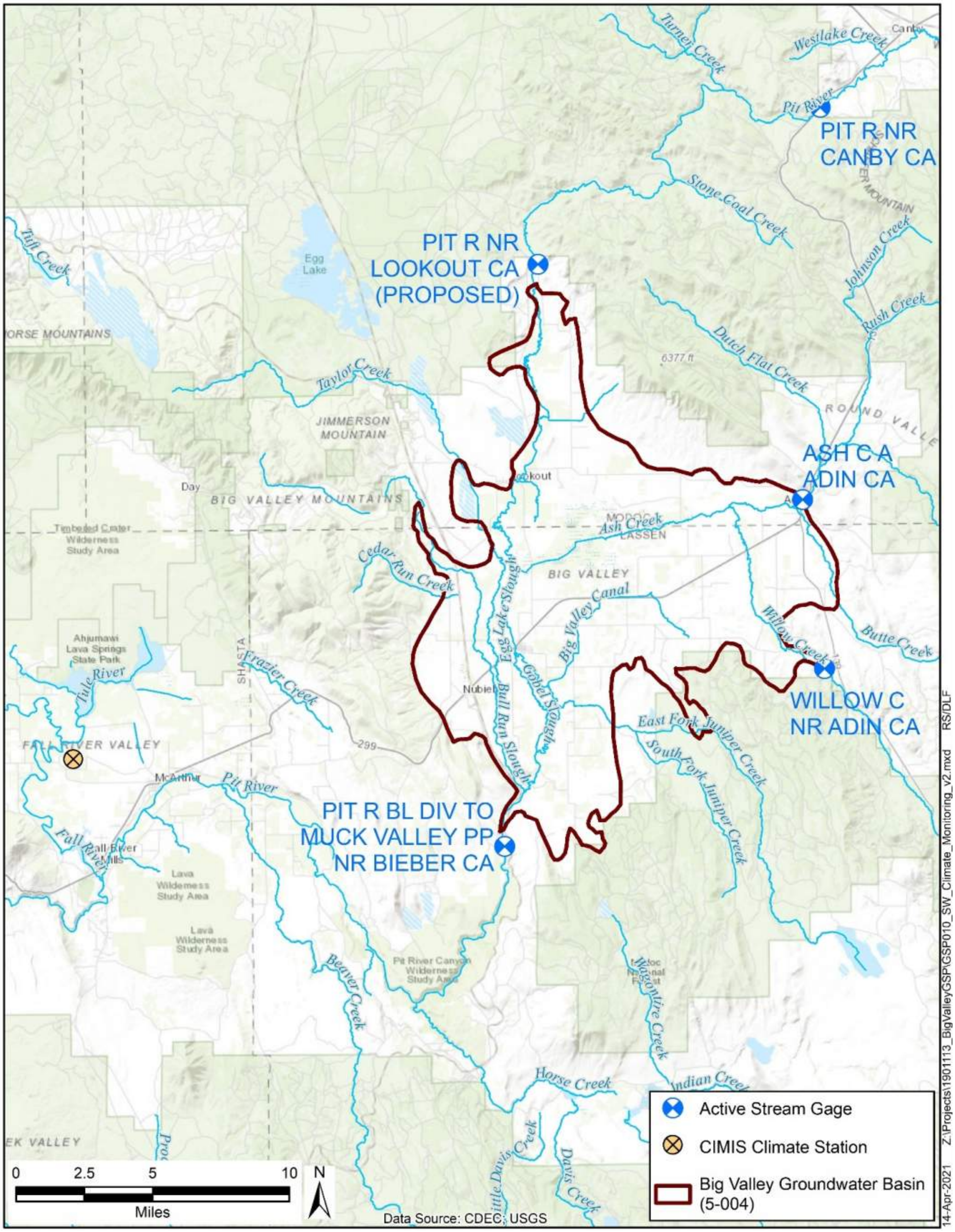
8.2.4.1 Streamflow and Climate

Streamflow and climate data are needed to update the water budget. Current monitoring sites are shown on **Figure 8-3**. Modoc County has been working to improve water budget estimates and is proposing to add a stream gage on the Pit River just north of the BVGB, shown on **Figure 8-3**, which will be maintained by the state. Data gaps for smaller streams, such as inflow from Roberts Reservoir, Taylor Creek and Juniper Creek are proposed to be filled by investigating SB-88 stream diversion records submitted to the State Water Board.

8.2.4.2 Land Use

Land use data is needed for updates to the water budget. Since 2014, DWR has provided land use mapping using remote sensing processed by DWR's LandIQ mapping resource. DWR has provided these datasets for 2014, 2016 and 2018[66]. The GSAs will rely on DWR continuing to provide this land use data to generate annual updates to the water budget. The most recent land use data available will be used to generate the evapotranspiration estimates. Current research is being performed to develop the relationship between evapotranspiration (ET) and applied water. This research indicates that crops in this area are typically irrigated less than indicated by the assumptions made by multiplying ETo by crop coefficients.

[66] Landowners in the Basin have pointed out that these datasets are inaccurate, but they represent the best available information.



2724
2725 **Figure 8-3 Surface Water and Climate Monitoring Network**

9. Projects and Management Actions §354.44

Through an extensive planning and public outreach process, the GSAs have identified an array of projects and management measures that may be implemented to meet sustainability objectives in the BVGB. Additionally, numerous state and federal programs are available in the Basin to help meet the sustainability goals. Some of the projects can be implemented immediately while others will take significantly more time for necessary planning and environmental review, navigation of regulatory processes and implementation. The Big Valley Basin is relatively small, and while recharge does occur within the Basin itself, significant recharge comes from the extensive uplands surrounding the Basin. Projects will be located within the greater Big Valley watershed boundary shown in **Figure 9-1**.

Although the Big Valley area is extremely rural and economically disadvantaged, and resource capacity is limited, there are several local, state and federal agencies that can assist in project development.

Project implementation will also be impacted by funding acquisition. **Table 9-1** lists current state and local funding sources that can be targeted to support project planning and implementation.

With a proactive approach to identify projects for increased recharge and conservation in the Big Valley Basin and surrounding watershed, it is envisioned that the GSAs will be successful in remaining a sustainable groundwater basin. With the possible exception of a large surface water storage project such as Allen Camp Dam, the projects and management measures describe in this chapter are expected to work in combination and should be considered as a whole rather than dependent on any single strategy. Should sustainability not be realized, additional projects and management actions will be considered and developed as appropriate. A timeline for projects can be found in **Table 9-2**. The Regulations require details about each project to satisfy§354.44. Most of those details can be found in **Table 9-3**. One of the items not included in **Table 9-3** is §354.44(b)(7) is a description of the legal authority required for each project. The GSAs have the legal authority to coordinate and/or implement each of the projects described based on their authority under SGMA and state law. Some of these projects include aspects that will be implemented on private and public land. In those cases, permission and authority to implement the project will be obtained from the land owner.

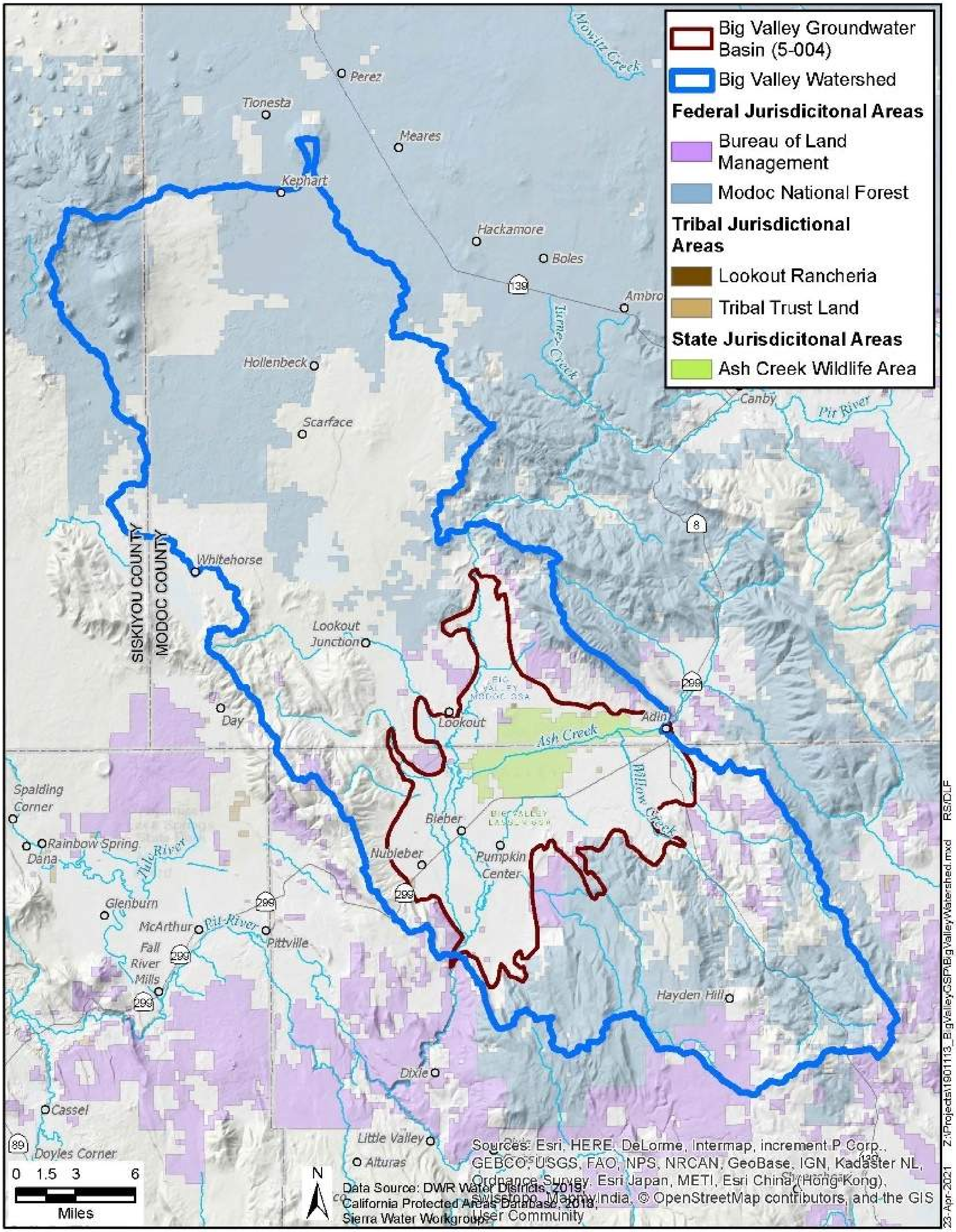


Figure 9-1 Big Valley Watershed Boundary

Table 9-1 Available Funding Supporting Water Conservation

Funding Program Title	Managing Agency	Description of Funding
Wetlands Reserve Program, Crop Reserve Program, Environmental Quality Improvement Program	NRCS (website)	Cost share funding for wide array of soil, water and wildlife conservation practices. Funding priorities developed locally.
Conservation Innovation Grants	NRCS (website)	Supports development of new tools, approaches, practices and technologies to further conservation on private lands.
Partners for Fish and Wildlife Program	US Fish and Wildlife Service (website)	Private land meadow, forest, or rangeland restoration, conservation easement.
State Water Efficiency and Enhancement Program (SWEEP)	California Dept of Food and Agriculture (CDFA) (website)	Supports implementation of water saving irrigation systems.
Healthy Soils Program	CDFA (website)	Supporting management and conservation practices for enhancing soil health (which includes water holding capacity).
Farmer/Rancher and/or Professional + Producer grants	Western Sustainable Agriculture Research and Education (website)	Farmer-driven innovations in agricultural sustainability including profitability, stewardship and quality of life.
Alternative Manure Management Program (AMMP) (link)	CDFA (website)	Financial assistance for non-digester manure management.
Sustainable Groundwater Management	DWR (website)	Planning and implementation grants supporting sustainable groundwater management. Disadvantaged communities and economically distressed areas.
State Forest Health Program	CAL FIRE (website)	Improve forest health throughout California.
USDA for household well deepening	USDA Rural Development (website)	No interest loan up to $11K to improve existing domestic wells.

Table 9-2 Projects and Potential Implementation Timeline

No.	Category	Description	Estimated Time for Potential Implementation (years)		
			0-2	2-8	>8
1	9.1 Recharge Projects	AgMAR	X	X	X
2		Drainage and Basin Recharge	X	X	X
3		Ag Injection Wells			X
4	9.2 Research and Data Development	Stream Gages	X		
5		Refined Water Budget	X	X	
6		Agro-Climate Station	X		
7		Voluntary Installation of Well Meters	X	X	
8		Adaptive Management	X	X	X
9		Mapping and Land Use	X	X	
10	9.3 Increased Storage Capacity	Expanding Existing Reservoirs		X	
11		Allan Camp Dam			X
12	9.4 Improved Hydrologic Function	Forest Thinning and Management	X	X	X
13		Juniper Removal	X	X	X
14		Stream and Meadow Restoration	X	X	X
15	9.5 Water Conservation	Irrigation Efficiency	X	X	
16		Landscaping and Domestic Water Conservation	X	X	
17		Conservation Projects	X	X	
18	9.6 Education and Outreach	Public Communication	X		
19		Information and Data Sharing	X	X	
20		Fostering Relationships	X		
21		Compiling Efforts	X	X	
22		Educational Workshops	X		

Note: AgMAR = Agricultural Managed Aquifer Recharge

Table 9-3 Required Elements for Projects and Management Actions

Project	Brief description	Circumstances under which the project will be implemented	Public notification process	Permitting and regulatory process	Benefits	Schedule	Estimated cost
9.1 Basin Recharge Projects	Agricultural Managed Aquifer Recharge is the practice of using excess surface water (when available) and applying it to agricultural fields to intentionally recharge groundwater aquifers	AgMAR will be performed during winter months during high surface flows. The nature, frequency and timing of these flows will be evaluated through a Water Availability Analysis (WAA).	Notification of available water and success of this projects will be communicated at public GSA meetings. Agreements will be made between the GSAs and interested producers.	Following development of the WAA, an AgMAR permit for surface water diversions can be solicited from the State Water Board. Currently this permitting process can take 6-18+ months and cause significant economic burden to the applicant. An organized application for Basin-wide winter diversions by the GSAs could lessen some of the regulatory burden since they qualify for a streamlined process but a waiver of fees for extremely disadvantaged communities working to improve groundwater recharge may also be needed.	Irrigating every 5-7 days for roughly 10 weeks in the winter/spring would benefit 2-5 AF of water per acre. Previous research has quantified that over 90% of water is recharged to deep aquifers or available in the soil profile with AgMAR. The limitation to this project is available winter for recharge but a project goal of 1,000 acres per year could provide roughly 10,000 AF of water per year benefit.	Water budget planning and permitting will take 6-18 months and possibly more depending on the case load at the department of water resources. After an off-season water budget is completed, permitting can be distributed to the GSAs for winter recharge location selection. AgMAR could start being used at productive scale by 2024 if all processes go smoothly.	The cost to develop the WAA is still being developed but may be covered under existing grants from DWR. The cost of submitting a streamlined permit will also be developed, including fees.
9.2 Research and Data Development	Stream gages are scientific instruments used to collect streamflow and water quality data to decrease scientific uncertainty in order to inform water management decisions. Agri-climate/CIMIS stations are helpful in monitoring for climactic factors such as temperature, humidity, wind speed, etc. and overall help refine estimates of ET in the Basin. Refining the water budget for the Basin will improve the accuracy with which management decisions are made because many of the assumptions used to generate the water budget stem from data gaps that need to be addressed, or other efforts to collect and analyze data submitted through other regulatory programs.	In addition to the continued use of existing stream gages which monitor many of the seasonal streams that contribute inflow to the Big Valley Basin, stream gages may be installed if locations and need are determined. Presently, Modoc County is working to install an additional stream gage where the Pit River enters the Basin. Data from agri-Climate/CIMIS stations may be utilized in order to make water management decisions with regard for climactic factors such as wind, rain etc. Adaptive management will be employed throughout the implementation process to allow for management decisions to reflect the best available data as more information comes available. Employing adaptive management strategies will expand our capacity to conduct research and data development, also. Refining the water budget will be done as more data becomes available through the combination of the data development projects described previously.	All research and data development progress will be shared at public GSA meetings. Data collected from gaging stations will be publicly available.	We will continue to work with DWR to ensure compliance with any relevant laws and to obtain any necessary permits related to stream gage installation and maintenance, as well as for other projects that fall under adaptive management strategies and the water budget.	Decreasing data gaps would decrease reliance on assumptions to govern groundwater management decisions. As more data becomes available, more accurate estimates of evapotranspiration would allow for more precise water budgeting estimates.	Gaging stations being installed where necessary early in the planning process in order to decrease uncertainty related to streamflow. They will be monitored throughout. Adaptive management strategies are anticipated to be employed throughout the GSP development and implementation phases. Refining the water budget is important early on in order to create a GSP that best reflects existing conditions in the Basin and which may be referenced in the future to perform adaptive management.	Funding is available for the development of new gaging stations. Maintenance costs may vary, but 1 estimate projects the annual maintenance cost for a single gage to be around $15,000. Funding for projects related to adaptive management and refining the water budget will be acquired as necessary. Presently, there is funding to maintain or install flow meters on private wells. More funding is likely available for similar projects, such as refining mapping and land use designations within the Basin.

Project	Brief description	Circumstances under which the project will be implemented	Public notification process	Permitting and regulatory process	Benefits	Schedule	Estimated cost
9.3 Increased Surface Water Storage Capacity	Surface water storage may be used to reduce reliance on groundwater by providing an alternative water source. Presently, Robert's Reservoir and several others including the Inverson, Silva and BLM reservoirs mitigate potential overdraft. As water levels in streams and other water courses diminish during the dry months, existing diversions may not adequately meet the needs of users. Expanding the capacity of these reservoirs and possibly constructing new reservoirs such as the Allan Camp Project would allow additional water from snowmelt and storm events to be stored. This would help circumvent reliance on groundwater and would provide reliable supplies of surface water for users.	Projects intended to increase surface water storage will be implemented when it is economically advisable to do so and when they may help mitigate Basin overdraft.	Pursuant to environmental review, these projects will have opportunities for public comment and project documents will be made publicly available whenever appropriate. Both National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) compliance mandate opportunities for public comment.	Permitting for surface water storage projects will be subject to NEPA and CEQA depending on whether the project sites are located on federal or state land respectively.	Increasing the capacity to store surface water by capturing runoff could reduce reliance on groundwater during summer months. Further, increasing surface water storage would improve water security during dry years.	The timeframe for largescale infrastructure projects would likely be upwards of 8 years, as the regulatory and environmental review processes generally require extensive coordination between agencies and stakeholders for planning and compliance.	Large infrastructure projects can be quite expensive. $1 in May 1981 had the same buying power as $2.97 in April 2021. A ballpark estimate of the capital costs for the Allan Camp Project in its entirety would amount to approximately $344,041,830, with the dam and reservoir component amounting to an additional $174,487,500. These figures are Funding may be available from the federal government in the form of loans under the Small Reclamation Projects Act of 1956. The cost associated with expanding existing reservoirs depends on the method employed. Sediment removal typically costs between "$8,000 and $32,000 per acre foot," (Lund 2014) and would be done infrequently. Increasing dam height typically costs between "1,700 to $2,700 per acre foot" (Lund 2014).
9.4 Improved Hydrologic Function and Upland Recharge	Upland forest recharge enhancement occurs in conjunction with vegetation management and forest fuels reduction by increasing snow water content and reducing dense forest canopy and associated evapotranspiration	Upland forest recharge will take place will be enhanced by implementation of forest health and fuels reduction projects within the Big Valley watershed. Such projects are on-going and in varying stages of planning and implantation. Support from GSAs and local, state and federal partners will increase implementation rate and scope. Water availability and recharge enhancement will be realized along with fire/fuels and wildlife habitat benefits.	On federally-managed lands public notification of projects will be conducted under NEPA by the Modoc National Forest or Applegate BLM. State funded projects will follow CEQA public notification process. Opportunities on private land be communicated by GSAs, Pit Resource Conservation District and other state and local entities.	Projects permitting will vary by land ownership. On federal lands: NEPA and applicable federal land policies. On private lands: state forestry rules are applicable and programs such as CAL FIRE's Forest Health Program will help clarify and streamline permitting processes.	Snow water content has been shown to increase by 33 to 44% from a dense conifer canopy to an open area. Surface run-off has also been shown to respond to treatments. Recharge figures are difficult to quantify, but even a modest increase in recharge over 10% of the potential upland recharge area could result several thousand AF of water.	The initial upland forest recharge project "Wagontire Project" is scheduled for implementation in 2022 and is expected completion in a 2- to 4-year window.	Project costs vary by site, but an estimated average is from $500 to $650 per acre.
9.5 Water Conservation Projects	Water conservation and water use efficiency projects would primarily be adopted by growers and homeowners on their private property. Infrastructure improvements, while requiring capital outlay are not subject to permitting or public environmental review.	Project implementation will be voluntary with cost-share incentives. Projects will be implemented on a site-by-site basis and designed for overall production and economic efficiency, along with water use savings.	Notification of opportunity to participate will be through local agricultural organizations, extension outreach meetings and by sponsoring agencies. Broad public notification of individual projects is not required.	Projects in this category such as upgrading irrigation infrastructure, irrigation management techniques, home landscaping, etc. are generally not subject to permitting requirements.	Some practices have been shown to result in efficiency increases in the range of 10% at the field scale. Multiplied over a number of farms, water use savings could be significant.	Irrigation infrastructure and water use efficiency incentives are on-going. UC Cooperative Extension has submitted a grant proposal to SWEEP to initiate an outreach education program in 2022.	Costs vary widely. New irrigation infrastructure on a field scale can exceed $100,000. Soil moisture meters for irrigation scheduling can be in the $100's to $1,000's of dollars per farm. Landscaping and homeowner water efficiency projects in the $100's to $1000's per home.
9.6 Education and Outreach	Education and outreach efforts can drive beneficial changes in patterns of use and protect water resources. Existing efforts employed by the GSAs include outreach about funding opportunities that support water conservation methods, coordinating information sharing efforts and facilitating informational meetings with stakeholder groups.	As an essential part of sustainability, outreach and education will be conducted throughout the development of the GSP, with many opportunities for public engagement.	Public information is available through the Big Valley GSP communication portal, accessible at bigvalleygsp.org. Informational brochures will be distributed to interested parties to make information about the GSP more accessible.	Public engagement is important to the regulatory process of SGMA and other acts that the GSP may be subject to. However, education and outreach are an incredibly important part of meeting the sustainability goals of this GSP, especially as it relates to equity and inclusion.	Public involvement in the GSP development is crucial in attaining sustainability. Research (OECD 2015) has shown that here are many social, economic and environmental benefits to education and outreach efforts in water management. These benefits can vary widely, but generally include increased levels of social cohesion, equity and conflict avoidance, improved water use efficiency and improved water quality.	Ongoing efforts to engage the public in outreach and education programs related to groundwater management are essential as part of the Groundwater Sustainability Plan. The anticipated timeline for outreach and education efforts is indefinite, but it is especially important throughout the planning and implementation process of the GSP.	Costs may vary depending on program type.

9.1 Basin Recharge Projects

Enhancing recharge to get more of the available water into the aquifer is one of the key means to attaining sustainability. Priority is given to the immediate Big Valley watershed, but additional recharge projects will be considered for surrounding upland and upstream areas of the Pit River watershed. A more detailed watershed map is provided in Chapter 3 – Plan Area. For off-season diversion recharge projects to be widely available in the Big Valley Basin, an off-season water availability study must be completed for the Pit River watershed up-river of Big Valley. This would allow growers to be able to obtain a permit for winter flow diversion. This study would include a survey of potential water rights held for off-season use, storage and hydroelectric power. *See* footnote link for a more detailed description of what is needed in this process.[67]

Once this survey is completed and approved by a licensed engineer, permits to divert for available surface water can be solicited from DWR. Currently this permitting process can take 6 to 18+ months and cause significant economic burden to the applicant. An organized application for Basin-wide winter diversions by the GSAs could lessen some of the regulatory burden since they qualify for a streamlined process but a waiver of fees for extremely disadvantaged communities working to improve groundwater recharge is needed. *See* footnote link for a more detailed description of what is needed in this process.[68]

Along with permitting costs, there are also costs to the irrigator in electricity and labor costs to apply water.

9.1.1 Agriculture Managed Aquifer Recharge

One approach to Basin recharge currently being considered is the intentional recharge of groundwater aquifers by spreading water over agricultural fields at times when excess surface water is AgMAR (Kocis & Dahlke, 2017, Dahlke et al. 2018). With significant surface water irrigation and diversions already present in Big Valley, AgMAR is a viable option in the Basin. Much of the current research on AgMAR has been completed on relatively well-drained soils that are not present in Big Valley. Research on Big Valley soils with slow to very slow infiltration rates appears to be initially promising. While recharge of groundwater may be slower in the Basin, it could still be a feasible means for deep water recharge and filling the shallow aquifer and root zone. AgMAR can be utilized for both, increasing recharge and decreasing water application of groundwater during the growing season due to a saturated soil profile. A conservative estimate suggests that 25,000 acres in Big Valley of agricultural and native vegetation lands are accessible to surface water and available for AgMAR. Priority will be given to low infiltration over very low infiltration soils for recharge and areas addressing more critical groundwater levels.

Among the perennial crops, alfalfa is considered a promising candidate for AgMAR for several reasons and significant initial research has been completed throughout California on its feasibility (Dahlke et al. 2018). 80 to 85 percent of the alfalfa in California is irrigated by flood irrigation which in turn could

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[67] https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/docs/streamlined_waa_guidance.pdf

[68] https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/streamlined_permits.html

allow for areas where surface water can be utilized for groundwater recharge (Dahlke et. al. 2018). Alfalfa is widely grown in Big Valley and flood irrigation is common. Alfalfa is a nitrogen-fixing plant that seldom receives nitrogen fertilizer, which reduces the risk of leaching excess nitrate to groundwater, one of the main concerns of AgMAR (Putnam and Lin 2016; Walley et al. 1996). Dahlke, H.E., Et. al. 2018 found that winter recharge had no discernible effect on alfalfa yield (first and second cutting) and led to increased crop water availability in the deep soil profile offsetting potential irrigation deficits during the growing season.

Research currently being completed in Big Valley on the feasibility of AgMAR on perennial grass pasture and hay fields looks promising. Although soils in Big Valley have lower infiltration rates, winter recharge rates of 0.2 - 0.5 AF per acre per irrigation between March and April have shown no damage to crops. Soil infiltration rates show 2 to 3.5 inches of infiltration over a 24-hour period to be feasible. Irrigating every 7 to 10 days for six irrigations in the winter/spring would benefit 1 to 2 AF of water per acre into groundwater storage. This is the first AgMAR research completed on grass which is a dominant perennial crop in Big Valley. Given that some forms of applied nitrogen, particularly nitrate, have a propensity for leaching which has presented a challenge in other parts of the state, there has been some concern over nitrogen application and AgMAR. This can easily be addressed with BMPs of applying nitrogen outside of the winter recharge window. This work could also be easily applied to AgMAR feasibility on adjacent rangeland, conservation reserve project (CRP) or NRCS WRP land.

9.1.2 Drainage or Basin Recharge

Using the same principles as used in AgMAR, excess surface water can be diverted into irrigation drainages or canals and recharge basins to percolate into the groundwater table and replenish upper levels of the aquifer. This water is then available to be extracted at a later date for beneficial use. The volume of water recharged is limited by the availability and access to surface water, infiltration rates of the soils, losses to evaporation and available infrastructure.

The total number of feet or miles of irrigation canals or ditches needs to be determined along with the availability of current water storage basins (reservoirs) for recharge. Additional basins may need to be created for the sole purpose of groundwater recharge. Producers wanting to participate in this program would notify the GSA and report diverted water for the purpose of drainage or Basin recharge. The development of a water availability study and permitting as described on in **Table 9-3** also applies to this project. Unlined drainages, canals and basins could recharge up to 90 percent of diverted surface water to the aquifer.

9.1.3 Aquifer Storage and Recovery and Injection Wells

Aquifer storage and recovery (ASR) is the use of a new or existing well to inject and store water underground during wet periods and then extract by the same or other nearly wells to meet demand during dry periods. Increased aquifer storage provides some of the same benefits as new surface storage but can be phased in over time and can be less expensive. From an operations perspective, increased aquifer storage is a practical option since it involves the use of new or existing groundwater wells retrofitted for injection. ASR projects require a permit from the RWQCB and the permitting method is usually the Statewide ASR General Order (General Order)[69] adopted by the State Water Board in 2012.

The General Order requires that the water being injected into aquifer storage meet drinking water standards, so in the case of Big Valley, this will require filtration and chlorination of surface water prior to injection into aquifer storage.

Because pre-treatment of the water source for injection and operation and maintenance of ASR wells is relatively expensive, ASR is typically used when surface spreading *via* basins or flooded fields is not feasible. ASR may be favored in areas of the Basin constrained by land area limitations, unfavorable surface soils or shallow confining layers at or near the ground surface preventing deep percolation of applied water.

In Big Valley, the most likely scenarios in which ASR would be implemented are when under the following conditions:

- Flood MAR projects are not able to stabilize groundwater levels in some location due to the presence of impermeable soils at or new the surface, or
- As mitigation to reverse declining groundwater levels near public or domestic supply wells

ASR would be implemented in phases if the conditions above warrant it. ASR would only be feasible with outside funding assistance through either state or federal grant programs to both cover the capital expenses and assist with the monitoring required for compliance with the ASR General Order. Under these conditions, ASR will be developed in phases as summarized below:

- Phase 1 – Assessment of wells and hydrogeology culminating in a technical report to accompany a notice of intent to inject provided to the regional water quality control board. This phase will identify locations and monitoring during ASR pilot testing.
- Phase 2 – ASR pilot testing following receipt of a Notice of Applicability from the RWQCB. Pilot testing may include a single well test or may involve multiple wells throughout the Basin based on the finding and recommendations in the technical report developed in Phase 1.
- Phase 3 – Implementation including retrofit of existing wells, construction of new wells and operation of these facilities to stabilize or increase aquifer storage.

More information about ASR is available from the U.S. Environmental Protection Agency.[70]

9.2 Research and Data Development

Data gaps are mentioned and detailed throughout the GSP chapters. Continuing to fill these gaps, participate in research and collect data to support the GSP is necessary to support sustainability using the best science available.

[69] https://www.waterboards.ca.gov/water_issues/programs/asr/
[70] https://www.epa.gov/uic/aquifer-recharge-and-aquifer-storage-and-recovery

9.2.1 Additional Stream Gages and Flow Measurement

Several seasonal streams contribute inflow to the Big Valley Basin (**Figure 9-2**). Many of these streams had historical stream gages or have current gages monitored by the USGS and DWR. The Pit River which is a major inflow river and significant contributor of surface water irrigation and recharge in Big Valley has a gage 13 miles from where the Pit River enters Big Valley at the Canby bridge. There are many springs and small tributaries that flow into the Pit River after the Canby bridge as well as irrigated lands water use between Canby and the Big Valley Basin. Modoc County has been working to install an additional stream gage where the Pit River enters the Basin to fill this data gap and provide more current stream flow information for GSP development and water management. There is also funding for additional stream gages if locations of need can be determined. The current and proposed stream gages are in **Figure 9-2**.

9.2.2 Refined Water Budget

Many assumptions were taken to create the Big Valley water budget in Chapter 6 – Water Budget. Some of these assumptions stem from data gaps that need to be addressed and other areas are opportunities to collect and analyze data that is being submitted through other regulatory programs. This section describes a combination of projects that will help improve the accuracy of the water budget and in-turn better inform groundwater management in Big Valley.

There is currently no agri-climate or CIMIS station located in Big Valley. Nearby stations in other basins have helped to create models to determine averages but significant geologic features affecting elevation often make weather patterns unpredictable from nearby basins. These stations have more sensors than typical weather stations including solar radiation, soil temperature, air temperature, wind speed and direction, relative humidity, soil moisture and rain gauging. These measurements can determine accurate ET which is very helpful in creating a more refined water budget for the Basin and help maintain sustainable groundwater conditions. ET is used as a metric for applied water especially when meters on actual applied water are not available. These stations can also help farmers in determining irrigation need and promote water conversation especially early in the growing season.

With an accurate estimate of ET, the next assumption is the relationship between ET and applied water in Big Valley. Since most crops grown in Big Valley are hay crops, irrigation must be stopped when cutting, drying and baling even though ET continues. Pinpointing the relationship between ET and applied water could greatly refine the water budget and amount of irrigation water that is being applied.

An effort to refine mapping and land use designations would further increase the accuracy of estimates related to water use within Big Valley. The water budget's assumptions are primarily derived from existing sources, many of which may need to be updated or expanded upon to reflect current conditions. LandIQ has been a primary tool in estimating irrigated acres, although there is some inaccuracy related to the land classifications which field studies could address.

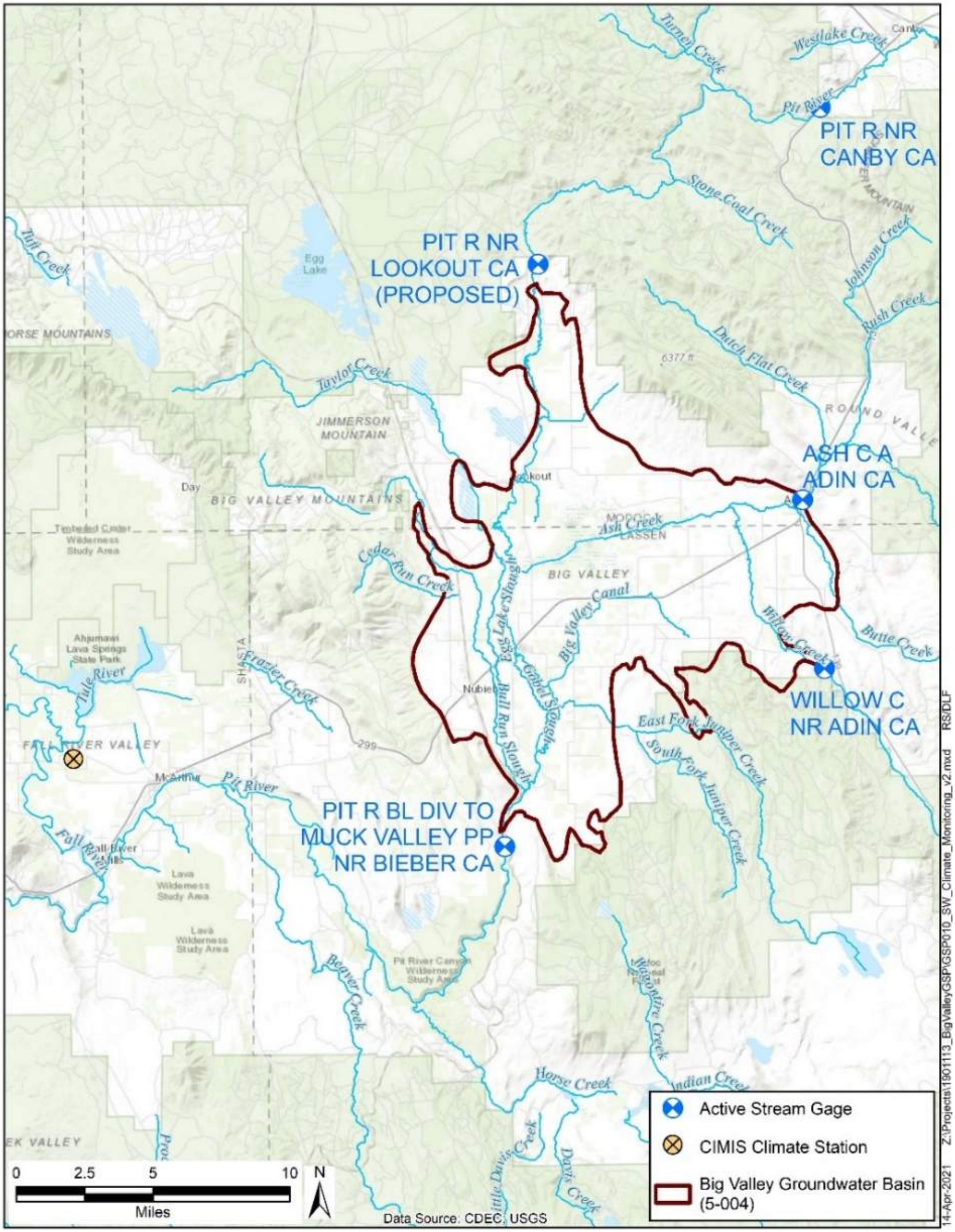


Figure 9-2 Current and Proposed Stream Gages

A voluntary well monitoring program has been available in Big Valley for upwards of 2 decades through the Lassen-Modoc Flood Control and Water Conservation District[71]. Reinvigorating this program by identifying meters that need to be replaced, conducting outreach to add new wells to the program and organizing the historical data fills a data gap and provides critical data to refine the water budget and pinpoint areas of concern. Meters are available for agricultural and domestic water users. Funding from DWR in a grant to Modoc County is currently available to provide well meters to voluntary applicants. Further, it would be beneficial to identify additional monitoring wells to provide unobstructed measurements year-round. Several such wells have been installed at five sites within the Basin and generate monthly data across 15-minute intervals. Expanding on this existing program would further refine the water budget.

Additionally, funding is available to install satellite transducers in key areas throughout the Basin, which would allow for real time monitoring of domestic well levels. Coupled with an increased effort to both verify well numbers and update lists to reflect active *versus* inactive wells, these real time monitoring locations will provide more accurate estimates of domestic groundwater demand and supply within the Basin. Thus, these combined actions will further inform water management strategies to ensure that domestic users' groundwater needs are represented equitably in the water budget.

Collectively, the continuation of applied research efforts will help to better quantify the impacts from those actions and thus help refine the water budget. Such research efforts, which will be discussed in depth in later sections of this chapter, include evaluating the effectiveness of off-season groundwater recharge in hay crop fields and pastures, the impacts of forest thinning projects such as fuels reductions and the removal of invasive junipers on water availability within the watershed, and the extent to which surface water systems, including drainages, canals and reservoirs contribute to recharge within the Basin. Additional research projects to support the water budget will be identified and undertaken as needed, contingent on funding.

9.2.3 Adaptive Management

There are many unknowns and data gaps with respect to groundwater resources in the Big Valley Basin. As a result, estimates and assumptions are currently used in the plan to determine several key variables. To address the lack of necessary information, a significant commitment to the continued monitoring of both ground and surface water is described in this plan. By further developing and enhancing monitoring networks in Big Valley we can gather the data necessary to inform management and set criteria as more information becomes available.

This describes an adaptive management strategy. Adaptive management is an approach to improve natural resource management which focuses on learning by doing. Learning occurs through monitoring, data development, outreach and collaborative interpretation. Then, the adaptation of management criteria and tools is applied to existing practices as critical information becomes available. This approach is very applicable to the BVGB and will serve as a bridge towards sustainability by providing current

[71] Lassen-Modoc County Flood Control and Water Conservation District

site-specific information to inform appropriate SMCs and thresholds as well as the ongoing assessment of projects and management actions in the Basin.

Although it is recognized and proven that the Big Valley Basin does not have the unsustainable conditions seen in other basins around the state, monitoring and filling data gaps from SMCs that were determined to not require thresholds helps us prepare for annual reports and 5-year revisions and make management decisions. These SMCs without identified thresholds include interconnected surface water and groundwater, water quality and subsidence. Additionally, monitoring could aid in the analysis of the relationship between groundwater levels and GDEs.

9.3 Increased Surface Water Storage Capacity

Increasing the capacity to store surface water run-off during winter/spring high-flows could provide significant amounts of water for summer irrigation. An increase in surface water available for irrigation would lessen the reliance on groundwater and thus remain sustainable.

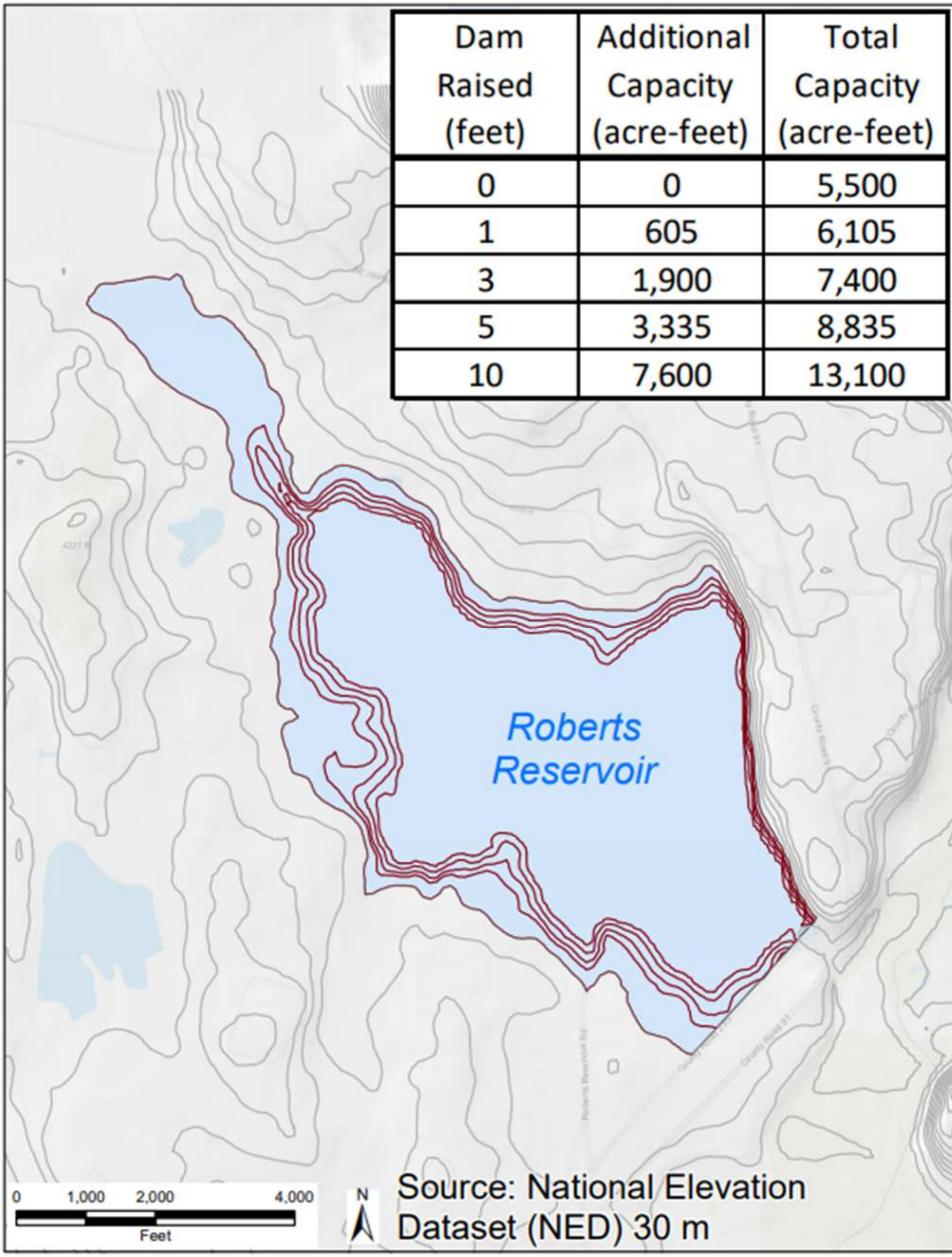
9.3.1 Expanding Existing Reservoirs

Expansion of several existing reservoirs serving Big Valley Basin would increase the capacity of surface water for irrigation and recharge projects as well as help balance the water budget. An increase in water storage would make the Basin more sustainable regarding climate variability and decreases in snowpack while also relieving pressure on groundwater for irrigation in Big Valley. One larger reservoir, Robert's Reservoir, is located northeast of Lookout and has a current capacity of 5,500 AF. Possible scenarios for raising this reservoir's dam are shown in **Figure 9-3**. For example, raising Robert's Reservoir 3 feet would increase capacity 1900 AF, an increase of 35 percent.

Other reservoirs include Iverson, Silva and BLM reservoirs. From an engineering perspective, the base of the Iverson reservoir is much wider than it needed to be at the time it was built. This suggests that the foundation would easily support construction to increase its height.

Expanding current reservoirs may possibly be the most time and cost-effective alternative for expanding surface water storage compared with building new reservoirs, for which navigating the environmental review process and other regulations can be difficult.

All reservoir expansion projects would undergo three phases. The Phase 1 examines the feasibility of the proposed project and planning. Engineering, permitting and project design take place during Phase 2. Phase 3 covers implementation and construction of the proposed project. Reservoir expansion is typically done through either sediment removal or by physically raising the height of the dam. Typically, expanding reservoirs through sediment removal is very costly, between "8,000 and 32,000 dollars per acre foot" (Lund 2014) and would be done very infrequently. Raising dam heights or building new reservoirs is also expensive; an acre foot of storage space generally costs between "1,700 and 2,700 dollars." (Lund 2014). Depending on funding, sediment removal may be investigated and removed sediment could potentially be repurposed to reinforce existing infrastructure such as the levees that protect Bieber and Lookout from Pit River flood events.



Dam Raised (feet)	Additional Capacity (acre-feet)	Total Capacity (acre-feet)
0	0	5,500
1	605	6,105
3	1,900	7,400
5	3,335	8,835
10	7,600	13,100

Figure 9-3 Robert's Reservoir Scenarios

9.3.2 Allen Camp Dam

The Allen Camp Dam and Reservoir (**Figure 9-4**) was authorized by the Department of the Interior (DOI) as part of the Allen Camp Unit of the Central Valley project in 1976 to regulate flows of the Pit River primarily for irrigation and fish and wildlife purposes, as well as flood control and recreation services. The DOI published a report (DOI 1981) that concluded that based on the existing criteria the proposed project was economically inadvisable, it may be appropriate to conduct a new investigation into the feasibility of this project to reflect the changes to water needs of the community, environment and state that have occurred over the last 40 years.

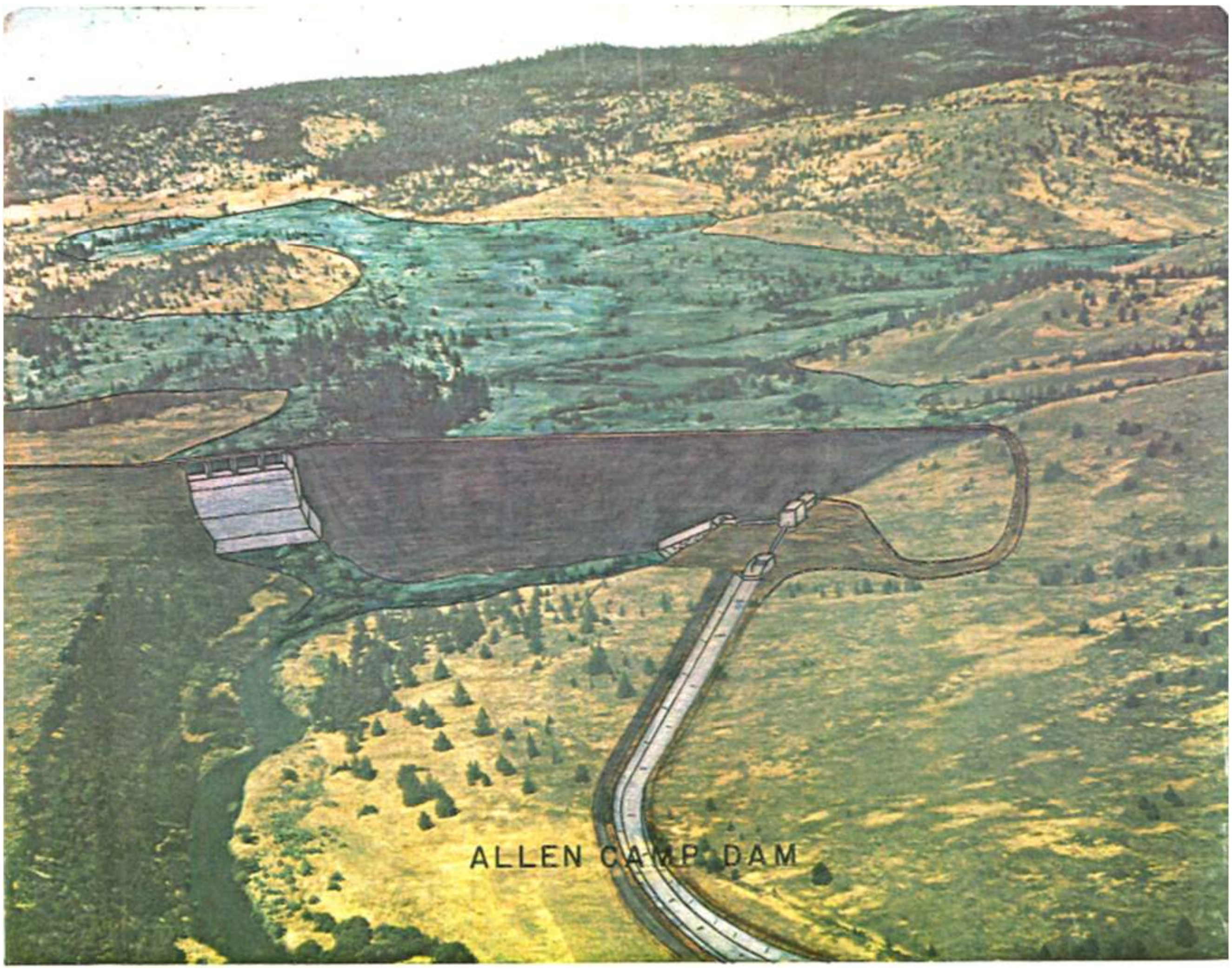


Figure 9-4 Allen Camp Dam Drawing

According to the original feasibility study (DOI 1981) the dam would be located around 11 miles north of the Modoc-Lassen county line, Allen Camp Reservoir would have a 90,000-AF storage capacity, a 18,000-AF surcharge, 2,350 acres of water surface area and a normal year yield of 22,400 AF. The dam would be constructed from earth and rock fill and would measure 103 feet from the streambed. The construction of the various proposed project components would require the acquisition of about 18,240 acres of private land through easements or through fee titles and the withdrawal of roughly 11,845 acres of public land. Most of the land acquired would be allocated for the dam and reservoir project features, a total of 18,015 acres. In the original document, another significant allocation, 11,562 acres, was for the proposed Big Valley National Wildlife Refuge. This addition was intended to offset habitat loss for species such as deer and migratory waterfowl. An updated feasibility study for this project should consider the expansion of the Ash Creek Wildlife Refuge since 1970 as an alternative for this proposed mitigation measure. The remaining land would be partitioned at 355 acres for the Hillside Canal, 148 acres for the lateral distribution system and 5 acres for the Nubieber protective dike.

In 1981, there were 62 ownerships slotted to receive deliveries from this project, accounting for a total 11,700 irrigable acres all of which would benefit from full or supplemental water deliveries. The report stated that the groundwater basin area of the project has a storage capacity of roughly 532,000 AF with a safe yield of 7,000 AFY, with 5,000 AF of that developed. These numbers may have changed over the 40 years that have elapsed since the report was published and should be reviewed under an updated feasibility study. An increasingly variable climate casts uncertainty over water availability, with drier years driving an increased reliance on groundwater supplies. Further, an updated feasibility study might consider how this project could mitigate some of the effects of climate variability and watershed conditions on the BVGB by providing a reliable source of surface water, thereby reducing dependence on groundwater.

9.4 Improved Hydrologic Function and Upland Recharge

9.4.1 Forest Health / Conifer and Juniper Thinning

The watershed surrounding the Big Valley Basin is comprised of approximately 800,000 acres of conifer forest and rangeland (**Figure 9-5**). Management policies have resulted in tree densities that are currently much higher than at the beginning of the 20th century. This includes western juniper and other mixed conifers (Stephens et. al. 2016) (Miller and Tausch 2001).

There are two main mechanisms by which dense junipers and other conifers impact water availability in forested watersheds. First is the interception of snow (primarily) and rain that gets caught in branches and needles and evaporates before ever reaching soil surface and second is the high rate of transpiration due to dense layered canopy and vigorous network of roots (Ryel and Leffler 2011). An excellent summary paper by Smerdon et al (2009) describes linkages between forest health and tree density and groundwater recharge in a variety of landscapes.

Spring snow water content ranged from 33 to 44 percent higher in the aspen and an open meadow snowpack telemetry (SNOTEL[72]) site *versus* adjacent juniper and conifer forest where interception of snowfall was much higher (LaMalfa and Ryel 2008). Averaged over the entire catchment, strategically placed fuel treatments in the wetter central Sierra Nevada (American River) creating a relatively light vegetation decrease (8%), resulted in a 12 percent runoff increase, averaged over wet and dry years. Wildfire, with and without forest treatments, reduced vegetation by 38 and 50 percent and increased

[72] SNOTEL is an automated system of snowpack and related climate sensors operated by the NRCS of the USDA in the Western U.S.

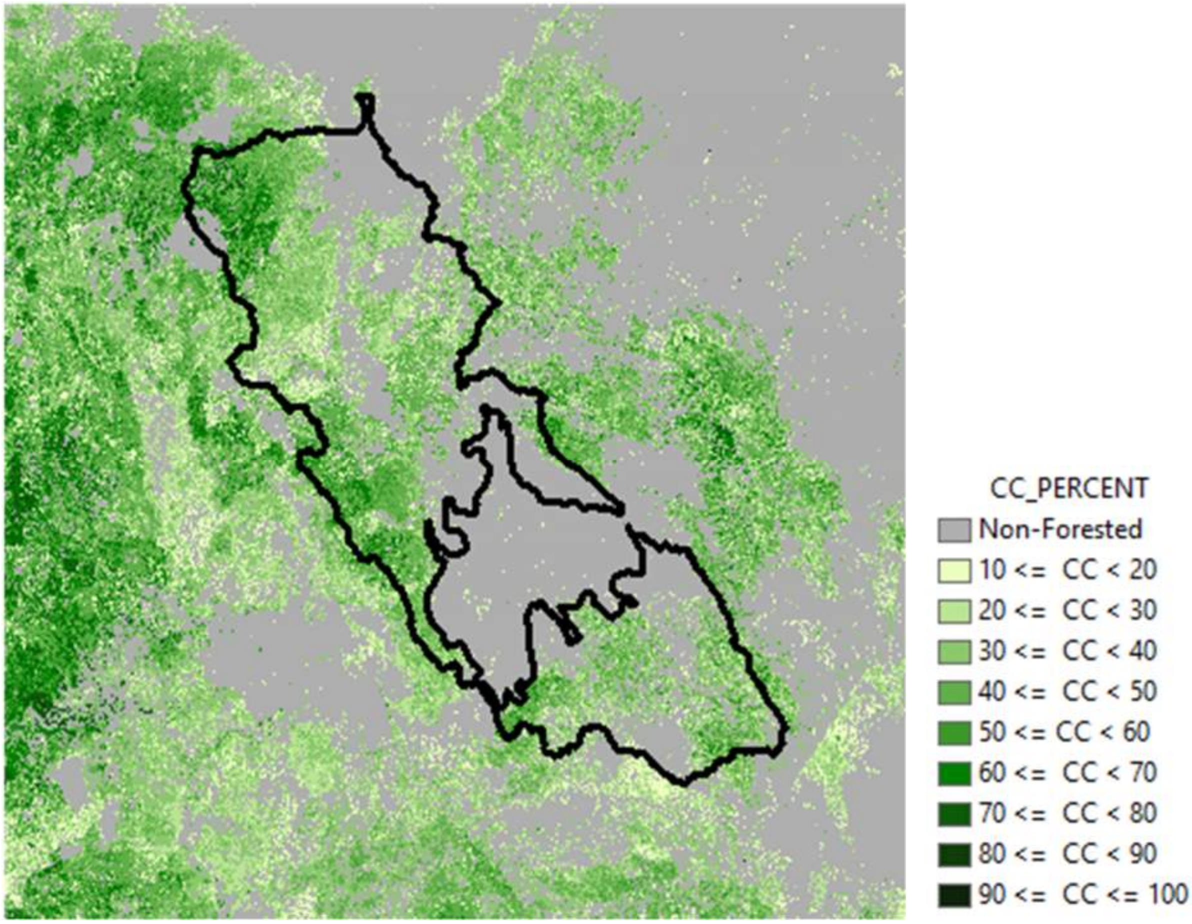


Figure 9-5 Canopy cover percentage of forested areas within the Big Valley watershed

runoff by 55 and 67 percent, respectively. Forest fuel reduction in drier sites in the southern Sierra had less increase in run-off than wetter sites in the central Sierra Nevada Range. (Saska 2019).

A similar increase in water availability has been documented on juniper-invaded rangelands. During the period of maximum water uptake, mature trees used between 45 and 69 times more water than juniper saplings depending on precipitation and, consequently, soil water availability. In summary, 1) juniper water use varies greatly with precipitation and 2) because of the large difference between mature and sapling trees, juniper control results in considerable water savings, even after a 14-year period of juniper regrowth. (Mata-Gonzales et. al. 2021). Paired watershed studies in Oregon have demonstrated increased deep soil moisture, increased spring flow and increased surface water run-off after juniper harvest compared to untreated areas. They have also documented a hydrologic connection between shallow groundwater on juniper sites and a nearby riparian valley. (Ochoa et. al. 2016).

The opportunity to enhance upland watershed recharge is significant as projects are already in planning and implementation stages to reduce fire risk and improved wildlife habitat (Miller 2001) and programs such as CAL FIRE’s Forest Health Program support project implementation funding. Forest health projects can be developed and meet multiple resource objectives including hydrologic values. Removal of conifers from meadow edges, drainages and spring areas as well as improving hydrologic function of road crossings, ditches and stream channels (where feasible) will enhance hydrologic and recharge benefits of forest health projects. Given the vast land area surrounding Big Valley, treatment of even a fraction of the land area would result in a significant amount of recharge. This could help mitigate any deficit. Recently, controlled burns and fuels reductions have gained considerable traction as forest management tools and could be utilized for the purposes discussed.

9.4.2 Stream Channel Enhancement and Meadow Restoration

Several meadow restoration techniques exist for the purpose of returning proper hydrologic function to montane and rangeland meadows. Two commonly used in the Big Valley Basin and surrounding uplands include pond and plug and beaver dam analogs. Both techniques result in reconnection of a stream channel with a functioning floodplain and restoration of a degraded meadow's water table up to its historic level. Restoration of the meadow water table results in re-watering of meadow soils and vegetation, with significant effects throughout the restored floodplain for meadow hydrology, wildlife and forage. Restored floodplain connectivity spreads flood flows so that a meadow's natural ability to settle the coarse or fine sediment delivered from steeper stream reaches is restored and natural percolation can occur. When floodplain function is restored, a portion of winter and spring runoff is stored in meadow soils rather than racing down the pre-project gully during the runoff season. Data indicates that release of this stored runoff results in increased stream flow in late spring. (Hunt et. al. 2018)

In mountains of the western U.S., channel incision has drawn down the water table in many meadow floodplains. Increasing climate variability is resulting in earlier melt and reduced snowpack and water resource managers are investing in meadow restoration which can increase springtime storage and summer flows. Between 2012 and 2015, during a record setting drought, a pond and plug restoration in Indian Valley in the Sierra Nevada Mountains was implemented and monitored. Despite sustained drought conditions after restoration, summer base-flow from the meadow increased 5 to12 times. Before restoration, the total summer outflow from the meadow was 5 percent more than the total summer inflow. After restoration, total summer outflow from the meadow was between 35 and 95 percent more than total summer inflow. In the worst year of the drought (2015), when inflow to the meadow ceased for at least one month, summer base-flow was at least five times greater than before restoration. Groundwater levels also rose at four out of five sites near the stream channel. Filling the incised channel and reconnecting the meadow floodplain increased water availability and streamflow, despite unprecedented drought conditions. (Hunt et. al. 2018).

Other studies have also shown that these techniques may increase surface and subsurface storage and groundwater elevations that contribute to channel complexity and residence times. These factors could lead to stronger flow permanence in channels subject to seasonal drying. Increased availability of water and productivity of riparian vegetation can also support human uses in arid regions, such as irrigation and livestock production. (Pilliod et. al. 2018).

9.5 Water Conservation

9.5.1 Irrigation Efficiency

The fundamental objective of an irrigation system is to deliver an optimum amount of water for crop growth during spring, summer and fall growing seasons while temperature and daylength are conducive to plant growth but natural precipitation is lacking. Irrigation water and water application costs comprise the single biggest operational cost associated with alfalfa or grass hay production in the intermountain area accounting for approximately 30 percent of total operating costs (Wilson et. al. 2020) (Orloff et. al. 2016). Increasing the efficiency of crop water use is an economic as well as a conservation minded goal. Farmers in the Big Valley area have been adopting water conservation measures as feasible opportunities arise and will continue to do so. Support for infrastructure, new technology and education outreach will help attain this goal.

Flood, wheel-line and center pivot irrigation systems are all used on Big Valley farms. The best irrigation system depends on water availability, crop, soil type and infrastructure. Commonly, center-pivots are rated as the most efficient systems but there are appropriate uses for all three types. Many advancements in irrigation efficiency have been made and will continue to be developed and implemented. It is critical that implementation is done at a farm-by-farm basis in such a way as to fit specific conditions and production systems. A one-size fits-all application will be neither effective nor economically viable, such as SGMA.

It is important that any irrigation system be well maintained to operate properly. Flood irrigated fields should be appropriately leveled with appropriate width and length of irrigation check to provide for a uniform application of water. Sprinkler systems should be regularly checked for function and be designed with the right nozzle size for available flow and pressure. Systems that can utilize larger diameter nozzles can reduce droplet size and evaporation loss. Length of irrigation set should make use of soil water holding capacity without incurring excessive tailwater. Specialized systems such as Low Energy Sprinkler Application can improve water use efficiency up to 15 percent. Length of irrigation set should make full use of soil water holding capacity without incurring excessive run-off.

To optimize efficiency of water use, the amount and timing of irrigation water applied should closely match the amount of water needed by the crop thus maintaining adequate soil moisture for crop growth while minimizing tail water run-off. Effective use of irrigation technology such as soil moisture sensors, tracking of evapotranspiration, flow meters etc. are available to help farmers manage irrigation timing and length of set to get the most of their irrigation system. While some of these have been applied in Big Valley some are relatively novel.

Genetic selection and the continued improvement of forage crop species has resulted in the increased availability of drought tolerant, heat tolerant, or short-season forage grasses that may provide growers and viable alternatives in certain situations where water availability is otherwise limited. Crop selection is often based on the best fit for particular soil depth, soil texture and water availability in conjunction with value and marketability. Although Big Valley cropping systems are heavily constrained by climate and growing season, on-going forage crop improvement may provide growers with a wider range of species and variety options.

Overall good agronomic practices in terms of soil fertility, weed control, harvest etc. is critical and promotes an efficient use of all resources including water. Finally, as mentioned in other places in this plan, agricultural fields and farms provide important wildlife habitat in the valley. Irrigated lands are an important part of the overall landscape. A good example is that flood irrigated pastures are highly valued by migratory birds particularly in the spring. Emphasis on water efficiency is important but should not become such a single-focused objective that other resource values or farm profitability are ignored.

It should be clear that efficient use of water for irrigated forage crop production is multi-faceted, and several small improvements, strategically together to fit on-farm conditions is the most effective approach. To this end, education outreach *via* U.C. Cooperative Extension, technical support from NRCS, and cost-share and grant programs are all critical to supporting water use efficiency measures. Support and incentive programs that have been used and can be further expanded upon in Big Valley are listed in **Table 9-1** (funding program table).

9.5.2 Landscaping and Domestic Water Conservation

While Big Valley is extremely rural and economically disadvantaged, there are opportunities to enhance water conservation among domestic water users. Particularly regarding domestic landscaping, use of native drought adapted plants, irrigation timers, effective mulch, and rainwater/snow water catchments can reduce water requirements. Low water landscaping can also be integrated with homeowner firesafe planning. Landscaping guides for homeowners can be distributed at public centers and at regional garden supply stores (Hartin et. al. 2014) (California Native Plant Society, 2021).

9.5.3 Illegal Diversions and Groundwater Uses

As detailed in Section 3.3 – Land and Water Use, water use for illegal activities (i.e., unlicensed marijuana growers) occurs in the Basin and surrounding watershed. Lassen and Modoc county staff have limited time and resources to address this issue, but they do utilize high-resolution aerial imagery from an imaging contractor as part of their effort to identify, map and report to the appropriate federal and state agencies responsible for taking enforcement action against the offenders. When county resources are available, staff will continue to work with their imaging contractors to identify and report illegal activities to the Bureau of Cannabis Control, CDFW, State Water Board and the BLM. The GSAs will rely on these agencies to take an aggressive approach in Big Valley with the objective of eradicating the Basin and watershed of illegal groundwater pumping and surface water diversions within the first 5 to 10 year of GSP implementation.

9.6 Public Education and Outreach

The GSAs believe that public education and outreach are an important component of this GSP. Education can change use patterns that promote water conservation and protection of water resources. The GSAs support continued education on preventing illegal dumping, illegal marijuana growers, properly sealing abandoned wells and BMPs. Continued outreach to support the coordination of efforts and information sharing, fostering relationships with relevant agencies and organizations and attending meetings with local and region groups involved in water management is also important. This includes increasing public outreach about funding opportunities and programs that support water conservation methods, increased recharge and mediation opportunities for decreasing water levels. **Table 9-1** lists current state and local funding sources that can be targeted to support project planning and implementation. More information on public outreach and communication can be found in Chapter 11 – Notice and Communications.

Outreach methods that can be expanded include radio public service announcements, cooperator workshops with University of California Cooperative Extension (UCCE) and social media posts informing the public about upcoming meetings and deadlines, BMPs, plan updates, recharge opportunities and updated water conditions. An organized effort to compile recharge and conservation activities would aid GSAs in tracking impacts for future Plan revisions.

10. Implementation Plan

GSP implementation generally consists of five categories of activities:

- GSA Administration and Public Outreach
- Monitoring and Data Management
- Annual Reporting
- Plan Evaluation (5-year updates)
- Projects and Management Actions

This chapter contains discussion of the details for each of these activities, then sets forth a schedule for implementation, estimates costs of implementation and discusses funding alternatives.

10.1 GSA Administration and Public Outreach

The nature of GSA administration is not addressed explicitly in the GSP Emergency Regulations. Much of the work to implement portions of the GSP (e.g., monitoring and projects and management actions) must be performed by outside entities such as DWR and hydrology professionals. However, this work will need to be coordinated by the GSAs and some work will need to be performed by GSA staff.

One category of work that rests on GSA shoulders is public outreach. The level of effort needed from GSA staff depends greatly on the details of public outreach discussed in Chapter 11 – Notice and Communications. In addition to the public outreach performed during GSP development, Regulations (§354.10(d)) require GSAs to develop a communication section of the plan that includes the following:

(1) An explanation of the Agency's decision-making process

(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used

(3) A description of how the Agency encourages the active involvement of diverse social, cultural and economic elements of the population within the basin

(4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions

Chapter 11 will contain the Communications and Engagement Plan, but the requirements of the Regulations are presented here for awareness by GSA staff to refine this chapter and understand the level of effort and expense that will be required for this component of GSP implementation. Decisions will need to be made regarding whether the BVAC continues as a functioning body after completion of the GSP and if the BVAC continues what role they take and how often they meet will determine the level of GSA staff effort to facilitate BVAC meetings and activities.

10.2 GSP Annual Reporting

According to §356.2 of the Regulations, the Big Valley GSAs are required to provide an annual report to DWR by April 1 of each year following the adoption of the GSP. The first annual report will be provided to DWR by April 1, 2022 and will include data for the prior WY, which will be WY 2021 (October 1, 2020 – September 30, 2021). While the WY as defined by DWR isn't ideal for use in Big Valley, the GSAs will assemble data based on DWR's definition as per SGMA statute and regulations. The Annual Report will establish the historic conditions of groundwater within the BVGB, the status of the GSP implementation and the trend towards maintaining sustainability. Unfortunately, while conditions won't differ significantly from when the GSP was developed, the GSAs are still required to submit the annual report to comply with GSP regulations. A general outline is included below:

- General Information
  - Executive Summary
  - Introduction (1 map of Basin)
- Basin Conditions
  - Groundwater Elevations (2 contour maps, 12 hydrographs)
  - Estimated Groundwater Extractions (1 table from water budget)
  - Estimated Surface Water Supply (1 table from water budget)
  - Estimated Total Water Use (1 table from water budget)
  - Estimated Change in Groundwater Storage (2 maps, 1 graph and 1 table)
- GSP Implementation Progress
  - Progress Toward Measurable Objectives
  - Updates on Projects and Management Actions

Another way to organize this requirement and for GSA staff and stakeholders to understand the level of effort and expense involved in developing annual reports is to outline major technical tasks. Much of the effort to develop the annual reports is to take available data collected by outside agencies, generate figures based on that data and then re-submit to DWR. Below is a summary outline of tasks to be performed by GSA staff and/or consultants to develop the annual report:

- Download Water Level Data from state website and generate:
  - Hydrographs for 12 representative wells
  - Assumed Spring and Fall groundwater contours
  - Assumed Groundwater difference contours (e.g., fall 2020 to fall 2021)
- Download water budget data from state websites[73]
  - Run water budget for the WY and generate estimates of:
    - Groundwater extractions
    - Surface water supply

[73] This includes precipitation and reference evapotranspiration (ETo) from CIMIS and streamflow data from CDEC, BVWUA, Brookfield Energy, and other sources.

        - Total water use
- Assemble and write annual report, of the estimates and assumptions.
- Upload report and data to state website, of the estimates and assumptions.

10.2.1 General Information

In accordance with §356.2(a), each Annual Report will include, at the front of the report, an executive summary that will summarize the activities and the condition of groundwater levels within the BVGB for the prior year. The executive summary shall also include a map of the BVGB, its GSAs and the monitoring network.

The annual report will include an introduction that will describe the following:

- A description of the BVGB and the two GSAs
- The general conditions of the BVGB for the prior WY (precipitation, surface water allocations, crop demands, municipal demands, etc.)
- Any significant activities or events that would impact the water supply and/or groundwater conditions for the BVGB

10.2.2 Basin Conditions

Included in the annual report will be a discussion of specific local water supply conditions per §356.2(b). This section will provide a description of the water supply conditions for the WY being reported along with a graphical representation of the conditions. A WY shall be defined as the 12-month period starting October 1 through September 30 of the following year. Water supply conditions that will be discussed include:

- Assumed Groundwater Elevations – elevation data from the monitoring network, including hydrographs for the representative wells and groundwater contours for spring and fall.
- Assumed Groundwater Extractions – groundwater pumping estimates and measurements for agricultural, municipal, domestic and industrial[74] pumping generated from the water budget.
- Assumed Surface Water Supply – data from surface water supplies to irrigation demand[75], conveyance losses and groundwater recharge, generated from the water budget.
- Assumed Total Water Use – total water uses by agricultural, municipal, domestic and industrial sectors, generated from the water budget.
- Assumed Change in Groundwater Storage – a determination of the groundwater (volumetric) change, calculated from groundwater difference contours and/or the water budget.

[74] This includes both in-basin industries as well as fire, wildlife, logging, and construction (which use both surface and groundwater).
[75] Summer flows in the BVGB are 100% allocated under existing water rights.

10.2.3 Plan Progress

The annual report also needs to describe the progress of the Plan since the previous report, including progress in maintaining measurable objectives and status of projects and management actions.

10.3 Data Management System

The Regulations require a data management system (DMS), but do not give strict guidance on format or how to develop and maintain the DMS. §352.6 of the Regulations states:

> Each Agency shall develop and maintain a data management system that is capable of storing and reporting information relevant to the development or implementation of the Plan and monitoring of the basin.

The DMS proposed for Big Valley is separated into two categories: data for annual reports and data for GSP updates much of which is taking data already managed by the state and returning it to the state in a new format.

10.3.1 Annual Report DMS

Annual reports require water level data and other data to update the water budget. **Table 10-1** lists the data needed and the sources of those data. The DMS can be stored using common software (Microsoft Excel and ArcGIS) on GSA servers. Water level data will be downloaded from the state website[76] and stored in an Excel hydrograph spreadsheet tool. This tool will store the well information, water level data, WY types and sustainable management criteria (minimum thresholds and measurable objectives). The tool will allow users to generate hydrographs and provide the data needed to generate contours. **Figure 10-1** shows a screenshot of the Excel Water Level Tool for storing water well and water level data and generating hydrographs.

Table 10-1 Annual Report DMS Data Types

Data Type	Collecting Entity	Data Source	DMS Tool
Water Levels	DWR	SGMA Data Viewer	Excel Water Level Tool
Precipitation	DWR	CIMIS	Excel Water Budget Tool
Evapotranspiration	DWR	CIMIS	Excel Water Budget Tool
Streamflow (gages)	USGS/DWR	CDEC	Excel Water Budget Tool
Streamflow (water rights reporting)	State Water Board	eWRIMS	Excel Water Budget Tool
GIS Base Data[1]	GSAs	various	GIS Database

Notes:
[1]Base data includes GIS layers such as the county boundaries, streams, roads, well locations, etc., which generally don't change over time and don't need to be updated.
CDEC = California Data Exchange Center

Water budget data will also be stored in an Excel spreadsheet tool as shown in **Figure 10-2**. Each of these spreadsheet tools has instructions, sheets to store raw data and sheets that perform calculations and generate the needed figures for annual reports or other purposes.

[76] Currently water level data for Big Valley is being managed and stored through DWR's CASGEM system. Once the GSP is completed, the data will be brought into DWR's new SGMA Portal Monitoring Network Module (MNM). Data from either of these systems is available through the SGMA Data Viewer.

Annual reports require maps, which are generated with widely used ArcGIS software. The geographic information system (GIS) data, including base data such as streams, roads and well locations will be organized into a folder structure as shown in **Figure 10-3**. Water level data will be imported into GIS to generate contours for annual reports.

10.3.2 GSP Update DMS

Additional types of data are needed to update the GSP, listed in **Table 10-2**. Much of this additional data is GIS-based and will be stored in the GIS database, shown in **Figure 10-3**. Water quality data will need to be downloaded from the State Water Board's GAMA groundwater system in 2026 to support the 5-year update.

Table 10-2 GSP Update DMS Data Types

Data Type	Collecting Entity	Data Source	DMS Tool
Water Levels	DWR	SGMA Data Viewer	Excel Water Level Tool
Precipitation	DWR	CIMIS	Excel Water Budget Tool
Evapotranspiration	DWR	CIMIS	Excel Water Budget Tool
Streamflow (gages)	USGS/DWR	CDEC	Excel Water Budget Tool
Streamflow (water rights reporting)	State Water Board	eWRIMS	Excel Water Budget Tool
Water Quality	State Water Board	GAMA	Data to be downloaded for 5-year update.
Land Use	DWR	SGMA Data Viewer	GIS Database
Subsidence (InSAR)	DWR	SGMA Data Viewer	GIS Database
GIS Base Data[1]	GSAs	various	GIS Database

Note:
[1] Base data includes GIS layers such as the county boundaries, streams, roads, well locations, etc. which generally don't change over time and won't need to be updated.

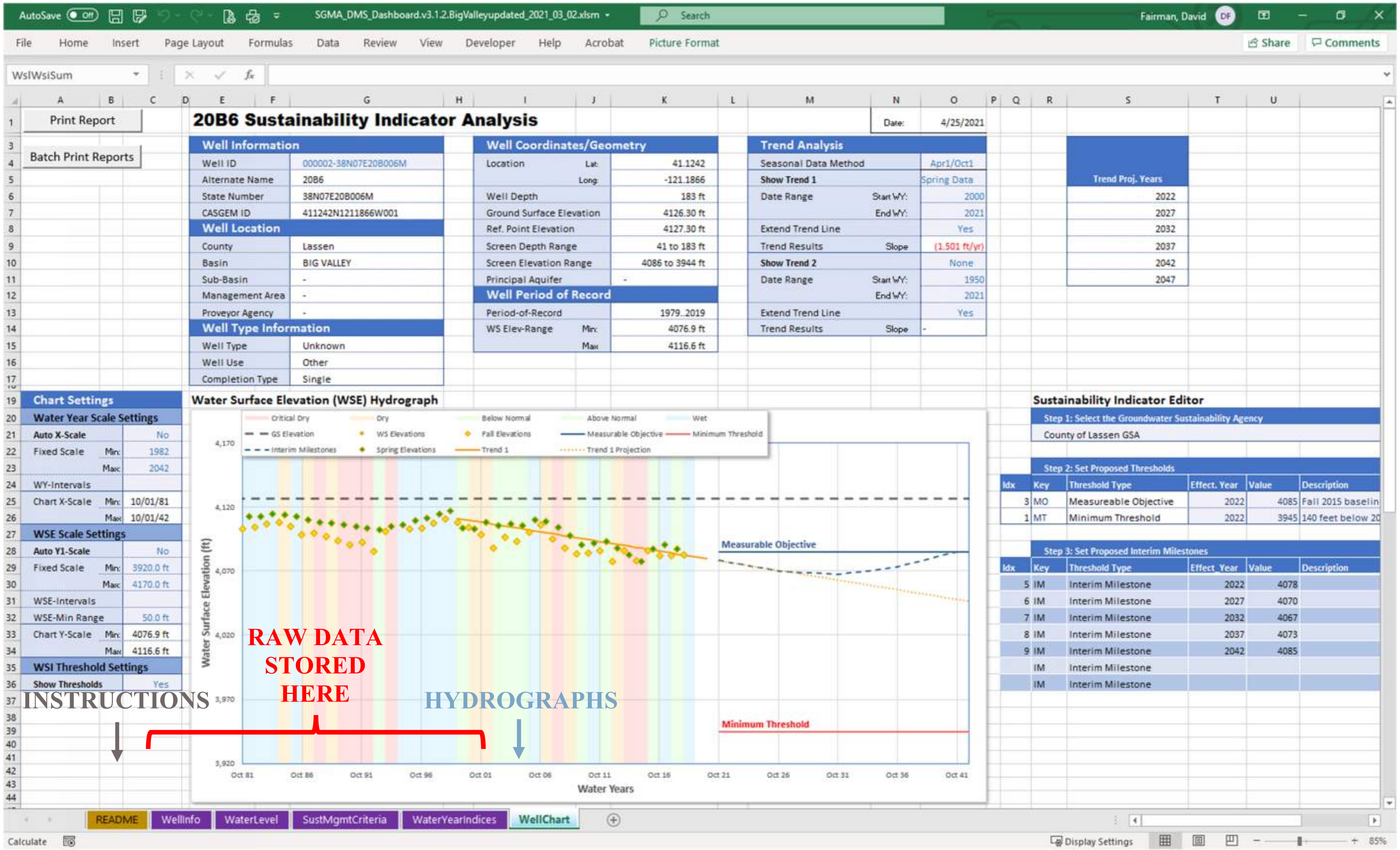
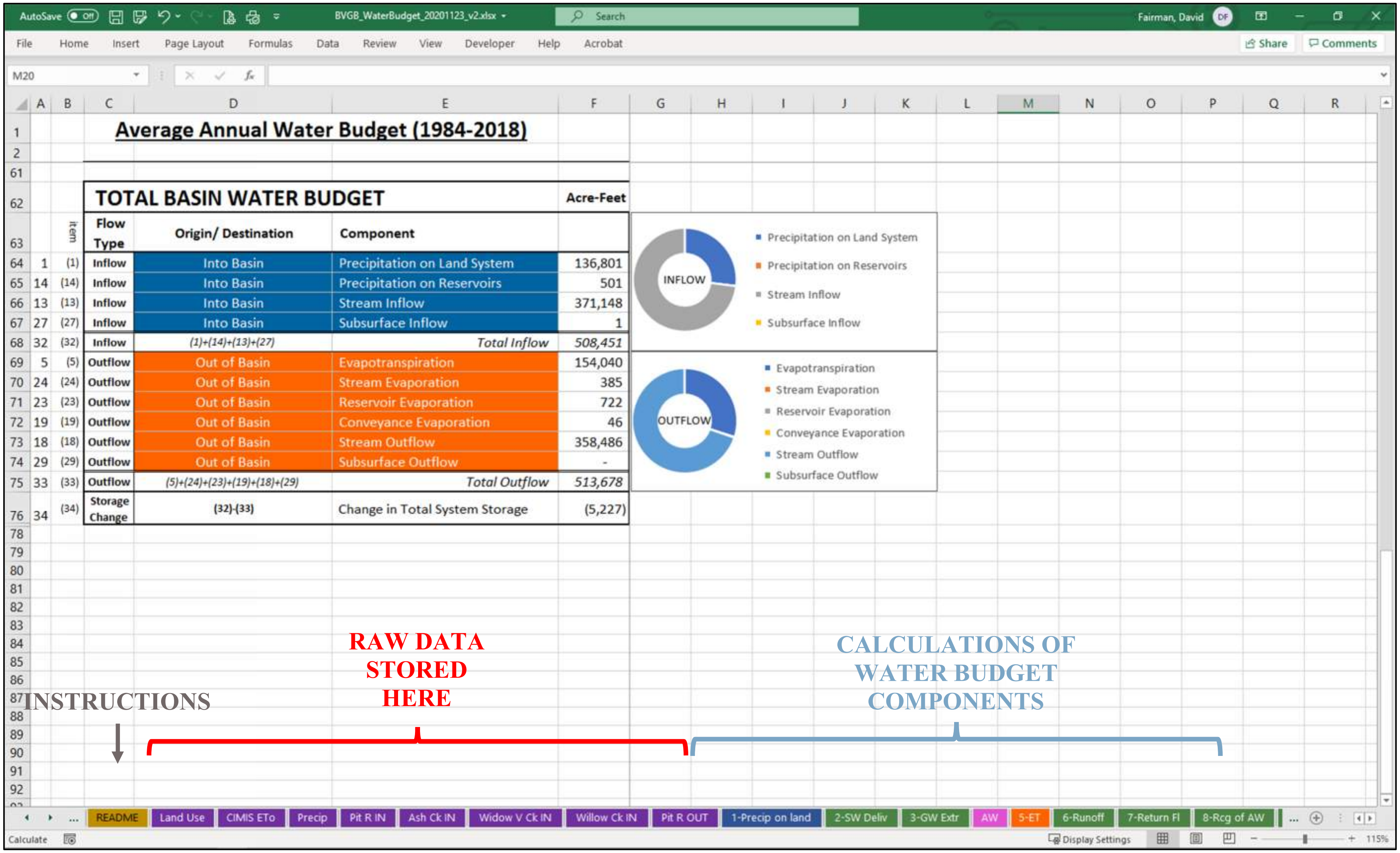


Figure 10-1 Excel Water Level Tool



Average Annual Water Budget (1984-2018)

	Item	Flow Type	Origin/ Destination	Component	Acre-Feet
1	(1)	Inflow	Into Basin	Precipitation on Land System	136,801
14	(14)	Inflow	Into Basin	Precipitation on Reservoirs	501
13	(13)	Inflow	Into Basin	Stream Inflow	371,148
27	(27)	Inflow	Into Basin	Subsurface Inflow	1
32	(32)	Inflow	(1)+(14)+(13)+(27)	Total Inflow	508,451
5	(5)	Outflow	Out of Basin	Evapotranspiration	154,040
24	(24)	Outflow	Out of Basin	Stream Evaporation	385
23	(23)	Outflow	Out of Basin	Reservoir Evaporation	722
19	(19)	Outflow	Out of Basin	Conveyance Evaporation	46
18	(18)	Outflow	Out of Basin	Stream Outflow	358,486
29	(29)	Outflow	Out of Basin	Subsurface Outflow	-
33	(33)	Outflow	(5)+(24)+(23)+(19)+(18)+(29)	Total Outflow	513,678
34	(34)	Storage Change	(32)-(33)	Change in Total System Storage	(5,227)

Figure 10-2 Excel Water Budget Tool

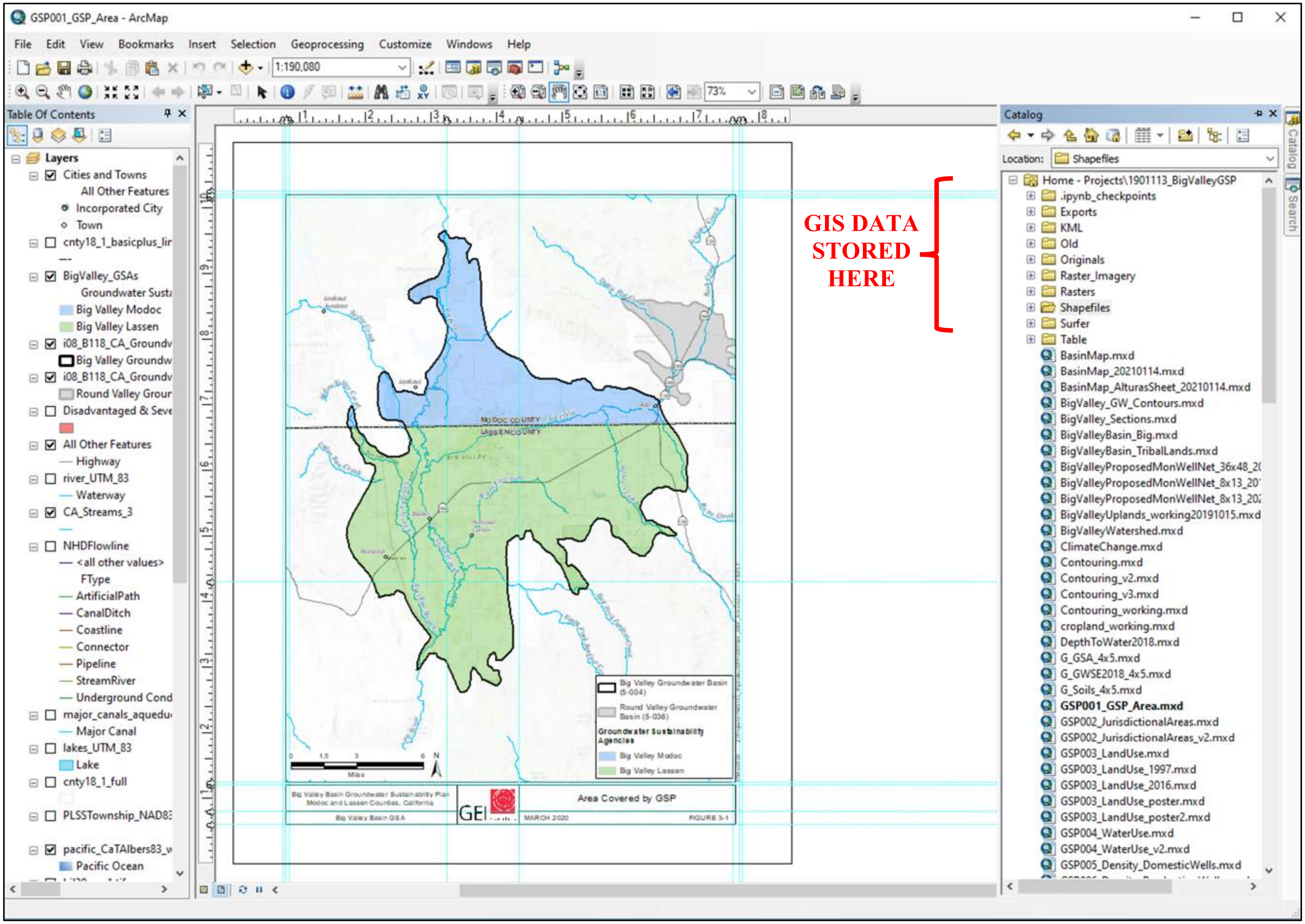


Figure 10-3 GIS Database

10.4 Periodic Evaluations of GSP (5-Year Updates)

Updates and amendments to the GSP can be performed at any time, but at a minimum the GSAs must submit an update and evaluation of the plan every 5 years. (§356.4) While much of the content of the GSP will likely remain unchanged for these 5-year updates, the Regulations require that most chapters of the plan be updated and supplemented with any new information obtained in the preceding 5 years. Chapters that are likely to require significant updates and re-evaluation include:

- Chapter 4 – Hydrogeologic Conceptual Model
- Chapter 5 – Groundwater Conditions
- Chapter 6 – Water Budget
- Chapter 7 – Sustainable Management Criteria
- Chapter 8 – Monitoring Network
- Chapter 9 – Projects and Management Actions

The Basin Setting (Chapters 4-6) is signed and stamped by a California Professional Geologist or Engineer.

10.5 Implementation Schedule

Figure 10-5 shows the implementation schedule. *See* Chapter 9 – Projects and Management Actions for the schedules for individual projects that are still under development.

10.6 Cost of Implementation

The legislation and regulations provide little guidance on how to develop and define costs. An analysis of GSPs from critically over drafted basins found a broad variety of approaches, categories of costs and level of detail, from a single cost with no detail or justification to detailed costs for multiple categories. The purpose of this section is to present some information of cost ranges given for other basins and to give estimates of costs for the categories of implementation presented in this chapter, listed below. These costs may change based on how the GSAs choose to implement the GSP (e.g., the amount and type of public outreach and the amount and type of support sought from outside hydrology professionals such as consultants and/or UCCE).

- GSA Administration and Public Outreach
- Monitoring and Data Management
- Annual Reporting
- Plan Evaluation (5-year updates)
- Projects and Management Actions

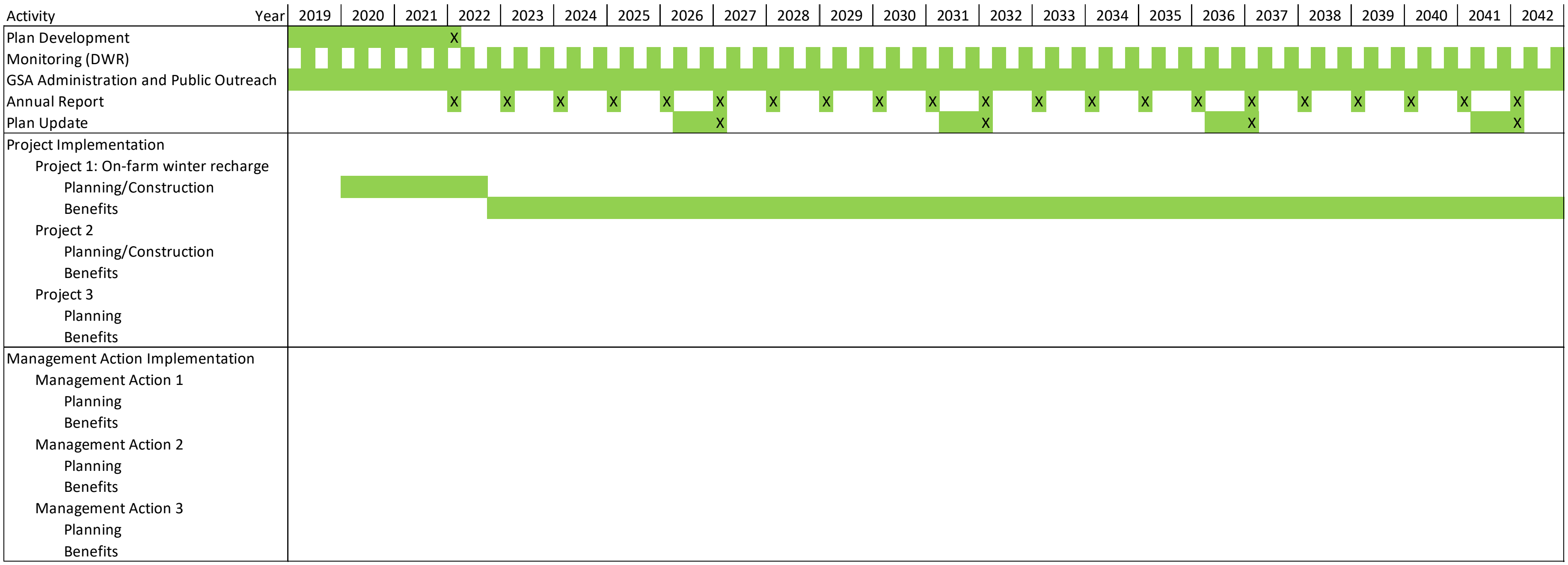


Figure 10-4 Implementation Schedule

Cost is a fundamental concern to the GSAs and stakeholders in the BVGB, as the Basin is a disadvantaged community and there is little to no revenue generated in the counties to fund the state unfunded mandates of SGMA. This is a big burden for a small, disadvantaged Basin that has no incorporated cities, low value crops and no revenue stream to pay the costs for the mandated GSP. Therefore, the approach in implementing the plan and estimating costs is to leverage as much outside funding and technical support as possible to cover costs. For costs that must be borne by the GSAs, efficient implementation methods while still meeting SGMA requirements to support the GSP is the desired outcome. **Table 10-3** shows a summary of the costs from GSPs submitted in 2020. As mentioned, not every GSP had every category of costs listed, but the number of GSPs that did detail costs for each category is shown. It should be noted that Big Valley is extremely unique in a variety of ways documented in this GSP.

Table 10-3 GSP Implementation Cost Statistics for 2020 GSPs in California

		Annual Cost Details					
	Total Annual	GSA Admin	Public Outreach	Annual Monitoring	DMS Update	Annual Report	5-Year Update
count	34	21	11	23	8	15	20
min	$ 50,000	$ 51,000	$ 5,000	$ 20,000	$ 10,000	$ 20,000	$ 50,000
max	$ 2,596,384	$ 1,538,794	$ 75,000	$ 1,057,590	$ 170,000	$ 350,000	$ 1,400,000
mean	$ 981,296	$ 607,861	$ 27,573	$ 293,907	$ 42,875	$ 56,267	$ 455,369
median	$ 720,100	$ 418,900	$ 20,000	$ 136,000	$ 20,000	$ 25,000	$ 330,000

Source: Fricke 2020

10.6.1 GSA Administration and Public Outreach

The fundamental activities that will need to be performed by the GSAs are public outreach and coordination of GSP activities. Public outreach may entail updates at County Board of Supervisors' meetings and/or public outreach meetings. At a minimum the GSAs will receive and respond to public input on the Plan and inform the public about progress implementing the GSP as required by §354.10(d)(4) of the Regulations. Coordination activities would include ensuring monitoring is performed, annual reports to DWR, 5-year GSP updates, and projects and management action coordination. Based on current grants which have funded filling of data gaps and identifying recharge opportunities, the GSA administrative costs of projects and management actions may be largely covered by grant funds.

In other GSPs already submitted, 21 itemized GSA administration and their estimates ranged in cost from $51,000 to over $1.5 million (M) per year, with a median of about $200,000. However, most of these basins are much larger than Big Valley, have more complex governance structures (i.e., have multiple GSPs in the Basin) and have more stakeholder groups. This cost for Big Valley could vary depending on the nature of public outreach written in the GSP.

10.6.2 Monitoring and Data Management

Twenty-three GSPs submitted to DWR to date have itemized annual monitoring with cost estimates ranging from $20,000 to over $1M per year with a median of about $65,000. Twelve GSPs itemized DMS updates with costs ranging from $3,000 to $170,000 with a median cost of $15,000.

DWR staff currently measures water levels in the Basin and posts them on their website and has indicated that they will continue to do so for the foreseeable future. DWR has also indicated that they could monitor water levels in the newly constructed monitoring wells. If DWR follows through on this assumption, there would be little to no costs to the GSAs for monitoring. The GSAs would need to download and populate the DMS tools detailed above. However, for costing purposes, we have assumed this to be covered under the Annual Report cost category.

If DWR chooses to discontinue its water level monitoring of wells in Big Valley, the cost could be on the order of $2,000 to $3,000, which equates to 40 to 60 staff-hours.

10.6.3 Annual Reporting

Annual report costs were estimated in 15 GSPs ranging from $20,000 to $350,000 with a median cost of $25,000. Annual reports have substantial requirements, including assembling the data, processing and generating the necessary charts, maps and tables and writing the text described in Section 10.2 – GSP Annual Reporting. There are ways to streamline and automate the process of retrieving, reformatting and returning the data to the state, many of which are described in Section 10.2.3 – Plan Progress. The level of effort and cost will be reduced over the course of the first few years, but an initial estimate of $25,000 for developing an annual report, then dropping to perhaps about $10,000, if the annual report is developed, written and submitted by GSA staff, this would equate to about 200 staff-hours.

10.6.4 Plan Evaluation (5-Year Updates)

The cost of updates to the GSP will be lower than the cost of initially developing the GSP. However, the Regulations require all parts of the GSP to be updated with recent data and information and will require substantial effort from a licensed professional. Of the 20 GSPs submitted that had GSP update cost estimates, they ranged from $50,000 to $1.4M with a median cost of $330,000. However, many of the GSPs already submitted are in basins with multiple GSPs. In those types of basins, the Basin Setting (Chapters 4-6) is typically performed on a Basin-wide basis. Big Valley will have to update the complete document. Therefore, a range of about $200,000 to $300,000 is estimated to update the GSP.

10.6.5 Projects and Management Actions

Costs of projects and management actions are addressed in Chapter 9 – Projects and Management Actions. If, and when, the GSAs seek outside funding, the costs will be put out to bid to ensure the reasonableness of the costs when implemented.

Table 10-4 summarizes the cost estimates of annual and 5-year updates discussed above. When the GSAs seek outside funding, the costs will be put out to bid to ensure the reasonableness of the costs.

Table 10-4 Summary of Big Valley Cost Estimates

		Annual Cost Details			
	Total Annual	GSA Admin and Public Outreach	Annual Monitoring and DMS Update	Annual Report	5-Year Update
Low	$ 30,000	$ 20,000	$ -	$ 10,000	$ 200,000
High	$ 68,000	$ 40,000	$ 3,000	$ 25,000	$ 300,000

10.7 Funding Alternatives

This section discusses funding alternatives. As discussed in various parts of this GSP, the GSAs and residents of Big Valley have no ability to take on the ongoing costs of implementing this GSP and contend that SGMA is an unfunded mandate. Therefore, the GSAs are forced to rely on outside sources to fund the Plan. **Table 10-5** describes the various funding options available to the GSAs. The table describes both outside funding (state and federal assistance and grants) and local funding (general fund, fees and taxes). Annual costs are less likely to be funded directly by outside sources because of the premise of SGMA that groundwater basins are best managed locally, and administration, monitoring and reporting costs are most likely to be seen as an obligation for the local GSAs under this premise. However, 5-year updates and projects and management actions are good candidates for outside funding. Some of this outside funding that currently exists could be through the DWR Prop 1 grants obtained by the North Cal-Neva and Modoc County could potentially be leveraged to support annual reporting in the next year or two. This depends on the degree that there is overlap between the scopes of work for the grants and the annual report requirements. These two existing grants are laying the groundwork for recharge projects and filling data gaps.

The entire BVGB is a disadvantaged community with much of the Basin designated as severely disadvantaged. The GSAs adamantly oppose new taxes or fees as additional taxes or fees would harm the community and alter the ability of residents to live and work in the Basin. The GSAs will identify and pursue grants to fund the implementation of this GSP. To that end the GSA will look toward funding options presented by the California Financing Coordinating Committee (CFCC) through their Funding Fairs[77].

[77] More information on CFCC including their 2021 Funding Fairs Handbook is available at https://www.cfcc.ca.gov/funding-fairs/.

Table 10-5 Summary of GSP Funding Mechanisms

Funding Mechanism		Description
Assistance Programs		DWR offers Technical Services Support and Facilitation Services Support Programs to assistance GSAs in development and implementation of their GSPs. If granted, services provided under these programs are offered at no-cost to the GSAs.
Grant Funding	State Grants	DWR's Sustainable Groundwater Management Grant Program, funded by Proposition 1 and Proposition 68, provides funding for sustainable groundwater planning and implementation projects. Both DWR and the State Water Board offer a number of grant and loan programs that support integrated water management, watershed protection, water quality improvement and access to safe drinking water. Other state agencies and entities with grant or loan programs related to water and environment include the CDFW and California Water Commission.
	Federal Grants	Federal grant and loan programs related to water planning and infrastructure include the Water Infrastructure Finance and Innovation Act, Water Infrastructure Improvement for the Nation Act and the DOI Reclamation's WaterSMART program.
General Funds		Cities and counties maintain a general fund which include funding from taxes, certain fees, state shared revenue, interest income and other revenues. While not a funding mechanism, the general funds from cities and counties may be used to fund or provide in-kind services for GSA activities and GSP implementation.
Fees	Fees	Fees include "various charges levied in exchanges for a specific service" (Hanak et al., 2014). This includes water and wastewater bills, or developer or connection fees, and permitting fees. Under rules established by Proposition 218 (1996), new property-related fee increases are subject to a public hearing and must be approved by either a simple majority of property owners subject to the fee or by two-thirds of all registered voters (Hanak et al., 2014; League of California Cities, 2019).
	Groundwater Extraction Fees	SGMA grants GSAs certain powers and authorities including the authority to impose fees. Section 10730 of the Water Code states that a GSA may "permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption and amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve."
	Assessments	Assessments are a specific type of fee that are levied on property to pay for a public improvement or service that benefits that property.
Taxes		Taxes imposed by local agencies include general taxes, special taxes, and property taxes. Taxes generally fall into one of two categories: general or special (Institute for Local Government, 2016). *General taxes* are defined as "any tax imposed for general governmental purposes." (Cal. Const. art. XIII C, § 1, subd. [a]) *Special taxes* are "any tax imposed for specific purposes, including a tax imposed for a specific purpose, which is placed into a general fund." (Cal. Const. art. XIII C, § 1, subd. [d]). Proposition 218 (1996) states that special districts, "could not levy general taxes, but only special taxes, and it clarified that local general taxes always required simple majority voter approval and that local special taxes always required two-thirds voter approval."

11. Notice and Communications §354.10

11.1 Background

SGMA compliance, outreach and communication efforts in the BVGB began before GSP development. When SGMA was signed into law, local agencies in the BVGB explored options for forming GSAs by the June 30, 2017 statutory deadline. On February 23, 2016, Lassen and Modoc counties held a public meeting of the Lassen and Modoc County Boards of Supervisors in Adin to explore whether the District[78] could become a GSA for the Basin and if that option was preferred over the two counties becoming the GSAs. These were the only two options available under existing public agency structures. The preferred options resulting from the meeting was that the two counties become the GSAs for their respective Basin jurisdictions and develop a single, coordinated GSP.

The county boards moved forward to become GSAs, held public hearings and passed resolutions in early 2017. They registered with DWR as the Big Valley Modoc GSA and Big Valley Lassen GSA, each covering the portion of the Basin in their respective county. After becoming established as the GSAs, the counties developed a workplan under guidance from consultants to determine the scope, schedule and cost for GSP development; an application for a state grant was submitted and grant awarded; and the GSAs submitted a notice of intent to develop one GSP to cover the entire BVGB. A timeline of these events is presented in **Table 11-1**.

Table 11-1 Pre-GSP Development Outreach Efforts

Date	Activity
November 2015	Public Outreach meeting in Adin
February 2016	Joint Lassen-Modoc Board of Supervisors meeting to explore GSA options to comply with SGMA
February 2016 to present	Modoc County Groundwater Advisory Committee Meetings (bimonthly)
January 2017	Public outreach meeting in Bieber to solicit comment on the counties becoming GSAs
February 2017	County of Modoc GSA Formation Public Hearing
March 2017	County of Lassen GSA Formation Public Hearing
July-September 2017	GSP Workplan developed to determine scope, schedule and cost of GSP development
November 2017	Lassen County submits application for state grant to fund GSP development
June 2018	Notice of Intent to develop one GSP for the entire BVGB submitted to DWR
November 2018	Lassen County entered into SGMA grant agreement with the state
February 2019	GSP development started

[78] Lassen-Modoc Flood Control and Water Conservation District

11.2 Challenges of Developing GSP During COVID Pandemic

A major challenge and constraint during the development of the GSP was the COVID 19 pandemic that started in early 2020. The pandemic made thorough and proper public outreach and participation impossible throughout 2020 and early 2021, the time during which key GSP content was developed and discussed by consultants, GSA staff and the BVAC. Due to state restrictions from the Governor's executive orders, GSA staff had to cancel BVAC meetings, restrict public attendance at meetings and facilitate participation through remote technology. Many interested parties did not feel safe attending meetings in person and remote attendance did not facilitate appropriate participation.

Internet connectivity and quality in this portion of the state is poor to nonexistent and the counties have very limited technological resources. These disadvantaged communities are on the losing end of the digital divide. While the GSAs made every attempt to conduct BVAC meetings with the ability for remote public participation, there were still major logistical and technical challenges both with conducting such meetings as well as members of the public participating. Those participants that had internet connectivity frequently could not hear or understand the dialogue in the Big Valley community venues and could not interact in the most effective way. However, the GSAs made the best of the circumstances and addressed all comments provided through the various means.

The GSAs recognized the obstacles presented by the COVID pandemic early in the efforts to develop a GSP and were proactive in reaching out to both the Governor and Legislature to identify potential solutions. The Governor severely restricted public meetings (and initially did not allow public meetings at all) because of the pandemic. Obviously, this made the GSAs' efforts to develop a GSP with constructive input from the public extremely difficult since, as outlined above, there is limited internet connectivity to conduct meetings remotely. Further, the limited GSA staff and technology was challenged to offer meetings remotely.

One obvious solution would be to recognize the emergency that is occurring across the state (and nation) and provide additional time to submit the required GSP. As such, on August 11, 2020, a letter was sent from the Lassen County Board of Supervisors (acting as the Lassen County GSA) to both the Legislature and the Governor requesting additional time. There was no response from either the Legislature or the Governor, so the Lassen County Board of Supervisors sent follow up letters to the Governor on November 17, 2020, February 16, 2021, March 23, 2021 and April 27, 2021. Neither the Legislature nor the Governor responded. However, a response was eventually received (dated June 3, 2021) from Karla A. Nemeth with DWR, denying said request, even though the Board of Supervisors sent the above letters to the Governor and not to DWR.

In February 2021, State Assembly Member Devon Mathis introduced Assembly Bill 754 which would have extended the GSP deadline. The Lassen and Modoc County Boards of Supervisors sent letters to State Assembly committee leaders in support of the bill. Supervisor Byrne testified before both the Senate and Assembly committees in support of the bill citing the constraints of inadequate broadband in the community for meaningful public participation. The bill was passed by the State Assembly but did not pass out of committee in the State Senate.

Letters from the GSA to the governor and assembly, along with the response letter from DWR are included in **Appendix 11A**.

11.3 Goals of Communication and Engagement

In developing the GSP, the GSAs implemented communication and engagement (C&E) with the goals of:

Educating the public about the importance of the GSP and their input. Public input is an important part of the GSP development process. The local community defines the values of the Basin and the priorities for groundwater management. This input guided decision-making and development of the GSP, particularly the development of the sustainability goal, sustainable management criteria and projects and management actions.

Engaging stakeholders through a variety of methods. One size does not fit all when it comes to stakeholder engagement in GSP development. This chapter outlines how the GSAs performed C&E at multiple venues through a variety of media to reach varied audiences.

Making public participation easy and accessible. The C&E described in this chapter describes the many methods employed to make it easy for the public to be informed and provide input.

Providing a roadmap for GSP development. The GSAs provided a schedule for stakeholders, keeping C&E efforts consistent and on track.

11.4 Stakeholder Identification

The Water Code §10723.2 requires consideration of all beneficial uses and users of groundwater. Primary beneficial uses of groundwater in the BVGB include agriculture, domestic use and habitat. In addition to farmers and individual well owners in the valley, this includes a small community system in Bieber, the Intermountain Conservation Camp and the CDFW which uses groundwater to supplement and maintain some habitat in the ACWA in the center of the Basin. Other significant uses include industrial uses such as logging, construction and fire suppression.

The Big Valley GSAs recognize that C&E with Big Valley water users and stakeholders is key to the success of GSP development and implementation. Particularly important is the engagement of local landowners given that the county seats are distant from Big Valley. Both counties have engaged stakeholders through various processes and efforts, including Modoc County's groundwater committee, the LCGMP development and Basin Management Objectives program implementation and the BVAC described in this chapter. In addition, the GSAs performed several public workshops to solicit more input from interested parties. A listing of the BVAC, public workshop and other public outreach meetings is included in **Appendix 11B**.

The following is an initial list of interested parties that were contacted during GSA formation and GSP development:

- Agricultural users
- Domestic well owners
- Public Water Systems
- CDFW
- Surface Water User Groups (including BVWUA)
- Lassen-Modoc County Flood Control and Water Conservation District
- Modoc County Groundwater Advisory Committee
- Federal Agencies (including the Forest Service and BLM)
- Tribes (including the Pit River Tribe)
- DWR
- North Cal-Neva

Prior to establishing themselves as the GSAs, the names and contact information for the above groups were compiled in spreadsheets. People on the interested parties' lists were under no obligations and received information about GSP development, including meeting announcements and opportunities to provide input and become more involved.

The GSAs developed a website (described below) to facilitate C&E, and anyone interested in GSP development or implementation in the BVGB was able add themselves to the interested parties list. In addition, sign-in sheets at all public meetings allowed attendees to add themselves to the interested parties list.

Outreach with the Pit River Tribe was performed, and tribal contacts were added to the interested parties list when it was first developed in February 2016. Therefore, tribal contacts have received all notifications of GSP development activity. Applications to become members of the BVAC were sent to the tribes. In addition, the Modoc County Groundwater Resources Advisory Committee, a committee of the Modoc County Board and a forum for obtaining updates about GSP development, has a tribal position. Numerous contacts between Modoc County staff and tribal contacts have occurred during GSP development. A list of outreach activities with tribal contacts is included in **Appendix 11C**.

11.5 Venues and Tools

11.5.1 Stakeholder Survey

The GSAs performed a C&E survey with the purpose of soliciting information about how stakeholders wish to be involved in the GSP and what concerns they have relevant to the GSP. Paper copies of the survey were available at public meetings and was also available online.[79]

[79] https://www.surveymonkey.com/r/TQ9HCQK

11.5.2 Website and Communication Portal

A website[80] was deployed for GSP development to facilitate communication and track the communication in a database. The website is not meant to replace, but to enhance, outreach efforts. Tools of the website allowed the GSAs to communicate with interested parties. These tools include the following:

- **Calendar.** The website includes a calendar with meeting dates, locations, times and documents such as meeting agendas, meeting minutes, presentations and BVAC packets.
- **Interested Parties List.** The website allows users to add themselves to the interested parties list and to select whether they wish to receive communication through email or physical mail.
- **Documents.** In addition to the meeting documents mentioned above, the website has a general documents page where the GSAs posted GSP chapters, scientific references and other supported documents related to GSP development.
- **E-Blast.** E-mails are sent to interested parties using the e-blast tool. E-blasts help to notify interested parties with email addresses to receive information about GSP development progress, upcoming meetings and new information or documents available.
- **Public Comment.** GSP chapters posted on the website are available for public comment during comment periods throughout GSP development. A web form is available for anyone to submit comments on documents open for comment. The form allows the user to comment by page and line number for GSA review and response.

The website address is included on printed materials and announced at public meetings.

11.5.3 Community Flyers

Physical copies of flyers announcing upcoming public meetings are posted in heavily trafficked locations such as community centers, public buildings, local markets and post offices.

11.5.4 Newspaper

All public meetings, including BVAC meetings are announced in the Lassen County Times, the Modoc Record and the Mountain Echo.

11.5.5 Social Media

Information about GSP development and meeting announcements have been and will continue to be made available through social media. UC Cooperative Extension in Modoc County hosts the Devil's Garden Research and Education Facebook page, as well as a website with the same name. Through their Facebook page[81], events are publicized and shared with other connected pages in the area to reach a wider stakeholder base. This platform also enables workshops and other events to be shared through live

[80] https://bigvalleygsp.org
[81] http://www.facebook.com/devilsgardenresearchandeducation

video and recordings. Recently, a blog detailing stakeholder engagement in Big Valley was published to the website.[82].

11.5.6 Brochure

In 2021, the GSAs transitioned from the background and scientific portions of the GSP (Chapters 1-6, including Basin Setting and Water Budget) to the policy and decision-making portions of the GSP (Chapters 7-9, Sustainable Management Criteria, Monitoring Networks and Projects and Management Actions). To facilitate engagement of people who may have been coming into the process at that time, a four-page informational brochure was developed, summarizing Chapters 1 through 6. This brochure was distributed on the website, through email and at public meetings. The brochure is included as **Appendix 11D**.

11.5.7 Big Valley Advisory Committee

The GSAs established the BVAC through an MOU to advise both Lassen and Modoc counties on GSP preparation. The goals of the BVAC, as stated in the MOU (**Appendix 1C**), include the following:

- Advise the two GSAs on the preparation of a GSP.
- Provide a forum for the public to comment during the preparation of the GSP.
- Provide recommendations to the two GSAs that would result in actions which have as minimal impact as possible on the residents of Big Valley.
- Advise the two GSAs on the preparation of a GSP to produce the lowest possible future costs to the residents of Big Valley.
- Ensure local control of the BVGB be maintained by the two GSAs.

Prepare a product that is acceptable to the GSA Boards for approval.Membership of the BVAC is composed of:

- One member of the Lassen County Board of Supervisors selected by said Board.
- One alternate member of the Lassen County Board of Supervisors selected by said Board.
- One member of the Modoc County Board of Supervisors selected by said Board.
- One alternate member of the Modoc County Board of Supervisors selected by said Board.
- Two public members selected by the Lassen County Board of Supervisors. Said members must either reside or own property within the Lassen County portion of the BVGB.
- Two public members selected by the Modoc County Board of Supervisors. Said members must either reside or own property within the Modoc County portion of the BVGB.

The BVAC operates in compliance with the Ralph M. Brown Act (Brown Act). BVAC meetings are noticed and agendas posted according to the Brown Act. BVAC meetings are open to the public and public comment is allowed, as much as possible given COVID pandemic restrictions.

[82] http://www.devilsgardenucce.org/

During the development of Chapters 7 through 9, the BVAC established Ad Hoc committees to investigate, discuss and recommend content for the sustainability goal, sustainable management criteria, monitoring network and projects and management actions.

11.6 Decision-Making Process

The MOA describes the decision-making process for the BVAC. However, while the BVAC made recommendations, it was not a formal decision-making body like the Lassen or Modoc GSAs. The Lassen County GSA, led by the Lassen County Board of Supervisors and the Modoc County GSA, led by the Modoc County Board of Supervisors, were ultimately responsible for adopting and submitting a GSP to DWR. The GSAs considered all input received from the BVAC and other interested parties.

To develop each chapter of the GSP, the GSAs followed an iterative process illustrated in **Figure 11-1**. The process involved multiple drafts of each chapter, including administrative, public and (often multiple) revised drafts. Once the BVAC was satisfied that the chapter was at a point where the GSAs were comfortable to move on, they voted to "set aside" the chapter until the entire draft GSP was assembled. This recommendation did not indicate approval but was implemented to keep the development process moving forward. The GSP was then assembled into a complete draft to undergo the same process of administrative, public and revised drafts. The BVAC will then vote whether to recommend to the GSA boards if they should approve the GSP. The GSA boards will vote whether to approve the GSP prior to submittal to DWR.

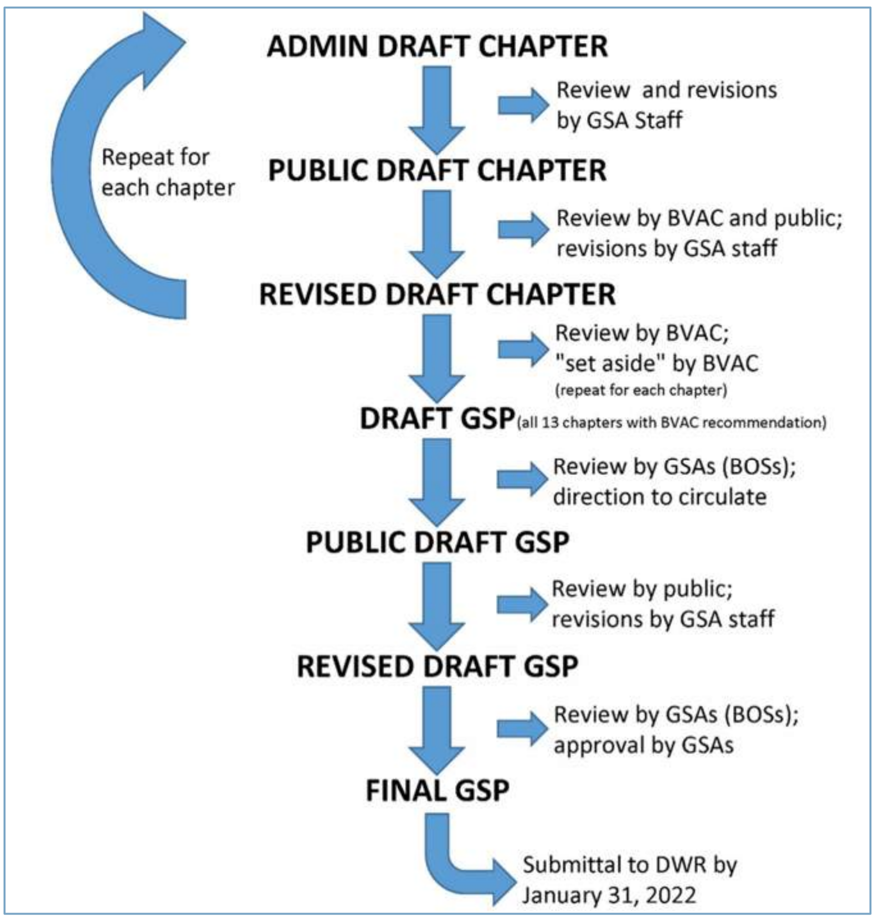


Figure 11-1 GSP Development Process

11.7 Comments and Incorporation of Feedback

All formal feedback on the GSP were documented both through the GSP website and from public meetings. The comments received, including how each comment was addressed is included in **Appendix 11E**.

11.8 Communication and Engagement During Plan Implementation

The BVAC was established by the GSAs for the specific purpose of advising during development of the GSP and providing a product that is acceptable to the GSA Boards for approval. The MOU establishing the BVAC therefore expires after the GSP is adopted by the GSAs and submitted to DWR. The C&E during Plan implementation will then shift to the GSA Boards who will continue to inform the public about Plan progress and status of projects and management actions as required by §354.10(d)(4) of the regulations.

This ongoing C&E will be performed through the forum of meetings of the County Boards of Supervisors where GSA staff will give regular reports to the boards and the public along with annual reports to be submitted to DWR as required by GSP Regulations. Communication to stakeholders on the interested parties list will continue to occur *via* email and physical mail. Development of annual reports and coordination and implementation of projects and management actions will require significant effort from GSA staff. The GSAs are considering the development of an MOU to clearly define roles, responsibilities and costs of each GSA.

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Appendix 1A Background Information

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY EDMUND G. BROWN JR., *Governor*

DEPARTMENT OF WATER RESOURCES
NORTHERN REGION OFFICE
2440 MAIN STREET
RED BLUFF, CA 96080-2356

April 15, 2016

Mr. Richard Egan, Administrative Officer
County of Lassen
Administrative Services
221 S. Roop Street, Suite 4
Susanville, California 96130

Dear Mr. Egan

This letter is in response to your request for information regarding the number of irrigated acres reported in the Big Valley Basin prioritization dataset.

As part of the California Statewide Groundwater Elevation Monitoring (CASGEM) Program legislation, and pursuant to the California Water Code, Section 10933, the Department of Water Resources (DWR) is required to prioritize California's 515 groundwater basins. CASGEM directs DWR to consider, to the extent available, all of the data components listed below:

1. The population overlying the basin
2. The rate of current and projected growth of the population overlying the basin
3. The number of public supply wells that draw from the basin
4. The total number of wells that draw from the basin
5. The irrigated acreage overlying the basin
6. The degree to which persons overlying the basin rely on groundwater as their primary source of water
7. Any documented impacts on the groundwater within the basin, including overdraft, subsidence, saline intrusion, and other water quality degradation
8. Any other information determined to be relevant by DWR (subsequently modified in 2014 to included adverse impacts on local habitat and local streamflow)

In response to the CASGEM legislation, each groundwater basin was prioritized with the best available data and statistically given one of the following rankings: very low, low, medium, or high. To calculate the total irrigated acreage for the initial prioritization, DWR relied on a land survey using detailed analysis units (DAU). Because the DAUs cover a different area than the groundwater basin, DWR estimated the proportion of overlap. For the Big Valley Basin, DWR estimated the irrigated acres for Big Valley groundwater basin based on the proportional amount of irrigated lands in the DAU and additional information gleaned from satellite imagery, ultimately arriving at a figure of 34,129 acres. Recognizing this method was an estimate, all of the groundwater basins were further analyzed by using their actual basin areas for the ranking. This step would have reduced the estimated value of irrigated acreage for the Big Valley basin to 25,545 acres but, for some reason, that did not occur and the value remained at 34,129 acres based on the estimated proportion from the DAU.

On the other hand, the portion of land in the basin identified as partially irrigated land or meadow pasture, which should have been included in the irrigated acreage calculation, was inadvertently omitted. Including this additional area of 26,260 acres brings the total irrigated acreage for the basin to over 51,800 acres.

DWR completed the initial draft basin prioritization in December of 2013. Public outreach for the draft basin prioritization consisted of three public workshops throughout the State and a statewide Webinar where DWR explained the basin prioritization process and requested feedback and comments. The public outreach for basin prioritization was followed by a three-month window where local agencies and water resource managers were encouraged to provide comments and information. During this time, DWR received and addressed a number of comments and data, and made adjustments to the basin prioritizations accordingly, but DWR did not receive any comments regarding the irrigated lands estimate for the Big Valley Basin. The basin prioritization was finalized in June 2014.

In September 2014, the Sustainable Groundwater Management Act (SGMA) was passed requiring all CASGEM medium and high priority basins to comply with the new SGMA law. SGMA also directed DWR to develop regulations to allow local agencies to revise their groundwater basin boundaries to help improve sustainable groundwater management, to update the basin prioritization once the basin boundaries have been modified, and to consider a new SGMA requirements for data component number eight on the previous page that includes adverse groundwater impacts on local habitat and local stream flows during the next basin prioritization update. (See the list of data components shown on the previous page.) The basin boundary regulation was adopted on October 21, 2015, and the solicitation for groundwater basin boundary changes ended in March 31, 2016. The 2016 basin boundary modifications will change basin areas and the number of basins, which could result in ranking changes for some basins. In addition, DWR is currently working with agencies and local water managers to identify the best available data, to gather and update many of the individual basin prioritization data components, and to improve the overall quality of the basin prioritization. Improvements to the basin prioritization data will include the following updated information:

1. Population and population growth will be recalculated for each of the modified basins, with new ranking breakpoints as necessary.
2. Public Supply Wells will be reprocessed for all basins with the assistance of California State Water Resources Control Board, Division of Drinking Water, employing additional selection criteria, with new ranking breakpoints as necessary.
3. The number of Total Wells will be reprocessed for all basins using DWR 's Online System for Well Completion Reports (OSWCR), employing production well selection criteria, with new ranking breakpoints as necessary;
4. Groundwater Reliance (Groundwater Use and percent of total supply) and Irrigated Acreage will be updated for all basins using the latest land use surveys (possibly 2015 statewide) and 2014 water year information.
5. Existing groundwater-related impacts will be reviewed and updated.
6. Potential adverse impacts to local habitat and streamflow due to groundwater extraction will be identified, and a process will be established for ranking these impacts.

DWR plans to begin public outreach for the updated draft basin prioritization in fall 2016, with the final basin prioritization update occurring between December 2016 and February 2017. Unfortunately, it is not possible to reprioritize individual basins outside of this process. Because the individual basin priority is dependent on the relative statewide distribution of each data component, there is no way to predict how the updated prioritization would affect the ranking of any particular basin. Even for those basins where it is known that individual data components have been changed due to improved data, the overall basin priority may remain the same, or even increase due to new SGMA requirements for data component number eight and improvements to the other seven data components. DWR is using new data to estimate irrigated acreage in the Big Valley Basin and, as noted above, the newer data, which was provided to Lassen County Administrative Office, supports a higher value (approximately 51,000 acres).

In closing, I encourage you to visit DWR's basin prioritization website at the following address: http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm. The website contains all of the groundwater basin ranking results, as well as the methodology used in the statistical analysis. If you have additional question concerning basin prioritization or if you might possibly have additional data associated with components one through eight (shown on the first page of this letter) that you would like DWR to consider during the next basin prioritization update, please contact Roy Hull, Engineering Geologist, at (530) 529-7337.

If you have any questions or need additional information, please contact me at (530) 528-7403.

Sincerely,

William Ehorn, Chief
Regional Planning Branch

cc: Scott Morgan, DWR Legal

County of Lassen
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Regina Schaap
Administrative Assistant
email: rschaap@co.lassen.ca.us

County Administration Office
221 S. Roop Street, Suite 4
Susanville, CA 96130
Phone: 530-251-8333
Fax: 530-251-2663

CERTIFIED MAIL/ RETURN RECEIPT
7015 0640 0005 0681 0168; 7015 0640 0005 0681 0175

March 18, 2016

Regional Planning Branch
Department of Water Resources
901 P Street, Room 213
Sacramento, CA 94236

Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Basin Boundary Modification - Big Valley, Bulletin 118 Basin 5-4

To Whom It May Concern:

This letter is intended to supplement a request by Lassen County to modify Bulletin 118 Basin 5-4 (Big Valley) as permitted under water code, section 340. The adjustment request is <u>External and Scientific</u> and primarily correlates to unmanaged (in terms of contemplating groundwater recharge) portions of the watershed directly impacting recharge in Big Valley.

<u>Summary</u>

The proposed boundary adjustment does not examine, or seek to alter, the extent of water-bearing formations identified in the Bulletin 118 Hydrogeologic analysis. Fundamentally (because Big Valley has been designated as medium priority by the Department of Water Resources), this request is an attempt by Lassen County to ensure management of Big Valley, as required by the Sustainable Groundwater Management Act (SGMA), is successful. Lassen County considers the proposed boundary adjustment to be a critical step toward effective and sustainable management because it empowers the Groundwater Sustainability Agency (GSA) with the ability to identify, consider, and mitigate potential impacts to basin recharge, originating in the basins watershed.

<u>Description</u>

Watershed and subwatershed hydrologic unit boundaries created by the Natural Resource Conservation Service (NRCS) form the proposed perimeter of the basin, after the adjustment. This data set was designed by the NRCS to be used as a tool for water-resource management and planning activities. The original dataset boundaries were adjusted by Lassen County at two points to exclude subwatershed boundaries providing recharge for two or more Bulletin 118 basins.

The NRCS data (table 1 below) assign 9 subwatershed basins to Big Valley totaling approximately 380 square miles. However, an adjustment of roughly 200 acres was applied to the Butte Creek subwatershed polygon, in order to include a portion of the Big Valley basin that had been assigned to the Bulletin 118 Basin 5-36 (Round Valley) watershed.

Table 1: Watershed data

OBJECTID	ACRES	HU_10_NAME	HU_12_NAME	HU_12_TYPE	STATES	SHAPE_Length	SHAPE_Area	
99800	31362	Blacks Canyon-Pit River	Roberts Reservoir-Pit River	S	CA	0.663846	0.013641	1
99589	11815	Juniper Creek	Deer Spring-Juniper Creek	S	CA	0.534262	0.005124	1
99607	9327	Butte Creek-Ash Creek	Hot Springs Slough	U	CA	0.284423	0.004047	1
99624	51531	Widow Valley Creek-Pit River	Bull Run Slough-Pit River	S	CA	0.878017	0.022349	1
99640	24868	Butte Creek-Ash Creek	Butte Creek	S	CA	0.594983	0.01079	1
99641	26769	Willow Creek	Lower Willow Creek	S	CA	0.682247	0.011607	1
99681	20256	Widow Valley Creek-Pit River	Widow Valley Creek	S	CA	0.493075	0.008799	1
99704	43355	Butte Creek-Ash Creek	Big Swamp-Ash Creek	S	CA	0.883789	0.018833	1
99746	24340	Taylor Reservoir	Taylor Creek	S	CA	0.723431	0.010581	1

The proposed boundary will include roughly 50,000 acres of federally managed timberland, 40,000 acres of privately managed timberland, and 60,000 acres of private and public range/grassland currently outside of the Big Valley (Bulletin 118) perimeter. Presently, management of these lands encompassing the Big Valley watershed does not actively consider implications to groundwater recharge. Lassen County contends that effective management of a groundwater basin must consider connectivity of groundwater/ surface water systems. The most basic form of combined groundwater surface water management seeks to ensure sustainable groundwater supplies, by managing and maintaining watersheds and thereby promoting desirable streamflow.

Watershed development to enhance groundwater would promote the use of natural resources, while mitigating the detrimental impacts of land-use activities on soil and water. This proposed adjustment and management approach recognizes that soil, water, and land use occurring in the upland watersheds, are all fundamentally connected to groundwater basins. Some components of watershed development and its role to groundwater are listed in Table 2 below.

Table 2 Common Components of watershed development and its role.

Activity	Objective	Impact
Check dams	Stop/slow down water runoff in gullies	Recharge of groundwater and nearby wells. Creations of open water bodies
Ponds	Groundwater recharge water for cattle	Recharge of groundwater. Creation of big open water bodies
Gully plugs, Gabions	Primarily to trap sediment/silt in gullies and to stabilize	Keeps sediment out of downstream areas. Increased water infiltration due to slowing down water

The intended impact of this proposal, to adjust the Big Valley basin boundary, is to ensure that watershed development is a function of the GSA through an adopted Groundwater Sustainability Plan (GSP). A coordinated management approach, which includes watershed development aimed at increasing groundwater recharge and overall water resource availability, will be necessary to ensure successful implementation of a GSP.

Lassen County has been in contact with Modoc County, the only other Local Agency with jurisdiction over Big Valley, and they are aware of this request. Please contact the Department of Planning and Building Services at (530) 251-8269, if there are any questions.

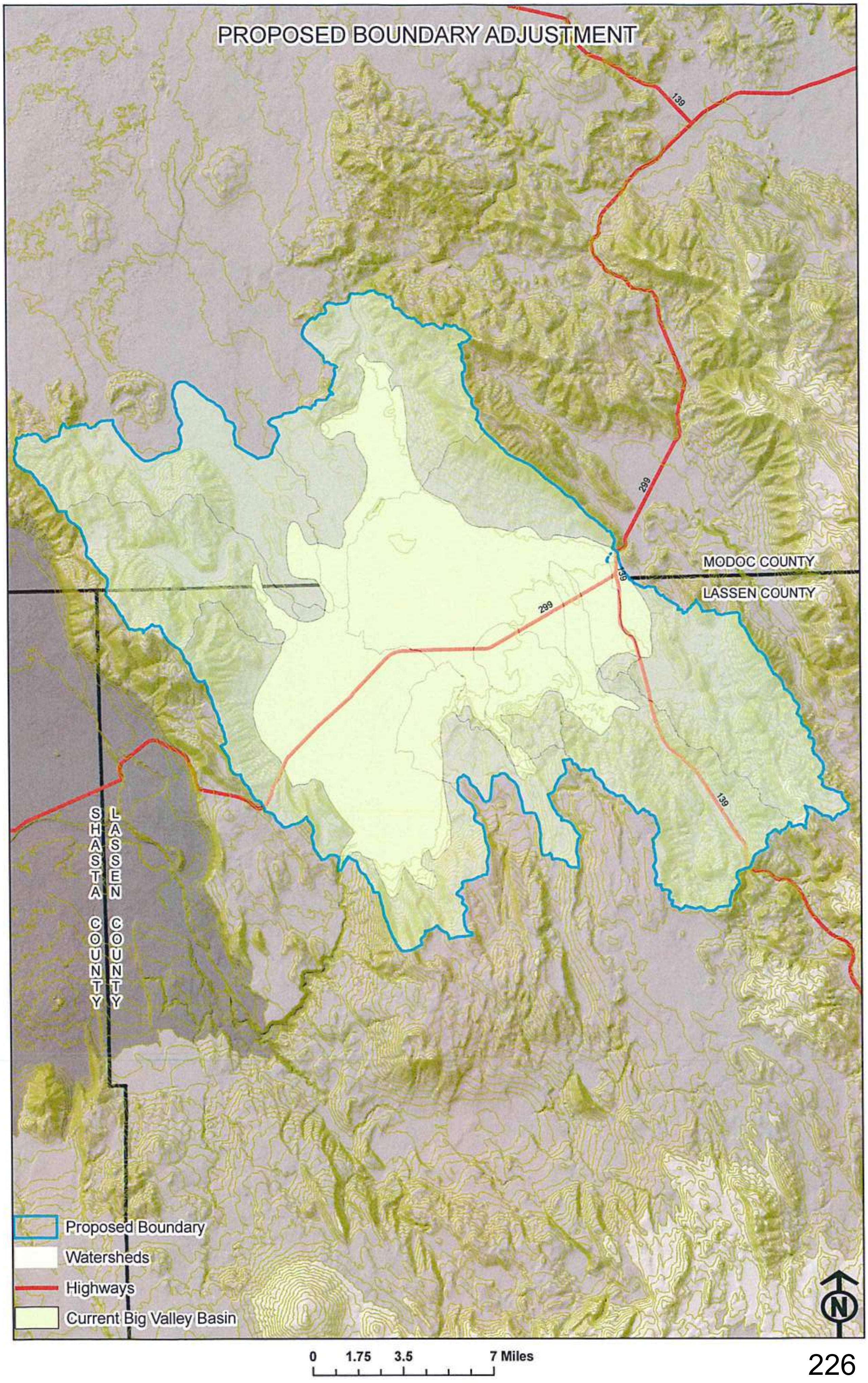
Sincerely,

FOR:
Richard Egan
County Administrative Officer

RE:MLA:mm

Cc: Supervisor Chapman, Chairman District 2; Supervisor Pyle, District 1; Supervisor Hemphill, District 3; Supervisor Albaugh, District 4; Supervisor Hammond, District 5; Bob Burns, County Counsel; Richard Egan, County Administrative Officer.

S:\PLA\Admin\FILES\1252\Response to denial of Big Valley boundary adjustment



PROPOSED BOUNDARY ADJUSTMENT
139
299
MODOC COUNTY
LASSEN COUNTY
139
299
139
SHASTA COUNTY
LASSEN COUNTY
Proposed Boundary
Watersheds
Highways
Current Big Valley Basin
N
0 1.75 3.5 7 Miles

Table 1. 2016 Final Basin Boundary Modifications

Basin/Subbasin	Request Agency	Lead Region Office	Short Description	Modification Type	Recommendation	Regulatory Basis for Denial Article 6	Summary Draft Decisions
1-02.01 KLAMATH RIVER VALLEY - TULELAKE	Tulelake Irrigation District	NRO	Tulelake Irrigation District (TID) is exploring a modification to the Tule Lake...	Scientific External	**Approved**		This request was approved because it met the technical requirements of the regulation and provided the necessary supporting documentation, technical studies, local outreach and/or notification.
5-04 BIG VALLEY	Lassen County	NRO	Watershed and subwatershed hydrologic unit boundaries form the proposed perimeter...	Scientific External	**Denied**	345.2(c) and (d)	This request did not include sufficient detail and/or required components necessary to support approval of the request. The proposed modification included volcanic rock geologic units (not alluvial basin material) and evidence was not provided to substantiate the connection to the porous permeable alluvial basin, nor were conditions presented that could potentially support radial groundwater flow as observed in alluvial basins.
5-21.52 SACRAMENTO VALLEY - COLUSA, 5-21.51 SACRAMENTO VALLEY - CORNING	Tehama County Flood Control & Water Conservation District	NRO	Jurisdictional Consolidation of the Tehama County portion of the Colusa Subbasin...	Jurisdiction Consolidation	**Approved**		This request was approved because it met the technical requirements of the regulation and provided the necessary supporting documentation, technical studies, local outreach and/or notification.
2-9.04 SANTA CLARA VALLEY - EAST BAY PLAIN, 2-9.01 SANTA CLARA VALLEY - NILES CONE	Alameda County Water District	NCRO	Request to correct the boundary of the Niles Cone Groundwater Basin (Niles Cone...	Jurisdiction Internal	**Approved, as modified**		This request was approved with minor modifications to the eastern boundary to align with the lateral extent of alluvium. The request for jurisdictional modification was supported by sufficient technical information and necessary affected local agencies provided letters in support of the modification.
3-03.01 GILROY-HOLLISTER VALLEY - LLAGAS AREA	Santa Clara Valley Water District	NCRO	Modify eastern Llagas Subbasin boundary to match extent of water-bearing sediment...	Scientific External	**Approved**		This request was approved because it met the technical requirements of the regulation and provided the necessary supporting documentation, technical studies, local outreach and/or notification.
5-21.60 SACRAMENTO VALLEY - NORTH YUBA	Yuba County Water Agency	NCRO	Subdivision of the North Yuba Subbasin along the Butte-Yuba county line	Jurisdiction Subdivision	**Approved, as modified**		The modification request was originally submitted as a jurisdictional subdivision, however, during the review of the request it was revealed that the Department introduced a significant error in the basin boundary sometime between 2003 and 2014, resulting in a portion of Butte County being applied to the North Yuba subbasin. The Department corrected the error during this modification submission period.
5-21.61 SACRAMENTO VALLEY - SOUTH YUBA, 5-21.64 SACRAMENTO VALLEY - NORTH AMERICAN	Placer County	NCRO	Request to adjust the subbasin boundary to align with the Yuba / Placer county ...	Jurisdiction Internal	**Approved**		This request was approved because it met the technical requirements of the regulation and provided the necessary supporting documentation, technical studies, local outreach and/or notification.
5-21.67 SACRAMENTO VALLEY - YOLO, 5-21.52 SACRAMENTO VALLEY - COLUSA, 5-21.68 SACRAMENTO VALLEY - CAPAY VALLEY, 5-21.66 SACRAMENTO VALLEY - SOLANO	Yolo County Flood Control And Water Conservation District	NCRO	County Basin Consolidation of four subbasins within Yolo County to existing County...	Jurisdiction Internal, Jurisdiction Consolidation	**Approved, as modified**		The request was approved as a county consolidation of basins within Yolo County with additional internal jurisdictional modifications. The internal jurisdictional modifications included exclusion of some local agency areas within Yolo County which remained in the Solano subbasin. There were also minor jurisdictional modifications applied to the eastern edge of the proposed subbasin and coincident boundaries of Sutter, North American and South American subbasins to align the boundary along county boundaries rather than along hydrologic features.
5-22.01 SAN JOAQUIN VALLEY - EASTERN SAN JOAQUIN, 5-22.16 SAN JOAQUIN VALLEY - COSUMNES	Eastern San Joaquin County Groundwater Basin Authority	NCRO	A boundary modification to merge a portion of the Cosumnes Subbasin into the Ea...	Jurisdiction Internal	**Approved**		This request was approved because it met the technical requirements of the regulation and provided the necessary supporting documentation, technical studies, local outreach and/or notification.

Richard Egan
County Administrative Officer
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Phone: 530-251-8333
Fax: 530-251-2663

August 14, 2018

Trevor Joseph
Department of Water Resources
Sustainable Groundwater Management Office
P.O. Box 942836
Sacramento CA 94236-0001

Dear Mr. Joseph:

This letter is in regard to the proposed ranking of the Big Valley Groundwater Basin as a medium priority basin pursuant to the Sustainable Groundwater Management Act (Part 2.74 of the California Water Code). The Lassen County Board of Supervisors has elected to be the Groundwater Sustainability Agency for the Lassen County portion of the basin and the Modoc County Board of Supervisors has elected to be the Groundwater Sustainability Agency for the Modoc County portion of the basin pursuant to said Act and has been designated as such. Lassen and Modoc County are working in a coordinated effort to comply with the Sustainable Groundwater Management Act by retaining local control for the benefit of our constituents.

This letter is to provide comments regarding the above ranking and present justification for consideration to reduce the 2018 Big Valley Groundwater Basin prioritization score.

The 2018 ranking considered the following additional criteria that were not previously considered for the 2014 prioritization (2018 SGMA Basin Prioritization Process and Results):

- The updated SGMA provision in component 8 that requires consideration of *"…adverse impacts on local habitat and local stream flows";*
- Other information from a sustainable groundwater management perspective in accordance with the provision *"Any other information determined to be relevant by the Department...";*
- Use of updated datasets and information in accordance with the provision *"…to the extent data are available"*.

Based on the SGMA updates to component 8, the 2018 SGMA Basin Prioritization considered the following four new sub-components:

- Adverse impacts on local habitat and local streamflows

- Adjudicated areas
- Critically overdrafted basins
- Groundwater related transfers

Lassen and Modoc County have carefully evaluated the information and data provided to establish the 2018 SGMA Basin Prioritization results. The datasets, methodologies, and documentation provided for this process are an improvement over the previous prioritization, and DWR made efforts to standardize the datasets and criteria used for nearly all the components including Component 7: Impacts. However, DWR did not make adequate consideration of the severity of the impacts for Component 7 and did not apply consistent methodologies and justification for Component 8. Particular inadequacies related to Big Valley's prioritization include:

Component 7 Impacts: Declining Groundwater Levels

Groundwater levels in Big Valley have remained stable in some areas and declined in others over the last 10 years. Declines have been as much as 30 feet, but have been rising since 2016. Prioritization points for declining groundwater level are appropriate in this basin, however the identical score was given to all basins in the state with documented water level declines. This includes critically overdrafted basins where water levels have declined hundreds of feet, chronically over the course of many decades. Evaluating Big Valley's water level declines on par with these basins does not adequately represent Big Valley's priority in the state and therefore we would like to request DWR reconsider the points associated with this portion of the scoring criteria.

Component 7 Impacts: Water Quality

This scoring appears to be based on 14 measurements that exceeded the Secondary MCL (maximum contaminant level) for iron and manganese at the two wells used to supply water to the town of Bieber. Although secondary MCLs are enforceable standards in California, they are *not* due to public health concerns but, due to nuisance and aesthetics such as taste, color, and odor. Iron and manganese are not typically concerns for agricultural use, which is the primary beneficial use in Big Valley. Iron and manganese are naturally occurring minerals that are prevalent in volcanic areas such as Big Valley. These water quality issues are therefore not due to mismanagement of the resource and conversely cannot be substantially addressed through better management. Again, DWR did not make adequate consideration of the severity of this issue, with Big Valley receiving the same number of points as areas of the state that have significant issues with salinity, nitrate, and toxic metals that have a much greater impact on beneficial uses and human health and have the potential to be better managed under SGMA.

Further we ask that DWR consider methodologies for Component 7 to account for the severity of each impact. If those methodologies cannot be developed, we ask that DWR use their discretion to adjust points in consideration of the low level of severity of these impacts for Big Valley.

Component 8b: Other Information Deemed Relevant by the Department

While DWR did apply their methodologies consistently for Components 1 through 7, they were not consistent with Component 8 and provided little justification in applying five (5) points to Big Valley Basin for:

1. "Headwaters for Pit River/Central Valley Project - Lake Shasta"
2. "Extensive restoration project at Ash Creek State Wildlife Area has improved groundwater levels in immediate vicinity of project but declining groundwater levels over past 10 years persist outside of project area which includes numerous wetlands and tributaries to the Pit River."

This limited information about the application of DWR's discretion on these points begs numerous questions such as:

1. What headwaters does this refer to? Headwaters of the Pit River? Headwaters of the CVP? Headwaters of Lake Shasta?
2. What are DWR's concerns relative to Big Valley's position within the watershed?
3. What concerns does DWR have specific to Big Valley, given that there are numerous other groundwater basins within the Pit River, Lake Shasta, CVP and State Water Project watersheds that were not awarded these points?
4. Why are water levels in the vicinity of Ash Creek and other wetlands considered "other information deemed relevant"? Wasn't this information already considered in Component 7: Declining Groundwater Levels and Component 8a: Streamflow and Habitat?

Due to the need for further clarification on the preceeding questions regarding component 8b, both Lassen and Modoc GSAs would like to request the points associated with this portion of the scoring criteria be reconsidered.

Lassen and Modoc County understand the vast complexity of evaluating each basins data and information, however, we feel a further assessment of the 2018 SGMA Basin Prioritization score is desired by both GSAs. For the above reasons, Lassen and Modoc County GSAs would like to request an assessment of the questions regarding the basins data, detailed in this letter, to be reviewed for a potential lowering of the overall basin score. We appreciate the consideration of our comments and look forward to hearing from you.

Sincerely,

Chris Gallagher, Chairman
Lassen County Board of Supervisors

Patricia Cullins, Chair
Modoc County Board of Supervisors

Appendix 2A Resolutions Establishing Lassen and Modoc Counties as the GSAs for the BVGB

RESOLUTION NO. 17-013

A RESOLUTION OF THE BOARD OF SUPERVISORS OF LASSEN COUNTY ELECTING TO BE THE GROUNDWATER SUSTAINABILITY AGENCY FOR ALL PORTIONS OF THE BIG VALLEY (BASIN NUMBER 5-004) GROUNDWATER BASIN LOCATED WITHIN LASSEN COUNTY, PURSUANT TO THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT OF 2014

WHEREAS, the Legislature has adopted, and the Governor has signed into law, Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act of 2014 (SGMA); and

WHEREAS, the Sustainable Groundwater Management Act of 2014 went into effect on January 1, 2015; and

WHEREAS, the legislative intent of SGMA is to, among other goals, provide for sustainable management of groundwater basins and sub-basins defined by the California Department of Water Resources (DWR), to enhance local management of groundwater, to establish minimum standards for sustainable groundwater management, and to provide specified local agencies with authority and technical and financial assistance necessary to sustainably manage groundwater; and

WHEREAS, the Sustainable Groundwater Management Act of 2014 enables the State Water Resources Control Board to intervene in groundwater basins unless a local public agency or combination of local public agencies form a groundwater sustainability agency (GSA) or agencies by June 30, 2017; and

WHEREAS, retaining local jurisdiction over water management and land use is essential to sustainably manage groundwater and to the vitality of Lassen County's economy, communities and environment, and

WHEREAS, any local public agency that has water supply, water management or land use responsibilities within a groundwater basin may elect to be the groundwater sustainability agency for that basin; and

WHEREAS, Lassen County is a local public agency organized as a general law County under the State Constitution; and

WHEREAS, in 1995 the California Supreme Court declined to review an appeal of a lower court decision, *Baldwin v. County of Tehama* (1994), that holds that State law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage groundwater under their police powers; and

WHEREAS, in 1999 the Lassen County Board of Supervisors adopted Ordinance Number 539 (codified at Chapter 17.01 of County Code), requiring a permit to export any groundwater from Lassen County; and

WHEREAS in 2007, the Lassen County Board of Supervisors adopted a *Groundwater*

Management Plan; as authorized by California Water Code Section 10753(a); and

WHEREAS, in 2012 the Lassen County Board of Supervisors adopted Ordinance Number 2012-001 (codified at Chapter 17.02 of County Code), which in part adopts a basin management objective program to facilitate the understanding and public dissemination of groundwater information in Lassen County; and

WHEREAS, in December of 2015, the Lassen County Board of Supervisors adopted the *Groundwater Monitoring Plan for Lassen County*, which was in turn approved by the California Department of Water Resources, making Lassen County the designated monitoring entity pursuant to the California Statewide Groundwater Elevation Monitoring (CASGEM) program; and

WHEREAS, the County overlies those portions of the Big Valley (Basin 5-004) Groundwater Basin located within Lassen County; and

WHEREAS, Section 10723.2 of the Sustainable Groundwater Management Act of 2014 requires that a GSA consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans; and

WHEREAS, Section 10723.8 of the Sustainable Groundwater Management Act of 2014 requires that a local agency electing to be a GSA notify the California Department of Water Resources of its election and its intent to undertake sustainable groundwater management within a basin; and

WHEREAS, On January 26, 2017, the Lassen County Planning and Building Services Department conducted a public meeting within the affected basin, in the community of Bieber, to solicit comment as to whether the Board of Supervisors should or should not be the sustainable groundwater agency for the Big Valley Basin. Notice of said public meeting was published in the Lassen County Times, Mountain Echo, and Modoc County Record; mailed to the list of interested parties; and posted at various places around the basin where announcements are posted; and

WHEREAS, The January 26, 2017, meeting resulted in the identification of additional "interested parties", that were added to the previously compiled list of interested parties.

WHEREAS, the County held a public hearing on this date after publication of notice pursuant to Government Code section 6066 to consider adoption of this Resolution. Notice, as provided for at Government Code Section 6066 was published in the Lassen County Times, Mountain Echo, and Modoc County Record; mailed to the list of interested parties; and posted at various places around the basin where announcements are posted; and

WHEREAS, it would be in the public interest of the people of Lassen County for the County to become the groundwater sustainability agency for all those portions of the Big Valley (Basin 5-004) Groundwater Basin located within Lassen County; and

WHEREAS, the County and other local public agencies have a long history of coordination and cooperation on water management; and

WHEREAS, it is the intent of the County to work cooperatively with other local agencies and Counties to manage the aforementioned groundwater basin in a sustainable fashion; and

WHEREAS, The Environmental Review Officer of Lassen County has determined that the action taken under this Resolution is exempt from the California Environmental Quality Act (Public Resources Code §21000, et seq.) ("CEQA") Under the Class 7 and Class 8, CEQA Guidelines Exemptions §§15307, 15308, and 15320 because the formation of a GSA, as provided for under state law, is meant to assure the maintenance, restoration, or enhancement of a natural resource and the regulatory process involves procedures for the protection of the environment.

NOW, THEREFORE BE IT RESOLVED AS FOLLOWS:

1. The foregoing recitals are true and correct.

2. The Board of Supervisors further finds that:

   a. The Board of Supervisors hereby concurs with the Lassen County Environmental Review Officer that adoption of this Resolution is exempt from the California Environmental Quality Act under CEQA Guidelines Exemptions §§15307, 15308, and 15320. The Environmental Review Officer is hereby directed to file a Notice of Exemption with the Lassen County Clerk for the actions taken in this Resolution.

   b. The proposed boundaries of the basin that the County intends to manage under the Sustainable Groundwater Management Act of 2014 shall be the entirety of the boundaries for the aforementioned groundwater basin, as set forth in California Department of Water Resources Bulletin 118 (updated in 2003), that lie within the County of Lassen; provided that the Board of Supervisors is authorized and directed to evaluate whether basin boundaries should be adjusted in a manner that will improve the likelihood of achieving sustainable groundwater management.

   c. Lassen County hereby elects to become the groundwater sustainability agency, as defined at Section 10721 of the California Water Code, for all those portions of the Big Valley (Basin 5-004) Groundwater Basin located within Lassen County.

   d. Within thirty days of the date of this Resolution, the Director of the Planning and Building Services Department is directed to provide notice of this election to the California Department of Water Resources in the manner required by law. Such notification shall include a map of the portion of the basin that the County intends to manage under the Sustainable Groundwater Management Act of 2014, a copy of this resolution, a list of interested parties developed pursuant to Section 10723.2 of the Act, and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's groundwater sustainability plan.

   e. The Director of the Planning and Building Services Department and legal counsel are hereby directed to promptly prepare a Memorandum of Understanding with Modoc County to collaboratively develop a groundwater sustainability plan for the Big Valley (Basin 5-004) Groundwater Basin for Board consideration.

f. The Director of the Planning and Building Services Department shall begin discussions with other local agencies in this basin in order to begin the process of developing a groundwater sustainability plan for the basin, in consultation and close coordination with other local agencies, as contemplated by the Act.

g. The Director of the Planning and Building Services Department be directed to report back to the Board at least quarterly on the progress toward developing the groundwater sustainability plan.

The foregoing resolution was adopted at a regular meeting of the Lassen County Board of Supervisors of the County of Lassen, State of California, held on the 14th day of March, 2017 by the following vote:

AYES: Supervisors Gallagher, Teeter, Hemphill, Albaugh and Hammond

NOES: NONE

ABSTAIN: NONE

ABSENT: NONE

[signature]
Chairman of the Board of Supervisors
County of Lassen, State of California

ATTEST:
JULIE BUSTAMANTE
Clerk of the Board

BY [signature]
~~SUSAN OSGOOD~~ Crystle Henderson, Deputy Clerk of the Board

I, ~~SUSAN OSGOOD~~ Crystle Henderson, Deputy Clerk of the Board of the Board of Supervisors, County of Lassen, do hereby certify that the foregoing resolution was adopted by the said Board of Supervisors at a regular meeting thereof held on the 14 th day of March, 2017

[signature]
Deputy Clerk of the County of Lassen Board of Supervisors

s/pla/admin/files/1252.02/3-14-17 resolution

RESOLUTION # 2017-09

A RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF MODOC ELECTING TO BE THE GROUNDWATER SUSTAINABILITY AGENCY FOR PORTIONS OF THE BIG VALLEY GROUNDWATER BASIN (BASIN NUMBER 5-004) WITHIN MODOC COUNTY

WHEREAS, the Legislature has adopted, and the Governor has signed into law, Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act of 2014; and

WHEREAS, the Sustainable Groundwater Management Act of 2014 went into effect on January 1, 2015; and

WHEREAS, the Sustainable Groundwater Management Act of 2014 enables the State Water Resources Control Board to intervene in groundwater basins unless a local public agency or combination of local public agencies form a Groundwater Sustainability Agency or Agencies (GSA) by June 30, 2017; and

WHEREAS, retaining local jurisdiction over water management and land use is essential to sustainably manage groundwater and to the vitality of Modoc County's economy, communities, and environment, and

WHEREAS, any local public agency that has water supply, water management, or land use responsibilities within a groundwater basin may elect to be the Groundwater Sustainability Agency for that basin; and

WHEREAS, Modoc County is a public agency as defined by 10721 of the Water Code; and

WHEREAS, under Section 10723(a), the County is responsible for portions of the Big Valley Groundwater Basin as shown on the map hereto in "Exhibit A"; and

WHEREAS, the County overlies those portions of the Big Valley 5-004 located within Modoc County; and

WHEREAS, Section 10723.2 of the Sustainable Groundwater Management Act of 2014 requires that a GSA consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans; and

WHEREAS, Section 10723.8 of the Sustainable Groundwater Management Act of 2014 requires that a local agency electing to be a GSA notify the Department of Water Resources of its election and its intent to undertake sustainable groundwater management within a basin; and

WHEREAS, the County held a public hearing on this date after publication of notice in the Modoc Record pursuant to Government Code section 6066 to consider adoption of this Resolution; and

WHEREAS, it would be in the public interest of the people of Modoc County for the County to become the groundwater sustainability agency for all those portions of the Big Valley 5-004 Groundwater Basin located within Modoc County; and

WHEREAS, the County and other local public agencies have a long history of coordination and cooperation on water management; and

WHEREAS, it is the intent of the County to work cooperatively with other local agencies and Counties to manage the aforementioned groundwater basins in a sustainable fashion;

NOW, THEREFORE, BE IT RESOLVED, that Modoc County hereby elects to become the Groundwater Sustainability Agency for all those portions of the Big Valley 5-004 Groundwater Basin located within Modoc County.

BE IT FURTHER RESOLVED that the proposed boundaries of the basin that the County intends to manage under the Sustainable Groundwater Management Act of 2014 shall be the entirety of the boundaries for the aforementioned basin, as set forth in California Department of Water Resources Bulletin 118 (updated in 2003), that lie within the County of Modoc; provided that the Board of Supervisors is authorized and directed to evaluate whether basin boundaries should be adjusted in a manner that will improve the likelihood of achieving sustainable groundwater management.

BE IT FURTHER RESOLVED that within thirty days of the date of this Resolution, the designated Staff Liaison to the Groundwater Resources Advisory Committee ("GRAC") is directed to provide notice of this election to the California Department of Water Resources in the manner required by law. Such notification shall include a map of the portion of the basin that the County intends to manage under the Sustainable Groundwater Management Act of 2014, a copy of this resolution, a list of interested parties developed pursuant to Section 10723.2 of the Act, and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's groundwater sustainability plan.

BE IT FURTHER RESOLVED that the designated Staff Liaison to the GRAC and County Counsel are hereby directed to promptly prepare a Memorandum of Understanding with Lassen County to collaboratively develop a Groundwater Sustainability Plan for the Big Valley 5-04 Groundwater Basin for Board consideration.

BE IT FURTHER RESOLVED that the designated Staff Liaison to the GRAC shall begin discussions with other local agencies in this basin in order to begin the process of developing groundwater sustainability plans for the basin, in consultation and close coordination with other local agencies, as contemplated by the Act.

BE IT FURTHER RESOLVED that that the designated Staff Liaison to the GRAC or the Chairman of the GRAC be directed to report back to the Board at least quarterly on the progress toward developing the groundwater sustainability plans.

PASSED AND ADOPTED by the Board of Supervisors of the County of Modoc, State of California, on the 28th day of February, 2017 by the following vote:

Motion Approved:

RESULT:	**APPROVED [UNANIMOUS]**
MOVER:	David Allan, Supervisor District I
SECONDER:	Patricia Cullins, Supervisor District II
AYES:	David Allan, Supervisor District I, Patricia Cullins, Supervisor District II, Kathie Rhoads, Supervisor District III, Geri Byrne, Supervisor District V
ABSENT:	Elizabeth Cavasso, Supervisor District IV

BOARD OF SUPERVISORS
OF THE COUNTY OF MODOC

Geri Byrne, Chair
Modoc County Board of Supervisors

ATTEST:

Tiffany Martinez
Deputy Clerk of the Board

Appendix 2B MOU Establishing the Big Valley Groundwater Advisory Committee

CONTRACT
#19-69

MEMORANDUM OF UNDERSTANDING FORMING THE BIG VALLEY GROUNDWATER BASIN ADVISORY COMMITTEE (BVAC) TO ADVISE THE LASSEN AND MODOC GROUNDWATER SUSTAINABILITY AGENCIES DURING THE DEVELOPMENT OF THE GROUNDWATER SUSTAINABILITY PLAN REQUIRED UNDER THE 2014 SUSTAINABLE GROUNDWATER MANAGEMENT ACT FOR THE BIG VALLEY GROUNDWATER BASIN

1. Background

The Sustainable Groundwater Management Act (SGMA) is codified as Part 2.74 of the California Water Code (Section 10720 et seq). The regulations adopted to enforce the provisions of the Act are found in Section 350 et seq, Division 2, Chapter 1.5, Subchapter 2 of Title 23 of the California Code of Regulations. The Sustainable Groundwater Management Act (SGMA) became effective January 1, 2015.

This memorandum of understanding pertains to the Big Valley Groundwater Basin (BVGB), which has been designated as a "medium priority" basin by the California Department of Water Resources (DWR). This designation as a medium priority basin requires preparation of a Groundwater Sustainability Plan (GSP) under the Act.

The SGMA was created to ensure groundwater basins throughout the state are managed to reliably meet the needs of all users, while mitigating changes in the quality and quantity of groundwater. The intent of the Act as described in section 10720.1 of the Water Code is to:

- Provide for the sustainable management of groundwater basins.
- Enhance local management of groundwater consistent with rights to use or store groundwater.
- Establish minimum standards for sustainable groundwater management.
- Provide local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater.
- Avoid or minimize subsidence.
- Improve data collection and understanding about groundwater.
- Increase groundwater storage and remove impediments to recharge.
- Manage groundwater basins through the action of local governmental agencies to the greatest extent feasible, while minimizing state intervention to only when necessary to ensure that local agencies manage groundwater in a sustainable manner.

The role of the Groundwater Sustainability Agency (GSA) is to create a GSP and then to implement and enforce that plan. The plan must include measurable objectives that can be used to demonstrate the basin is sustainably managed within twenty (20) years of implementation.

2. Purpose

The purpose of this memorandum is to:

a. Establish the Big Valley Groundwater Basin Advisory Committee (BVAC) and its responsibilities.
b. Establish the membership of the BVAC.
c. Describe how meetings of the BVAC will be conducted and how information, findings, conclusions, decisions, etc. of the BVAC will be conveyed to the Lassen County Groundwater Sustainability Agency (GSA) and to the Modoc County Groundwater Sustainability Agency (GSA).

3. Recitals

a. In September 2014, the Governor signed into law a legislative package (three bills), collectively known as the Sustainable Groundwater Management Act (SGMA), which requires local agencies with land use and/or water management or water supply authority to do certain things to reach sustainability of medium and high priority groundwater basins as designated by the State of California Department of Water Resources (DWR). SGMA became effective on January 1, 2015.

b. The Big Valley Groundwater Basin has been designated a medium priority basin by the DWR.

c. This MOU is dedicated to the Big Valley Groundwater Basin, not any other basin in either Lassen or Modoc Counties.

d. The Lassen and Modoc County Board of Supervisors have adopted resolutions (17-013 and 2017-09 respectively) declaring themselves to be the Groundwater Sustainability Agency (GSA) for the portion of the Big Valley Groundwater Basin within their respective jurisdictions.

e. No other agency pursued GSA status and therefore Lassen and Modoc Counties were awarded exclusive GSA status by DWR for the portion of the Big Valley Groundwater Basin within their respective jurisdictions.

f. GSAs are required to develop Groundwater Sustainability Plans (GSP) for all medium and high priority basins, and said GSP for the BVGB is to be submitted to the DWR by January 31, 2022.

g. Absent a qualified planning process which produces a Groundwater Sustainability Plan, the State Water Resources Control Board (State Board) is authorized to declare that the subbasins are out of compliance and thereby they will intervene and place the subbasins on probation with regard to SGMA.

h. Lassen County has been awarded a grant (Grant Number 4600012669) to provide funding for the preparation of a GSP for the BVGB.

i. Lassen and Modoc Counties intend to work cooperatively in the preparation of a GSP for the BVGB and prepare one GSP that covers the entirety of the basin.

j. Lassen and Modoc Counties see the value of stakeholder input into the development and implementation of a Groundwater Sustainability Plan for the Big Valley Groundwater Basin.

k. It is the intent of this MOU to form an advisory committee that would advise both Lassen and Modoc Counties on the preparation of a GSP for the basin.

4. Goals of the BVAC are as follows:

a. Work collaboratively and transparently with other members to identify common goals, foster mutual understanding, and develop a GSP that all members and their constituents can live with and support;
b. Develop a common understanding of existing groundwater resources, including groundwater dependent habitats, public trust resources and the current and future needs of all beneficial uses and users in the Big Valley groundwater basin, as well as current and future water needs;
c. Solicit and incorporate community and stakeholder interests into committee discussions and emerging committee agreements in order to develop a locally-informed and broadly supported GSP;
d. Consider and integrate science, to the best of its ability and with support from qualified scientific consultants, during GSP development and implementation;
e. Support implementation efforts guided by GSP goals to use, monitor, and manage water resources in a sustainable manner, ensure local control, address current and future local water needs, and support the agricultural economy, Adin, Bieber, Nubieber, Lookout, and outlying communities, tourist visitation and fish and wildlife habitat in the basin;
f. Negotiate in good faith to achieve consensus on management of groundwater resources in the Big Valley groundwater basin into the future;
g. Advise the Lassen and Modoc GSAs on the preparation of a Groundwater Sustainability Plan (GSP);
h. Provide a forum for the public to comment during the preparation of the GSP;
i. Provide recommendations to the Lassen and Modoc GSAs that would result in actions which have as minimal impact as possible on the residents of Big Valley groundwater basin;
j. Advise the Lassen and Modoc GSAs on the preparation of a GSP to produce the lowest possible future costs to the residents of Big Valley; and
k. Ensure local control of the Big Valley Groundwater Basin be maintained by the Lassen and Modoc GSAs.

As a standing committee of the Lassen and Modoc GSA's, the Advisory Committee will operate in compliance with the Ralph M. Brown Act (Brown Act). Committee meetings will be noticed and agendas posted according to the Brown Act. All meetings will be open to the public and allow public comment. Speakers will generally be limited to three minutes, but time may be adjusted based upon meeting circumstances. As needed, the Chair may place time limits on public comments to ensure that the committee is reasonably able to address all agenda items during the course of a meeting. The Lassen GSA will announce committee meetings on its website and through its regular communication channels. Recommendations and advice from the committee will be presented to the Lassen and Modoc GSA's through their staff.

5. BVAC Membership Composition

1. One (1) member of the Lassen County Board of Supervisors selected by said Board.
2. One (1) alternate member of the Lassen County Board of Supervisors selected by said Board
3. One (1) member of the Modoc County Board of Supervisors selected by said Board.
4. One (1) alternate member of the Modoc County Board of Supervisors selected by said Board
5. Two (2) public members selected by the Lassen County Board of Supervisors. Said members must either reside or own property within the Lassen County portion of the Big Valley Groundwater Basin.
6. Two (2) public members selected by the Modoc County Board of Supervisors. Said members must either reside or own property within the Modoc County portion of the Big Valley Groundwater Basin.

Member vacancies

If a vacancy occurs, the respective GSA will select a new committee member. Applications or letter of intent for all members of the committee must be kept on file with the respective GSA. An appointing GSA must notify the other GSA in writing if a member of the BVAC has been replaced.

Committee Member Terms

- Committee members serve four (4) year terms starting from the date of their appointment. If any committee member decides, for any reason, to terminate his or her role, he/she will notify GSA staff as soon as possible after making such a determination. Committee members interested in serving beyond four (4) years must re-apply through the GSA's application process.
- The chair and vice-chair will serve one a (1) year term. At the culmination of the term of a chair or vice-chair, the committee will use its decision-making procedures to nominate and confirm a new chair and vice-chair. Any interested chair or vice chair may be nominated for a second term, however, no chair or vice-chair shall serve more than two (2) consecutive terms.

6. BVAC Roles and Responsibilities

This section describes roles and responsibilities that the Big Valley Advisory Committee Members commit to during development and implementation of the Big Valley groundwater basin GSP.

Convener

The Lassen and Modoc GSA's, are the final decision maker in the GSP process. The GSA's will:

- Provide guidance, evaluation and feedback that directs GSA staff and Advisory Committee members to build and implement an effective GSP;

- Work collaboratively with GSA staff, Advisory Committee members, consultants, and constituents;
- Receive, evaluate, and decide on all GSP and SGMA related actions that come in the form of advice and recommendations from the Big Valley Advisory Committee;
- Welcome feedback that pertains to the GSP from all diverse stakeholder interests in each groundwater basin; and
- Serve as a representative for the basin, making decisions in the best interest of achieving and maintaining long-term groundwater sustainability for all beneficial uses and users of water in the basin.

Advisory Committee Members
Members of the Advisory Committee ("members") collectively represent the diversity of beneficial groundwater uses and users in the Big Valley groundwater basin. Committee members commit to:

- Serve as strong, effective advocates and educators for the interest group (constituency) represented;
- Nominate and confirm a committee chair and vice chair every year;
- Arrive at each meeting fully prepared to discuss all agenda items and relevant issues. Preparation may include, but is not limited to, reviewing previous meeting summaries, draft and final GSP chapters, and other information distributed in advance of each meeting;
- Develop an innovative problem-solving approach in which the interests and viewpoints of all members are considered;
- Explore all options to resolve disagreements, including, as needed, one-on-one discussions with GSA staff, or, at Advisory Committee meetings, interest-based caucuses or small group discussions;
- Act as liaisons throughout the GSP development and implementation process to educate, inform and solicit input from the wider local community and interested constituencies not represented on the committee;
- Present constituent views on the issues being discussed and commit to engage in civil, respectful and constructive dialogue with other members, as well as GSA staff, technical team members and potentially a facilitator;
- Ensure accuracy of information dissemination during or outside meetings, and correct false information as needed or appropriate;
- Avoid representing individual viewpoints as those of the committee and respect confidential conversations;
- Work collaboratively to ensure broad constituent understanding and support for any advice and recommendations that the committee shares with the Lassen and Modoc GSA Boards;
- Coordinate with Lassen and Modoc GSA staff regarding recommendations for any additional committee tasks that should be undertaken by the committee, and which items shall be presented to the GSA Boards for its review and approval;
- Operate at all times in compliance with the Brown Act;
- Attend meetings consistently – participation in 75% of the meetings is the minimum expectation. (*Given the volume of information to be considered and discussed, it is*

essential that members actively participate in committee meetings on a consistent basis. It is understood that professional and personal commitments may at times prevent members from attending committee meetings. In such cases, members shall notify Lassen GSA staff no less than 24 hours in advance to be excused from attending any given committee meeting. As needed, staff will reach out to members who are not actively participating to give them the opportunity to explain their absence and reaffirm their interest to participate on the committee, and thus not lose their seat. Members who do not meet the threshold for active participation, and have not expressed an interest to continue participating, will, at the recommendation of Lassen and Modoc GSA staff, be automatically removed by the appropriate GSA Board from the committee. Alternates may attend in the absence of a committee member but must alert the Lassen and Modoc GSA staff prior to the meeting.); and

- Recuse him/herself from discussion and voting if he/she has a personal interest or stake in the outcome [BVAC members are subject to recusal due to conflicts of interest (as that term is defined by the Political Reform Act) in accordance with *Government Code Title 9, Political Reform; Chapter 7, Conflicts of Interest*].

Through its public meetings, the committee shall serve as an additional forum for public dialogue on SGMA and GSP development. Finally, with approval by the Lassen and Modoc GSA's, committee tasks may be amended, repealed, or additionally added at any time with the intent to comply with SGMA related activities provided said activities comply under the authorities granted by SGMA law. Alternates may vote on all matters before the BVAC in the absence of the appointed member. Each alternate shall be informed of the business of the BVAC and the actions to be taken when acting on behalf of a member.

The following are desired attributes for BVAC members:

a. Have knowledge and experience in water resources management.
b. Represent an agency, organization, tribe, academia, or interest that is under-represented in the region (e.g., disadvantaged communities or unincorporated areas).
c. Have the ability and desire to objectively articulate the perspective of his/her BVAC seat and caucus at a level beyond that of his/her individual interest.
d. Provide recommendations with the best interests of the entire Big Valley region in mind.

7. Appointment

Members of the BVAC shall be appointed by the respective Board of Supervisors acting as the GSA. Members will serve at the pleasure of said Boards and may be terminated at any time without cause. Persons interested in serving on the BVAC shall submit a letter of interest or application to the pertinent Clerk of the Board of Supervisors which includes the following:

a. Current level of SGMA knowledge;
b. Knowledge of groundwater in the Big Valley Groundwater Basin;
c. Their ability to commit to attending meetings of the Advisory Committee
d. Committee members should have demonstrated ability to work collaboratively with others of differing viewpoints and achieve good faith compromise.

8. BVAC Chair and Vice Chair Roles

The BVAC Chair and Vice Chair must be BVAC members. The Chair and Vice Chair will be determined by a majority vote of the BVAC. The Chair and Vice Chair shall serve for one (1) year term (multiple terms may be held, not to exceed two (2) years).

Although not required, the following attributes are desirable for the Chair and Vice Chair:

- Chair: prior experience working in the role of a Chair of a committee.
- Vice Chair: attributes and ability to assume Chair role and responsibilities, but not necessarily as much experience as the Chair.
- Chair and Vice Chair should come from different GSAs.
- Familiar with the purpose, structure, and content of meetings.
- Willing and able to attend each BVAC meeting until the GSP is drafted. The GSP must be submitted to the DWR by January 31, 2022.
- Ability to even-handedly articulate all interests.
- Consensus-builder.

The role of the Chair and Vice Chair will vary between BVAC meetings; however, the Vice Chair's primary role is to take on Chair responsibilities in the absence of the Chair and/or at the discretion of the Chair. General responsibilities for the Chair are as follows:

a. Review BVAC agenda prior to finalization and distribution to stakeholders (one week prior to BVAC meetings);
b. Meet with staff prior to each BVAC meeting to go over the BVAC agenda and presentation(s) so that the BVAC meeting runs smoothly and without interruption;
c. Manage the BVAC agenda, select members to speak in turn, and keep the BVAC on task and on time;
d. Convene each BVAC meeting and initiate introductions;
e. Organize and call on public speakers during appropriate agenda items (if applicable) and determine public comment procedures;
f. Identify when the BVAC has reached an impasse and needs to move forward with formal voting to resolve an issue;
g. Summarize key decisions and action items at the end of each BVAC meeting.
h. Close meetings;
i. Ensure that notes are prepared summarizing discussion, agreements, and decisions; and
j. Review and provide comments on BVAC meeting notes.

9. Meetings

Meetings will be conducted on a monthly basis or as often as is needed during preparation of the Big Valley Groundwater Basin GSP. Meetings shall be noticed in accordance with the Brown Act. The Lassen County Department of Planning and Building Services will coordinate Brown Act noticing and any other noticing that is executed. The Lassen County Department of Planning and Building Services will prepare and disseminate packets in advance of all meetings, if applicable. Said Department shall serve as staff to the BVAC, and be the repository of all associated records, with a copy of all records sent to the Modoc County Clerk of the Board. The

Director of the Lassen County Planning and Building Services Department or his or her designee shall serve as secretary of the BVAC and may comment on any item but does not have a vote. The designated Modoc County GSA groundwater staff member may comment on any item but does not have a vote. Legal counsel shall be provided by the Modoc County Counsel.

Meetings shall be conducted in accordance with this MOU, SGMA and any other applicable rules or regulations. A quorum is required to convene. The BVAC Chair or Vice Chair will determine if a quorum exists at any BVAC meeting. Formal voting may not occur without a quorum of BVAC members; however, presentations and discussion of agenda topics may occur. A quorum shall be defined as having at least four BVAC representatives, present at every meeting.

Meeting Location

All meetings of the Big Valley Groundwater Advisory Committee must be held within the boundary of the Big Valley Groundwater basin. Lassen GSA staff will work collaboratively with the Chair to determine a location which will encourage the most participation from all stakeholders. Meeting locations shall remain consistent to prevent reduced participation from all stakeholders.

10. Public Comments at BVAC Meetings

BVAC meetings are open to the public, and public comments are welcomed and encouraged. To ensure that members of the public have an adequate chance to provide comments, the BVAC Chair will invite public comments by members of the public in attendance on any agenda item in which the BVAC is making a decision or formulating a recommendation. An open public comment period will be offered at the end of BVAC meetings to allow members of the public to speak to non-agenda topics.

If there is substantial public interest or comment on a topic, the BVAC Chair or Vice Chair may implement the following procedures to ensure that such comments are received in a timely manner:

- Members of the public will be asked to fill out a speaker card to indicate their name, affiliation, contact, and the specific agenda item they wish to speak to (if applicable).
- Speaker cards will be limited to one per person per agenda item. Participants may submit multiple speaker cards to address multiple agenda items.
- The BVAC Chair or Vice Chair will invite those who submitted speaker cards to address the agenda item prior to calling for a consensus decision and/or vote on that item.
- Speaker cards will generally allow three minutes of public speaking time per speaker. However, in the event that there are a large number of public speaker comments, it will be up to the discretion of the BVAC Chair or Vice Chair to reduce the time for each public speaker to ensure that all agenda items are addressed and that the BVAC meeting closes on time.

11. Decision-making Procedures

In order to hold a meeting and conduct its work, a quorum of the Big Valley GSA Advisory Committee must be present.

1) **Consensus as the Fundamental Principle:** The advisory committee shall strive for consensus (agreement among all participants) in all of its decision-making. Working toward consensus is a fundamental principle which will guide group efforts, particularly when crafting any draft or final advisory committee proposals, reports or recommendations for GSA Boards consideration. If the committee is unable to reach consensus, the range of opinions provided, including areas of agreement and disagreement, will be documented in meeting summaries or otherwise communicated in written reports when advisory committee work is shared with the GSA Boards.

2) **Definition of Consensus:** Consensus means all committee members either fully support or can live with a particular decision and believe that their constituents can as well. In reaching consensus, some committee members may strongly endorse a particular proposal, report or recommendation while others may simply accept it as "workable." Others may only be able to "live with it" as less than desired but still acceptable. Still others may choose to "stand aside" by verbally noting disagreement, yet allowing the group to reach consensus without them, or by abstaining altogether. Any of these actions constitutes consensus.

3) **Types of Decision-Making:**
    a. Administrative: Decisions about the daily administrative activities of the committee—including, but not limited to meeting logistics, meeting dates and times, agenda revisions and schedules. A*dministrative decisions* will typically be put forward to the group by Lassen County Department of Planning and Building Services staff. As needed, staff will consult with the committee. Any administrative decisions by the committee will be made on a simple majority vote of all members present at a meeting. The committee will defer to the decision-making procedures outlined in this section of the MOU in circumstances where it is unclear if a committee decision is *administrative* in nature, or represents a more substantive *GSP/SGMA* decision (described below).

    b. Groundwater Sustainability Planning/SGMA Advice and Recommendations: Advice and recommendations about the Big Valley GSP—including but not limited to topics mandated by SGMA and other groundwater related topics that the committee chooses to address. All *GSP/SGMA advice and recommendation decisions* will be made by the decision-making procedures outlined in this section of the MOU.

4) **Consensus with Accountability:** Consensus seeking efforts recognize that a convened group such as Big Valley Advisory Committee makes recommendations, but is not a formal decision-making body like the Lassen or Modoc GSA's. That said, achieving consensus is the goal, as this allows all stakeholder interests represented on the committee to communicate a unified group perspective to the GSA Boards as it considers public policy decisions and actions which may affect the constituencies that members represent, and the wider community. Using a model of consensus with accountability, all committee members shall commit to two principles:
    a. All members are expected to routinely express their interests and analyze conditions to ensure they have clarity on how their interests and those of others may shift over time;

b. All members shall negotiate agreements in a manner that serves their interests, and offers either neutral impact to others, or ideally provides benefit to others' interests as well as their own.

Operating by consensus with accountability will encourage multi-interest solutions based on shared member interests. Such solutions are in turn more sustainable and durable as they represent shared agreements rather than majority/minority dynamics. Most consensus building during the course of GSP development and SGMA implementation will be based on verbal dialogue, deliberation and iterative development of group ideas. The Chair may commonly ask, when it appears consensus or near consensus agreement has emerged or is emerging, if any member cannot live with said agreement. For any final decisions, committee members will demonstrate consensus, or lack thereof, in the following manner:

Nay:	*I do not support the proposal.*
Aye:	*I support the proposal.*
Stand Aside:	*Member verbally notes he/she is willing to stand aside and allow group consensus*
Abstention:	*At times, a pending decision may be infeasible for a participant to weigh in on. Member verbally notes he/she abstains. Abstentions do not prevent group consensus.*

Any member that stands aside or abstains from a decision is encouraged to explain why his/her choice is in his/her best interest.

5) **Less than 100% Consensus Decision Making:** The advisory committee is consensus seeking but shall not limit itself to strict consensus if 100% agreement among all participants cannot be reached after all interests and options have been thoroughly identified, explored and discussed. Less-than-consensus decision-making shall not be undertaken lightly. If the committee cannot come to 100% agreement, it could set aside the particular issue while it continues work on other issues, then revisit the disagreement later in the process. Finally, the committee recognizes that certain deadlines must be met during the collaborative process to ensure completion of all SGMA opportunities and requirements on time.

If, after thoroughly exploring all ideas and options, consensus is absent or otherwise not forthcoming, the committee, with assistance from the GSA staff, will clearly document majority and minority viewpoints. The Chair and Vice-Chair will then work with GSA staff to incorporate all viewpoints into the meeting summary, and, as warranted, prepare a committee report to the GSA Boards. The chair, in coordination with GSA staff, will then present the report to the GSA Boards, ensuring that all majority and minority viewpoints are clearly communicated and accurately represent the outcomes of committee discussions. Any committee member holding minority viewpoints will have the opportunity, if he/she is not comfortable with the process, to present his/her viewpoints directly to the GSA Boards at the time the report is presented. Members wishing to do this will express their interest and minority viewpoints with GSA staff in advance of said GSA Board meetings.

6) **Decision Outcomes:** Advisory committee decisions will be made at appropriate meetings and, in accordance with the Brown Act, will be publicly noticed in advance and shared via the Lassen County GSA's website and SGMA interested parties email list. As described above, all committee proposals, reports and recommendations will reflect the outcomes of collaborative member discussions. All consensus agreements and other negotiated outcomes during GSP development and implementation, as well as discussion outcomes when consensus is not forthcoming, will be documented, as described above, and shared with the GSA Boards.

12. Collaborative Process Agreements and Meeting Ground Rules

Members commit to the following process agreements during discussion, deliberation and attempts to find consensus-based solutions to sustainable groundwater management in the Big Valley groundwater basin. Moreover, members also agree to abide by meeting ground rules in order to intentionally and consistently engage each other in civil and constructive dialogue during the collaborative process.

Process Agreements

- **Strive to focus on interests versus positions.** A focus on interests instead of positions will help reveal the needs, hopes or concerns behind any member's words. By extension this can help identify shared interests among committee members and, based on those shared interests, multiple options for mutually beneficial agreements.

- **Foster mutual understanding and attempt to address the interests and concerns of all participants.** For the collaborative process to be successful, all members must seek to understand the interests and concerns of other members, then strive to reach agreements that take all member interests under consideration.

- **Inform, educate and seek input from community constituents.** To the extent possible, members will share information and solicit input from their constituents, scientific advisors, and others about ongoing committee discussions and potential agreements or recommendations as they emerge.

- **View challenges as problems to be solved rather than battles to be won.** Challenges will at times arise during discussion of issues. Remember to focus on the challenge versus on each other. Search for multi-interest solutions, rather than win/lose agreements.

- **Be creative and innovative problem solvers.** Creative thinking and problem solving are essential to success in any collaboration. Get beyond the past, climb out of the perceived "box" and attempt to think about the problem, and potential solutions, in new ways.

- **Negotiate in good faith.** All members agree to candidly and honestly participate in decision making, to act in good faith in all aspects of this effort, and to communicate their interests in group meetings. Good faith also requires that parties not make commitments for which they cannot or do not intend to honor.

- **Consider the long-term view.** SGMA requires submission and approval of a Big Valley GSP by January 31st, 2022. Taking a long-term view of the planning horizon, may help inform collaborative discussions, reduce conflict and thereby ensure long-term sustainability of groundwater resources.

Ground rules

- **Use common conversational courtesy and treat each other with respect.** Civil and respectful dialogue tends to foster a constructive, thorough and solutions-oriented environment within multi-stakeholder groups.

- **Remember that all ideas and points of view linked to the committee's charge have value.** All ideas have value in this setting. Simply listen, you do not have to agree. If you hear something you do not agree with or you think is silly or wrong, please remember that a fundamental purpose of this forum is to encourage diverse ideas.

- **Be candid, listen actively and seek to understand others.** This promotes genuine dialogue and mutual understanding. Mutual understanding in turn helps parties identify shared interests. Shared interests set the foundation to finding and developing mutually acceptable agreements.

- **Be concise and share the air.** Keep in mind that time is limited at meetings. Be concise when sharing your perspective so that all members can participate in the discussion. And remember, people's time is precious, treat it with respect.

- **Avoid editorial comments.** At times it will be tempting to try and interpret the intentions or motivations of others. Please avoid this temptation and instead speak to your own interests and the motivation behind them.

- **Stay focused on the meeting agenda.** The committee is a Brown Act compliant body. As such it is important to stay focused on the posted agenda for any given meeting.

- **Welcome levity and humor to the discussions.** Work around water can at times be daunting and filled with challenges. Levity and humor is both welcome and helpful at times, as long as it does not come at the expense of others.

- **Turn cell phones off or to vibrate.** Help the group avoid distractions by turning cell phones to vibrate, not checking email during meetings and, if you must take a call, taking it outside the room.

13. Communications/Media Relations

Members are asked to speak only for themselves or the constituency they represent when asked by external parties, including the media, about the committee's work, unless there has been a formal adoption of a statement, report or recommendations by the committee. Members will refer media inquiries to GSA staff while also having the freedom to express their own opinions to the media. Members should inform media and external parties that they only speak for themselves and do not represent other members or the committee as a whole. The temptation to discuss someone else's statements or positions should be avoided.

14. Indemnification/Defense

Claims Arising from Acts or Omissions.

No GSA, nor any officer or employee of a GSA, shall be responsible for any damage or liability occurring by reason of anything done or omitted to be done by another GSA under or in connection with this MOU. The GSA's further agree, pursuant to California Government Code section 895.4, that each GSA shall fully indemnify and hold harmless each other GSA and its agents, officers, employees and contractors from and against all claims, damages, losses, judgements, liabilities, expenses, and other costs, including litigation costs and attorney fees, arising out of, resulting from, or in connection with any work delegated to or action taken or omitted to be taken by such GSA under this MOU.

15. Litigation

In the event that any lawsuit is brought by a third party against any Party based upon or arising out of the terms of this MOU, the Parties shall cooperate in the defense of the action. Each Party shall bear its own legal costs associated with such litigation.

16. Books and Records

Each Governing Body will be entitled to receive copies of documents, records, historical data, data compiled through consultants and any and all information related to groundwater within the Big Valley Groundwater basin developed pursuant to this MOU; provided that nothing in this paragraph shall be construed to operate as a waiver of any right to assert any privilege that might apply to protect the disclosure to information or materials subject to the attorney-client privilege, attorney work product privilege, or other applicable privilege or exception to disclosure.

17. Miscellaneous

A. Term of Agreement.

This MOU shall remain in full force and effect until the date upon which all Parties have executed a document terminating the provisions of this MOU.

B. No Third-Party Beneficiaries.

This MOU is not intended and will not be construed to confer a benefit or create any right on any third party, or the power or right to bring an action to implement any of its terms.

C. Amendments.

This MOU may be amended only by written instrument duly signed and executed by all Parties.

D. Compliance with Law.

In performing their respective obligations under this MOU, the Parties shall comply with and conform to all applicable laws, rules, regulations and ordinances.

E. Construction of Agreement.

This MOU shall be construed and enforced in accordance with the laws of the United States and the State of California.

18. All notice required by this MOU will be deemed to have been given when made in writing and delivered or mailed to the respective representatives of the Parties at their respective addresses as follows:

For the County of Modoc:
Clerk of the Board
204 South Court Street
Alturas, CA 96101

For the County of Lassen:
Lassen County Planning and Building Services
707 Nevada Street, Suite 5
Susanville, CA 96130

19. Signature

The parties hereto have executed this Memorandum of Understanding as of the dates shown below.

The effective date of this MOU is the latest signature date affixed to this page. This MOU may be executed in multiple originals or counterparts. A complete original of this MOU shall be maintained in the records of each of the parties.

COUNTY OF LASSEN

By: ______________________________ Date: __________
Chairman, Lassen County Board of Supervisors

ATTEST:

By: ______________________________ Date: __________
Clerk of the Board

APPROVED AS TO FORM:

______________________________ Date: __________
Lassen County Counsel

COUNTY OF MODOC

By: [signature] Date: MAY 2 1 2019
Chairman, Modoc County Board of Supervisors

ATTEST:

By: [signature] Date: MAY 2 1 2019
Clerk of the Board

APPROVED AS TO FORM:

[signature] Date: MAY 2 8 2019
Modoc County Counsel

19. Signature

The parties hereto have executed this Memorandum of Understanding as of the dates shown below.

The effective date of this MOU is the latest signature date affixed to this page. This MOU may be executed in multiple originals or counterparts. A complete original of this MOU shall be maintained in the records of each of the parties.

COUNTY OF LASSEN

By: Jeff Hemphill Date: 6-11-19
Chairman, Lassen County Board of Supervisors

ATTEST:

By: ____________________ Date: 6/11/2019
Clerk of the Board

APPROVED AS TO FORM:

____________________ Date: __________
Lassen County Counsel

COUNTY OF MODOC

By: ____________________ Date: MAY 2 1 2019
Chairman, Modoc County Board of Supervisors

ATTEST:

By: Tiffany A. Martinez Date: MAY 2 1 2019
Clerk of the Board

APPROVED AS TO FORM:

____________________ Date: MAY 2 0 2019
Modoc County Counsel

Appendix 3A Monitoring Well Surveyors Report

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Project: Big Valley Groundwater Basin Survey, Adin, Ca.
Client: GEI Consultants
2868 Prospect Park Drive, Suite 400
Rancho Cordova, Ca 95670

PROFESSIONAL ENGINEER REGISTERED KEVIN R. BUTLER No. C057153 CIVIL STATE OF CALIFORNIA

Project Details

Equipment Used:

Trimble Precision GPS R-12 Surveying System
SECO 4811-32 Level System

Report Units:

Lat/Lon:	WGS84 formatted Degree, Minutes, Seconds
Elevation:	US Survey Feet
Grid Coordinates:	California State Plane Zone 1 Coordinates

Survey Conditions:

Date Surveyed:	7.28.2020
Date of Report:	8.3.2020, Revised 8.5.2020
Weather:	Sunny 60°F - 95°F, Smokey, Wind <10 MPH

Survey Benchmarks:

Source:	National Geodetic Survey	
Designation:	"B 136 RM 2"	
Description:	Brass disc set in concrete	
Location:	Northeast end of runway near Adin, Ca.	
	NAD 83 (2011)	
	Latitude	41° 11' 04.52985" N
	Longitude	120° 57' 00.44655" W
	Ortho Height	4237.75 ft.
	California State Plane Zone 1 Coordinates	
	Northing:	2,316,557.62
	Easting:	6,850,625.60

Source:	National Geodetic Survey	
Designation:	"W 135 RESET"	
Description:	Brass disc set in concrete	
Location:	Approximately 2.5 miles North on HWY 299 from Bieber	
	NAD 83 (2011)	
	Latitude	41° 08' 43.09015" N
	Longitude	120° 06' 43.08683" W
	Ortho Height	4152.57 ft.
	California State Plane Zone 1 Coordinates	
	Northing:	2,301,751.78
	Easting:	6,806,227.62

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Project Procedures:

Project control was established by using our GPS equipment to calibrate to the two NGS benchmarks described above.
Horizontal control is derived from both of the NGS benchmarks, Vertical control is derived from one NGS benchmark designation "B 136 RM 2".

At each site, all monitoring wells were located and each vault lid and casing plug was removed. Then a notch approximately 1/4" wide x 1/4" deep was cut into the side of the PVC well casing in line with the two vault lid mounting bolts. This notch is the elevation point for each well per tasks #1 & #2

At each site, all monitoring wells were located and the center of the vault lid was shot for horizontal location. This was recorded as Latitude / Longitude per task #1 & #2

At each site monitoring well 3 was identified and a PK nail was inserted into the concrete well pad 4" away from the vault lid in line with the two mounting fasteners. This PK nail serves at the site control for subsidence monitoring per task #3

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Task #1 Lassen County Monitoring Well Survey

Site 5 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 5-1	Center of Lid	41°07'18.77103"N	121°08'01.91978"W	-
	Notch on PVC Casing	-	-	4,128.72
MW 5-2	Center of Lid	41°07'19.02273"N	121°08'01.90396"W	-
	Notch on PVC Casing	-	-	4,128.59
MW 5-3	Center of Lid	41°07'16.26339"N	121°08'11.92014"W	-
	Notch on PVC Casing	-	-	4,131.40
MW 5-4	Center of Lid	41°07'14.01725"N	121°08'02.37919"W	-
	Notch on PVC Casing	-	-	4,129.90

Site 5 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.04 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #2 Modoc County Monitoring Well Survey

Site 1 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 1-1	Center of Lid	41°11'16.91704"N	120°57'35.46950"W	-
	Notch on PVC Casing	-	-	4,213.84
MW 1-2	Center of Lid	41°11'17.17232"N	120°57'35.20508"W	-
	Notch on PVC Casing	-	-	4,214.21
MW 1-3	Center of Lid	41°11'16.05393"N	120°57'33.61346"W	-
	Notch on PVC Casing	-	-	4,218.17
MW 1-4	Center of Lid	41°11'16.95194"N	120°57'32.38078"W	-
	Notch on PVC Casing	-	-	4,218.06

Site 1 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.03 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #2 Modoc County Monitoring Well Survey

Site 2 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 2-1	Center of Lid	41°12'42.69267"N	121°01'43.03716"W	-
	Notch on PVC Casing	-	-	4,216.18
MW 2-2	Center of Lid	41°12'42.61763"N	121°01'42.78528"W	-
	Notch on PVC Casing	-	-	4,216.44
MW 2-3	Center of Lid	41°12'39.42222"N	121°01'43.25643"W	-
	Notch on PVC Casing	-	-	4,213.93
MW 2-4	Center of Lid	41°12'43.18967"N	121°01'45.76289"W	-
	Notch on PVC Casing	-	-	4,209.62

Site 2 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.03 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #2 Modoc County Monitoring Well Survey

Site 3 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 3-1	Center of Lid	41°13'00.98392"N	121°06'17.84041"W	-
	Notch on PVC Casing	-	-	4,164.41
MW 3-2	Center of Lid	41°13'01.22973"N	121°06'17.84528"W	-
	Notch on PVC Casing	-	-	4,164.58
MW 3-3	Center of Lid	41°12'56.58659"N	121°06'18.32460"W	-
	Notch on PVC Casing	-	-	4,164.02
MW 3-4	Center of Lid	41°12'56.60289"N	121°06'19.47421"W	-
	Notch on PVC Casing	-	-	4,164.97

Site 3 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.04 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #2 Modoc County Monitoring Well Survey

Site 4 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 4-1	Center of Lid	41°12'10.53971"N	121°09'31.31845"W	-
	Notch on PVC Casing	-	-	4,152.40
MW 4-2	Center of Lid	41°12'10.56692"N	121°09'31.64559"W	-
	Notch on PVC Casing	-	-	4,152.73
MW 4-3	Center of Lid	41°12'10.76781"N	121°09'28.29350"W	-
	Notch on PVC Casing	-	-	4,152.33
MW 4-4	Center of Lid	41°12'12.74277"N	121°09'28.23603"W	-
	Notch on PVC Casing	-	-	4,161.32

Site 4 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.04 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #3 Subsidence Monitoring Network

Well ID	Description of Surveyed Point	California State Plane Zone 1		Elevation (ft.)	Accuracy	
		Northing	Easting		Horizontal	Vertical
MW 1-3	PK Nail in Concrete	2,317,688.600	6,848,083.631	4,218.51	±0.01 ft.	±0.03 ft.
MW 2-3	PK Nail in Concrete	2,325,906.143	6,828,905.491	4,214.55	±0.01 ft.	±0.03 ft.
MW 3-3	PK Nail in Concrete	2,327,419.328	6,807,866.938	4,164.48	±0.02 ft.	±0.04 ft.
MW 4-3	PK Nail in Concrete	2,322,637.642	6,793,395.855	4,152.75	±0.02 ft.	±0.04 ft.
MW 5-3	PK Nail in Concrete	2,292,892.375	6,799,525.718	4,131.74	±0.02 ft.	±0.04 ft.

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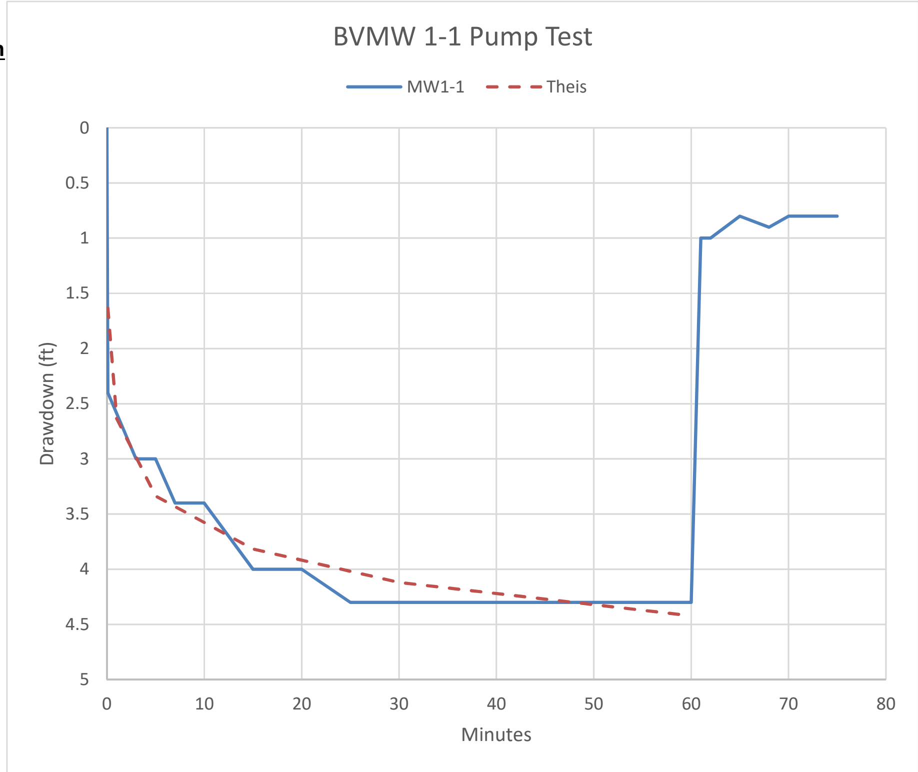
Appendix 4A Aquifer Test Results

Pumping Test

MW1-1		Adin Airport	
Time	**Minutes**	**Depth to Water (ft)**	**Drawdown**
10:59	0.0	31.6	0
11:00	0.1	34	2.4
11:03	3	34.6	3
11:05	5	34.6	3
11:07	7	35	3.4
11:10	10	35	3.4
11:15	15	35.6	4
11:20	20	35.6	4
11:25	25	35.9	4.3
11:30	30	35.9	4.3
11:35	35	35.9	4.3
11:40	40	35.9	4.3
11:45	45	35.9	4.3
11:50	50	35.9	4.3
11:55	55	35.9	4.3
12:00	60	35.9	4.3
12:01	61	32.6	1
12:02	62	32.6	1
12:05	65	32.4	0.8
12:08	68	32.5	0.9
12:10	70	32.4	0.8
12:15	75	32.4	0.8



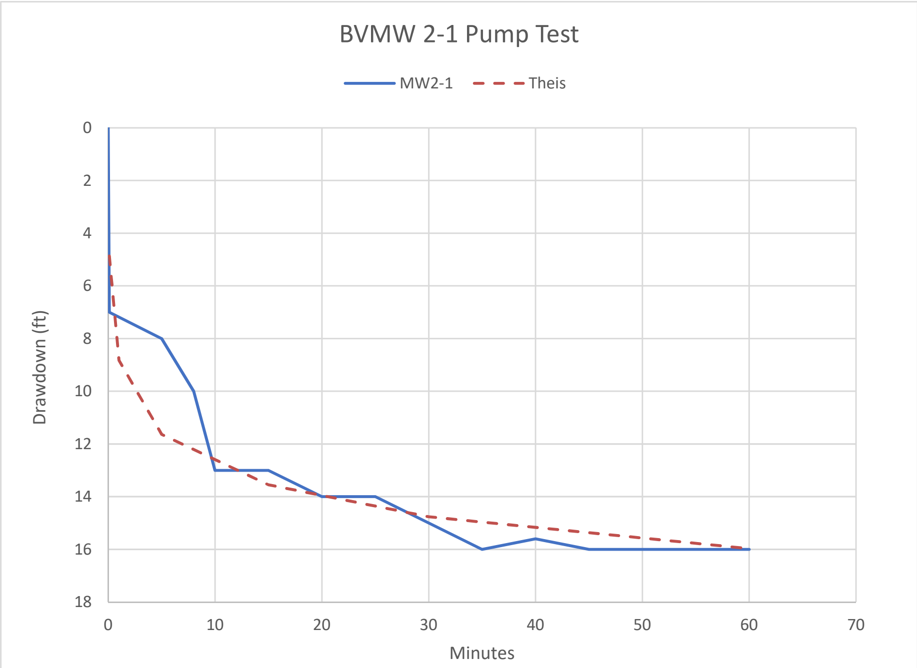
Theis Solution

Thickness (b)	50	ft
Flow (Q)	8	gpm
Well Efficiency	0.7	unitless
Transmissivity (T)	3000	gpd/ft
Radius (r)	1	ft
Storativity (S)1	1.5E-03	unitless
Hydraulic Conductivity (K)	8	ft/d

Pumping Test

MW2-1

Time	**Minutes**	**Depth to Water (ft)**	**Drawdown**
7:40	0	26	0
7:41	0.1	33	7
7:45	5	34	8
7:48	8	36	10
7:50	10	39	13
7:55	15	39	13
8:00	20	40	14
8:05	25	40	14
8:10	30	41	15
8:15	35	42	16
8:20	40	41.6	15.6
8:25	45	42	16
8:30	50	42	16
8:35	55	42	16
8:40	60	42	16

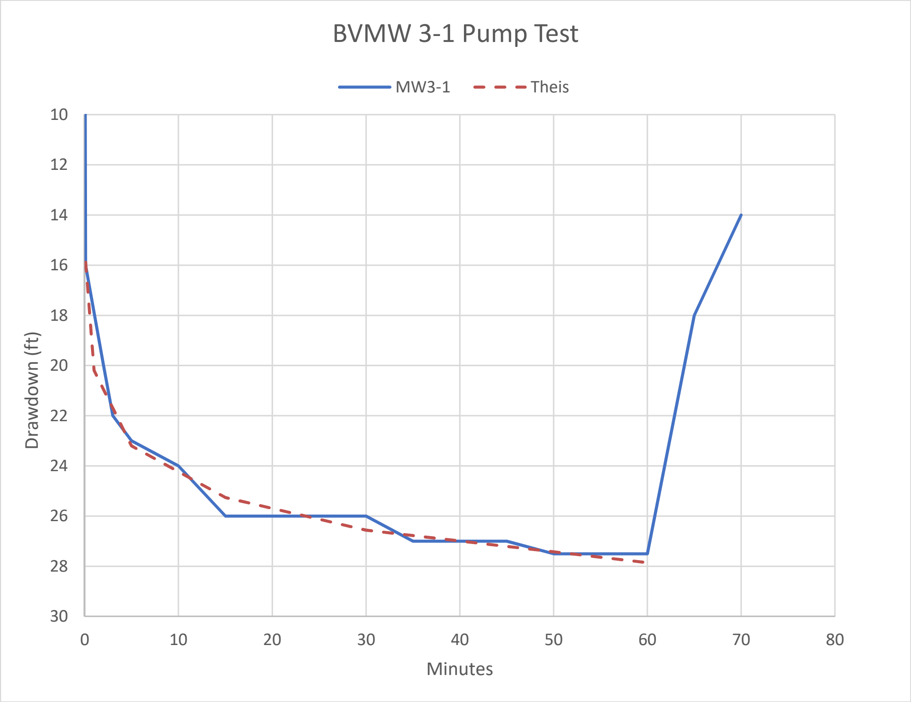


Theis Solution

Thickness (b)	40	ft
Flow (Q)	8	gpm
Well Efficiency	13	unitless
Transmissivity (T)	750	gpd/ft
Radius (r)	1	ft
Storativity (S)1	0	unitless
Hydraulic Conductivity (K)	3	ft/d

Pumpng Test

MW3-1		Lookout	
Time	**Minutes**	**Depth to Water (ft)**	**Drawdown**
9:20	0	18	0
9:21	0.1	34	16
9:22	2	38	20
9:23	3	40	22
9:25	5	41	23
9:30	10	42	24
9:35	15	44	26
9:40	20	44	26
9:45	25	44	26
9:50	30	44	26
9:55	35	45	27
10:00	40	45	27
10:05	45	45	27
10:10	50	45.5	27.5
10:15	55	45.5	27.5
10:20	60	45.5	27.5
10:25	65	36	18
10:30	70	32	14



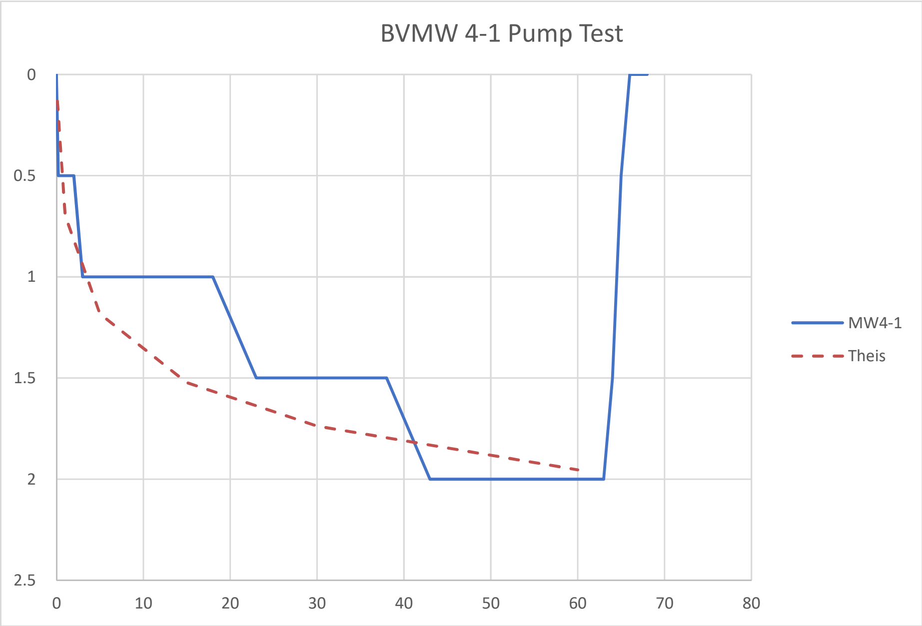
Theis Solution

Thickness (b)	50	ft
Flow (Q)	8	gpm
Well Efficiency	13	unitless
Transmissivity (T)	700	gpd/ft
Radius (r)	1	ft
Storativity (S)1	0.000003	unitless
Hydraulic Conductivity (	1.87	ft/d

Pumping Test

MW4-1

Time	Minutes	Depth to Water (ft)	Drawdown
1:55	0	33.5	0
1:57	0.2	34	0.5
1:58	1	34	0.5
1:59	2	34	0.5
2:00	3	34.5	1
2:05	8	34.5	1
2:10	13	34.5	1
2:15	18	34.5	1
2:20	23	35	1.5
2:25	28	35	1.5
2:30	33	35	1.5
2:35	38	35	1.5
2:40	43	35.5	2
2:45	48	35.5	2
2:50	53	35.5	2
2:55	58	35.5	2
3:00	63	35.5	2
3:01	64	35	1.5
3:02	65	34	0.5
3:03	66	33.5	0
3:04	67	33.5	0
3:05	68	33.5	0



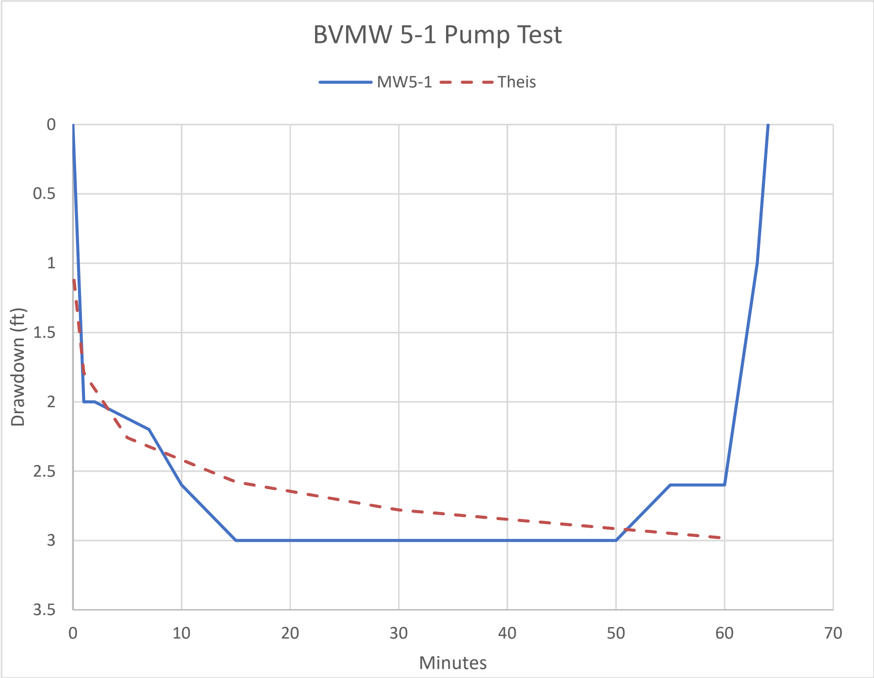
Theis Solution

Thickness (b)	30	ft
Flow (Q)	8	gpm
Well Efficiency	13	unitless
Transmissivity (T)	4200	gpd/ft
Radius (r)	1	ft
Storativity (S)1	0.1	unitless
Hydraulic Conductivity (K)	19	ft/d

Pumping Test

MW5-1

Time	Minutes	Depth to Water (ft)	Drawdown
11:50	0	42	0
11:51	1	44	2
11:52	2	44	2
11:57	7	44.2	2.2
12:00	10	44.6	2.6
12:05	15	45	3
12:10	20	45	3
12:15	25	45	3
12:20	30	45	3
12:30	40	45	3
12:35	45	45	3
12:40	50	45	3
12:45	55	44.6	2.6
12:50	60	44.6	2.6
12:57	63	43	1
12:58	64	42	0



Theis Solution

Thickness (b)	50	ft
Flow (Q)	8	gpm
Well Efficiency	13	unitless
Transmissivity (T)	4500	gpd/ft
Radius (r)	1	ft
Storativity (S)1	0.002	unitless
Hydraulic Conductivity (K)	12	ft/d

Appendix 5A Water Level Hydrographs

Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	022094_38N07E20B006M
Well Name	20B6
State Number	38N07E20B006M
WCR Number	128135
Site Code	411242N1211866W001

Well Location

County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Residential
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1242
	Long:	-121.1866
Well Depth		183.00 ft
Ground Surface Elevation		4126.30 ft
Ref. Point Elevation		4127.30 ft
Screen Depth Range		-
Screen Elevation Range		-

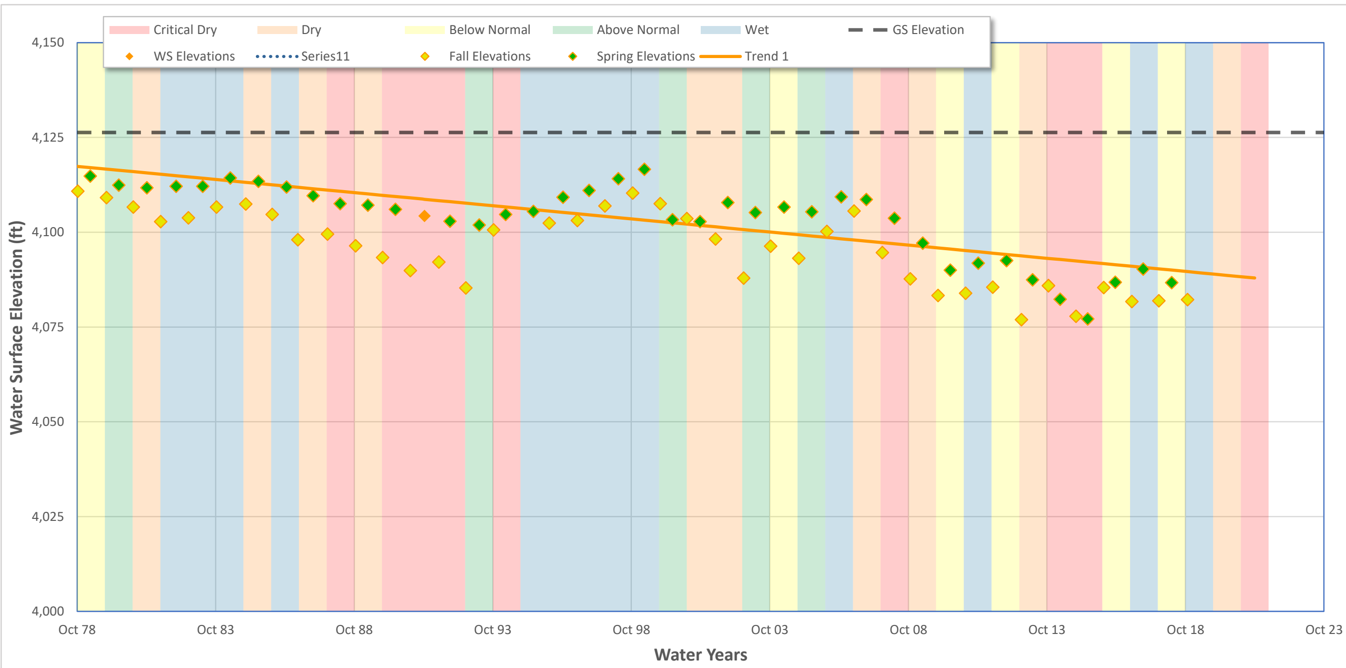
Well Period of Record

Period-of-Record		1979..2021
WS Elev-Range	Min:	4076.9 ft
	Max	4116.6 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.692 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	022095_38N07E24J002M
Well Name	24J2
State Number	38N07E24J002M
WCR Number	5327
Site Code	411228N1211054W001

Well Location

County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1226
	Long:	-121.1054
Well Depth		192.00 ft
Ground Surface Elevation		4138.40 ft
Ref. Point Elevation		4139.40 ft
Screen Depth Range		1 to 192 ft
Screen Elevation Range		4128 to 3937 ft

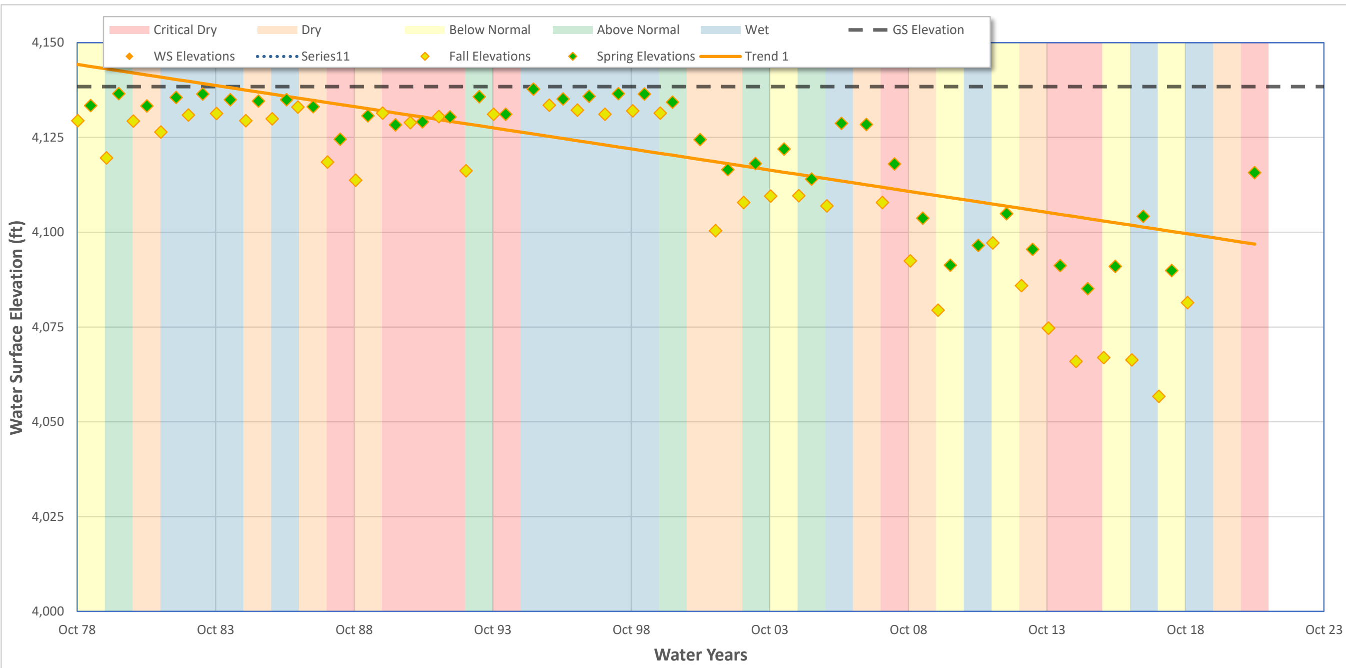
Well Period of Record

Period-of-Record		1979..2021
WS Elev-Range	Min:	4056.7 ft
	Max	4137.7 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(1.115 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	022096_38N07E32A002M
Well Name	32A2
State Number	38N07E32A002M
WCR Number	-
Site Code	410950N1211839W001

Well Location

County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Other
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.0950
	Long:	-121.1839
Well Depth		49.00 ft
Ground Surface Elevation		4118.80 ft
Ref. Point Elevation		4119.50 ft
Screen Depth Range		-
Screen Elevation Range		-

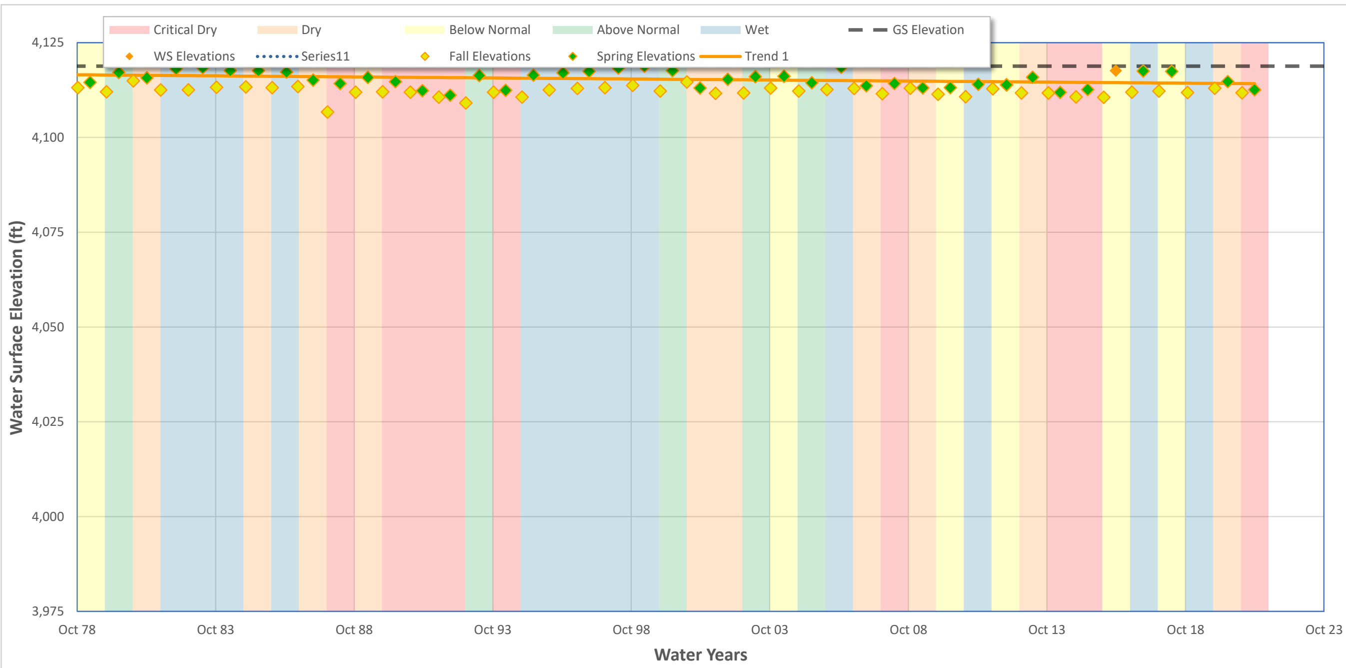
Well Period of Record

Period-of-Record		1959..2021
WS Elev-Range	Min:	4106.7 ft
	Max	4118.8 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.055 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

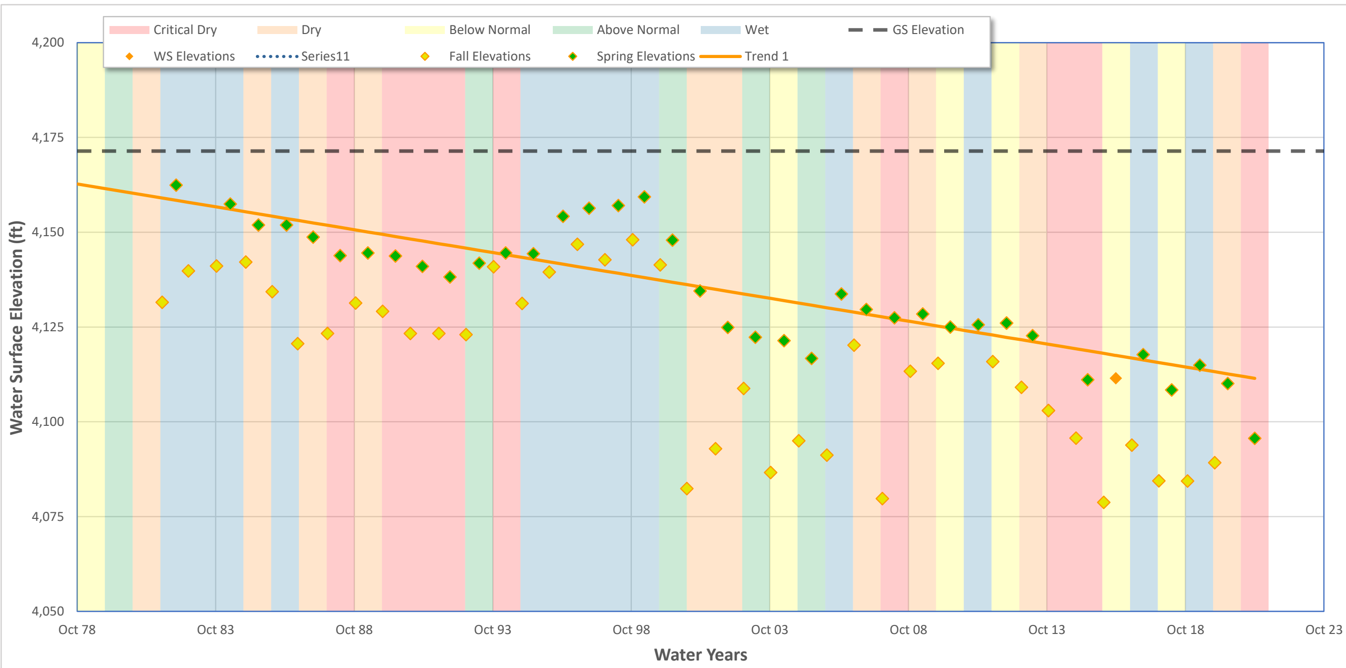
Date: 8/17/2021

Well Information	
Well ID	022097_38N08E16D001M
Well Name	16D1
State Number	38N08E16D001M
WCR Number	090143
Site Code	411359N1210625W001
Well Location	
County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services
Well Type Information	
Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.1358
	Long:	-121.0625
Well Depth		491.00 ft
Ground Surface Elevation		4171.40 ft
Ref. Point Elevation		4171.60 ft
Screen Depth Range		-
Screen Elevation Range		-
Well Period of Record		
Period-of-Record		1982..2021
WS Elev-Range	Min:	4078.7 ft
	Max	4162.4 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(1.206 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

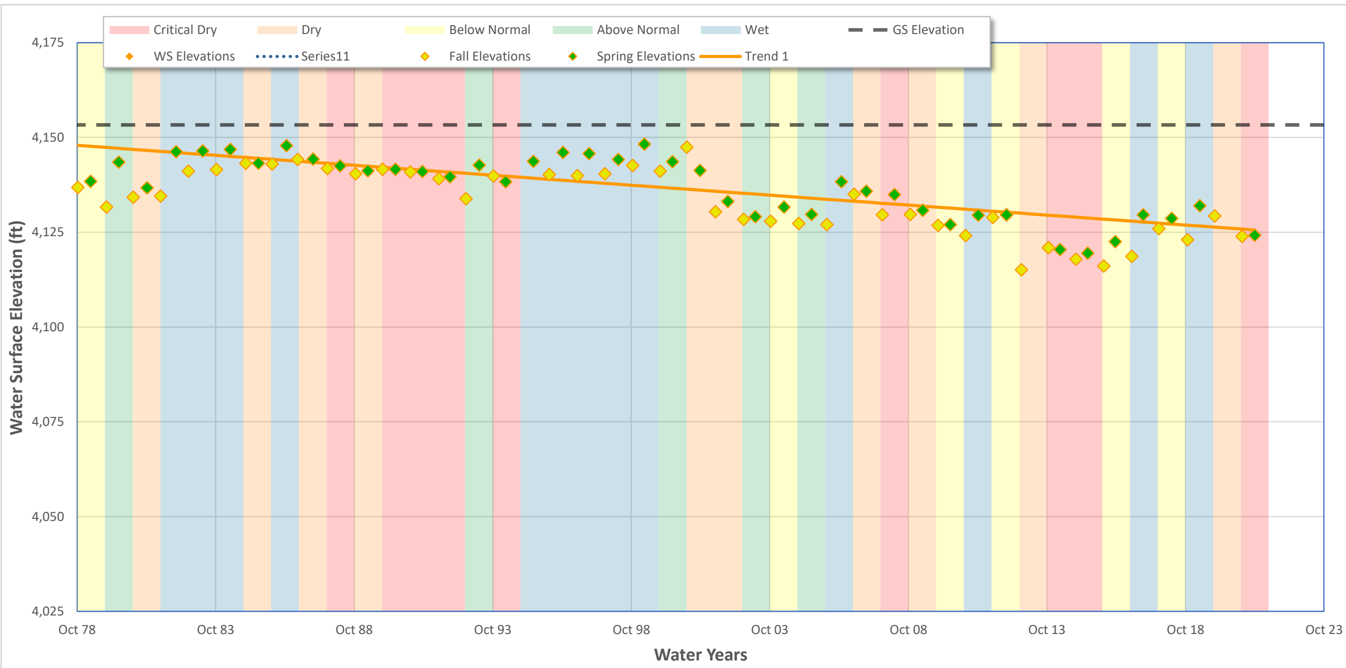
Date: 8/17/2021

Well Information	
Well ID	022098_38N08E17K001M
Well Name	17K1
State Number	38N08E17K001M
WCR Number	218
Site Code	411320N1210766W001
Well Location	
County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services
Well Type Information	
Well Use	Residential
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.1320
	Long:	-121.0766
Well Depth		180.00 ft
Ground Surface Elevation		4153.30 ft
Ref. Point Elevation		4154.30 ft
Screen Depth Range		30 to 180 ft
Screen Elevation Range		4259 to 4109 ft
Well Period of Record		
Period-of-Record		1957..2021
WS Elev-Range	Min:	4115.1 ft
	Max	4150.0 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.525 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	022099_38N09E18E001M
Well Name	18E1
State Number	38N09E18E001M
WCR Number	138559
Site Code	411356N1209900W001

Well Location

County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1356
	Long:	-120.9900
Well Depth		520.00 ft
Ground Surface Elevation		4248.40 ft
Ref. Point Elevation		4249.50 ft
Screen Depth Range		-
Screen Elevation Range		-

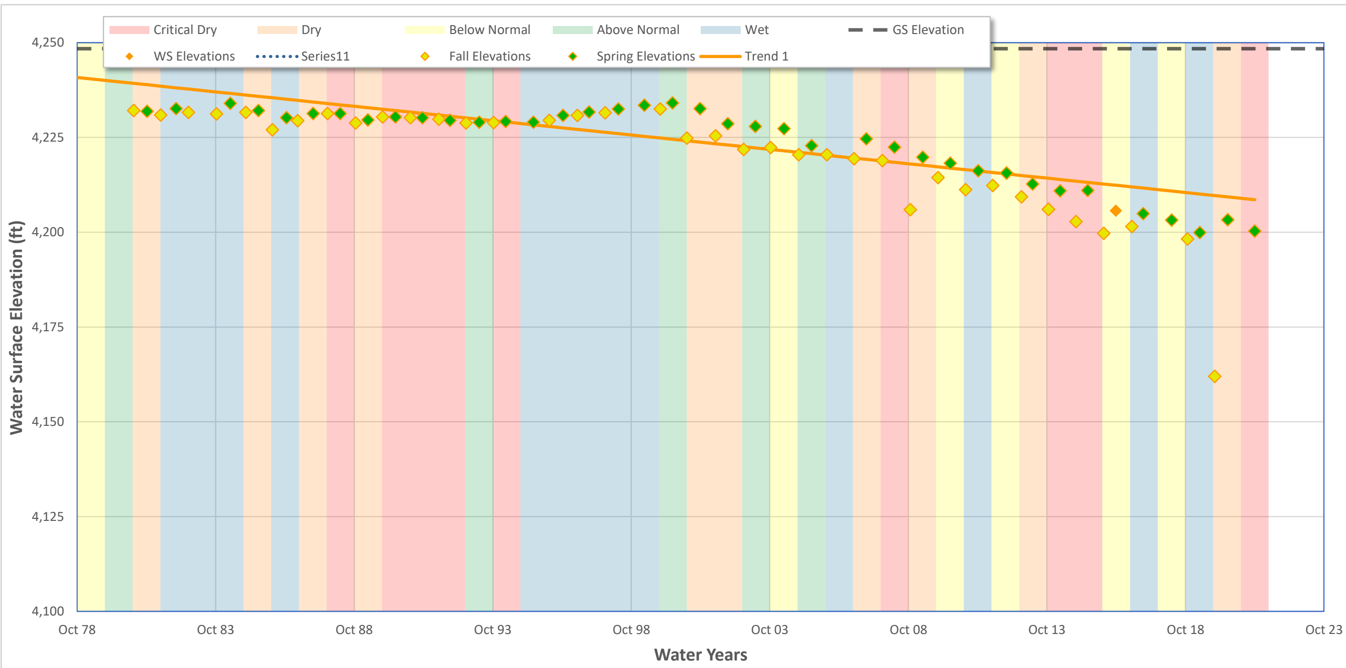
Well Period of Record

Period-of-Record		1981..2021
WS Elev-Range	Min:	4162.0 ft
	Max	4234.1 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.758 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

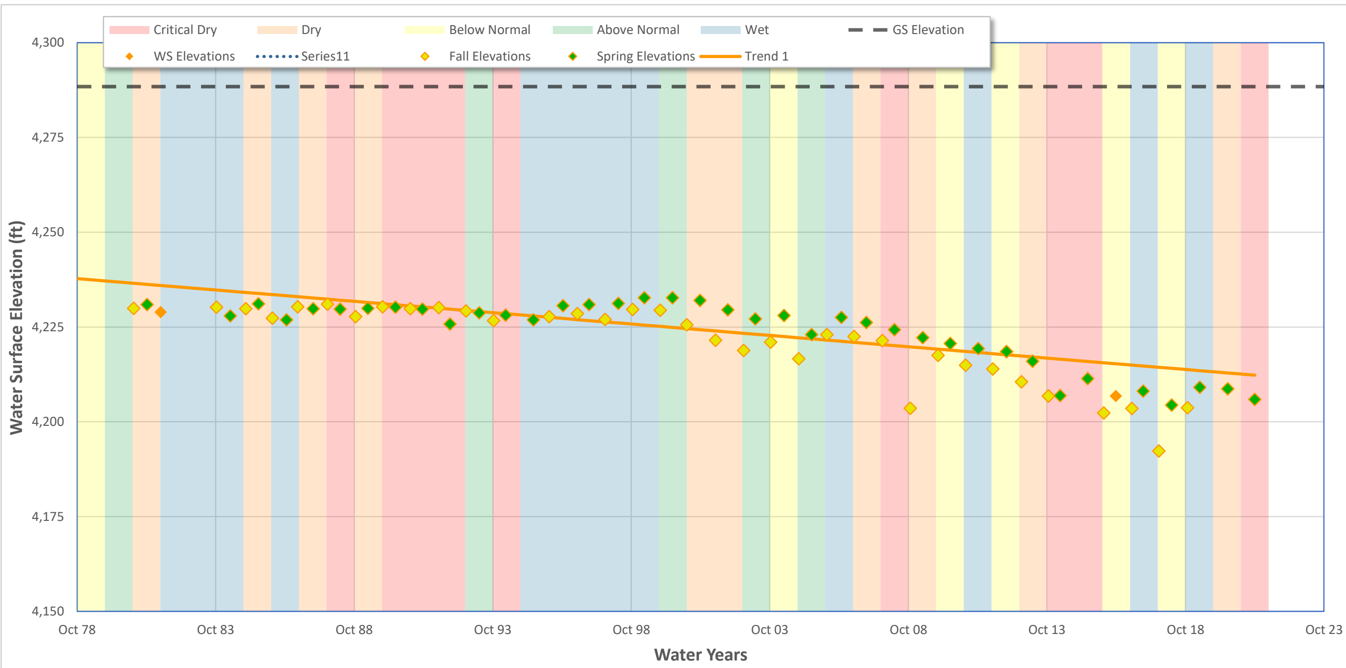
Date: 8/17/2021

Well Information	
Well ID	022100_38N09E18M001M
Well Name	18M1
State Number	38N09E18M001M
WCR Number	138563
Site Code	411305N1209896W001
Well Location	
County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services
Well Type Information	
Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.1305
	Long:	-120.9897
Well Depth		525.00 ft
Ground Surface Elevation		4288.40 ft
Ref. Point Elevation		4288.90 ft
Screen Depth Range		-
Screen Elevation Range		-
Well Period of Record		
Period-of-Record		1981..2021
WS Elev-Range	Min:	4192.3 ft
	Max	4232.7 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.599 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	022102_39N07E26E001M
Well Name	26E1
State Number	39N07E26E001M
WCR Number	127484
Site Code	411911N1211354W001

Well Location

County	Modoc
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Modoc County Planning Department

Well Type Information

Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1911
	Long:	-121.1354
Well Depth		400.00 ft
Ground Surface Elevation		4133.40 ft
Ref. Point Elevation		4135.00 ft
Screen Depth Range		20 to 400 ft
Screen Elevation Range		4187 to 3807 ft

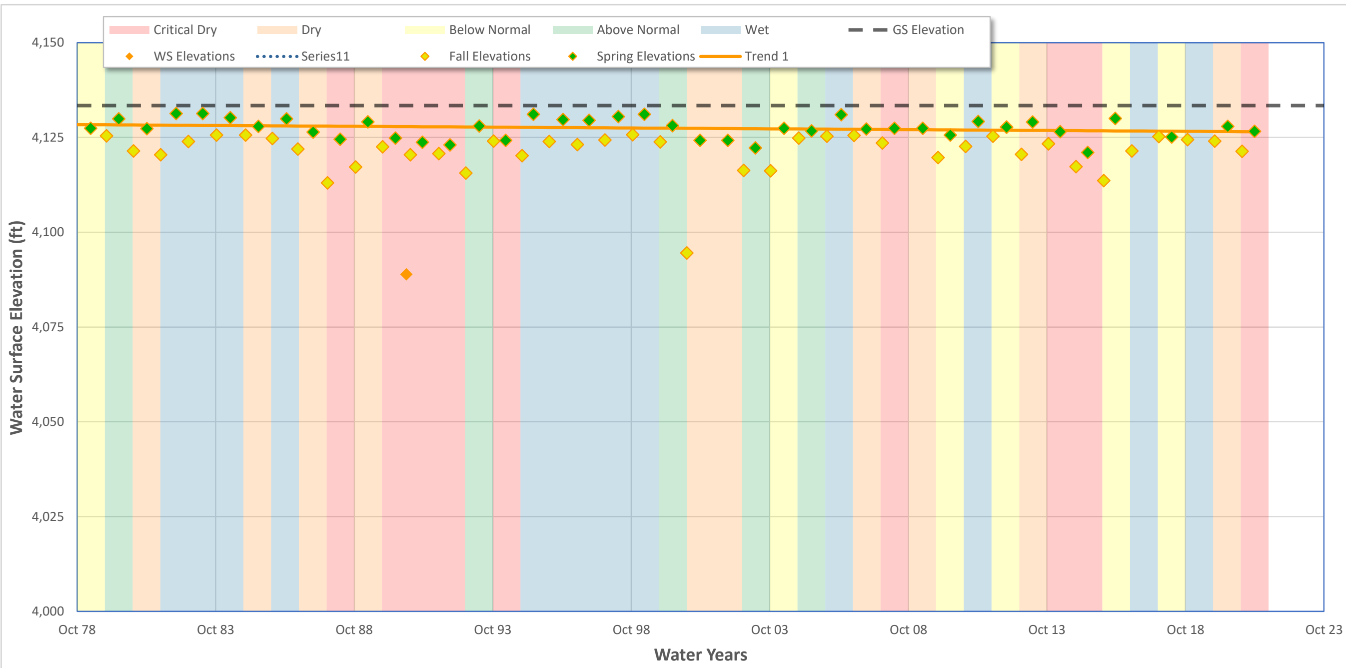
Well Period of Record

Period-of-Record		1979..2021
WS Elev-Range	Min:	4088.9 ft
	Max	4131.3 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.044 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

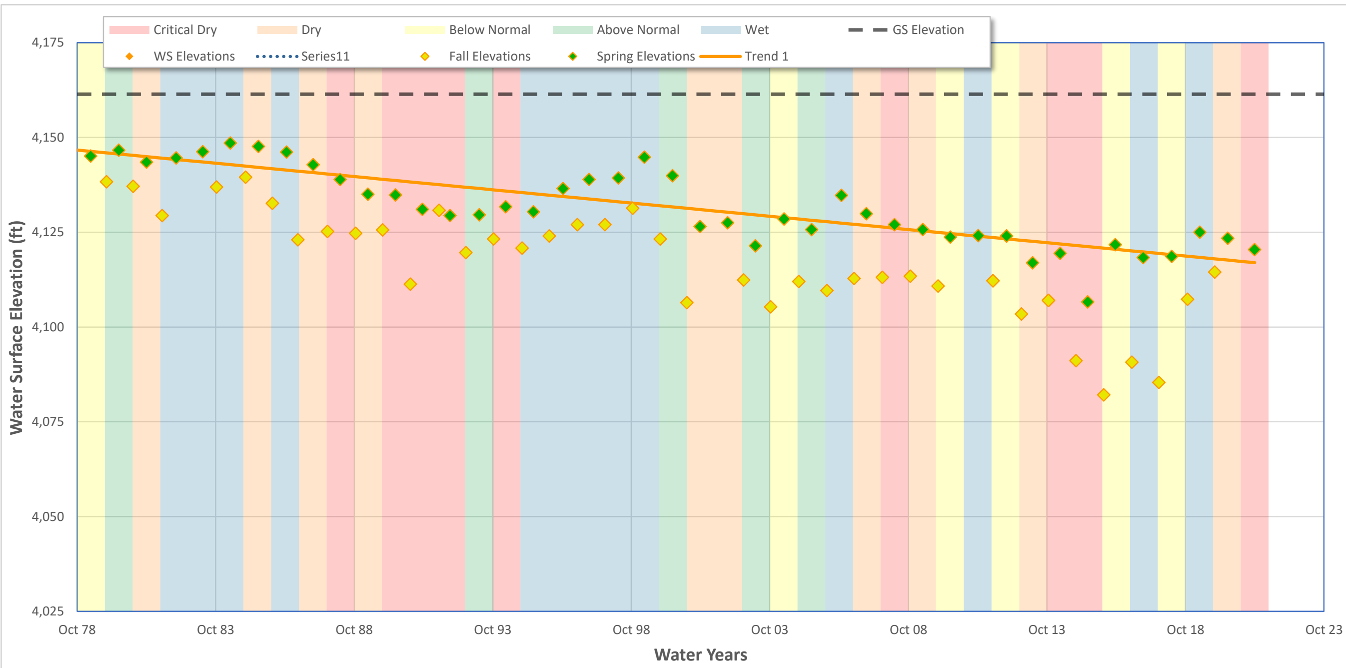
Date: 8/17/2021

Well Information	
Well ID	022103_39N08E21C001M
Well Name	21C1
State Number	39N08E21C001M
WCR Number	127008
Site Code	412086N1210574W001
Well Location	
County	Modoc
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Modoc County Planning Department
Well Type Information	
Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.2084
	Long:	-121.0576
Well Depth		300.00 ft
Ground Surface Elevation		4161.40 ft
Ref. Point Elevation		4161.70 ft
Screen Depth Range		30 to 40 ft
Screen Elevation Range		4114 to 4104 ft
Well Period of Record		
Period-of-Record		1979..2021
WS Elev-Range	Min:	4082.1 ft
	Max	4148.5 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.699 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	022107_39N09E28F001M
Well Name	28F1
State Number	39N09E28F001M
WCR Number	-
Site Code	411907N1209447W001

Well Location

County	Modoc
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Modoc County Planning Department

Well Type Information

Well Use	Residential
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1907
	Long:	-120.9447
Well Depth		73.00 ft
Ground Surface Elevation		4206.60 ft
Ref. Point Elevation		4207.10 ft
Screen Depth Range		-
Screen Elevation Range		-

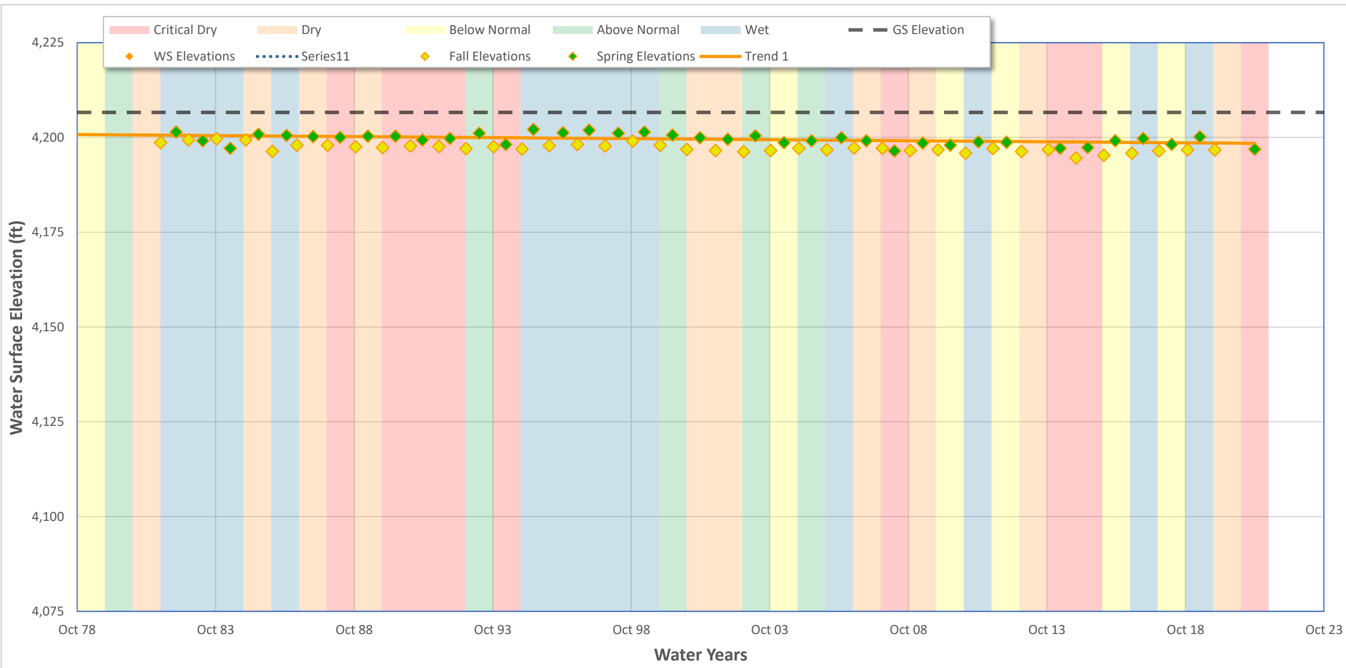
Well Period of Record

Period-of-Record		1982..2021
WS Elev-Range	Min:	4194.6 ft
	Max	4202.1 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.055 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

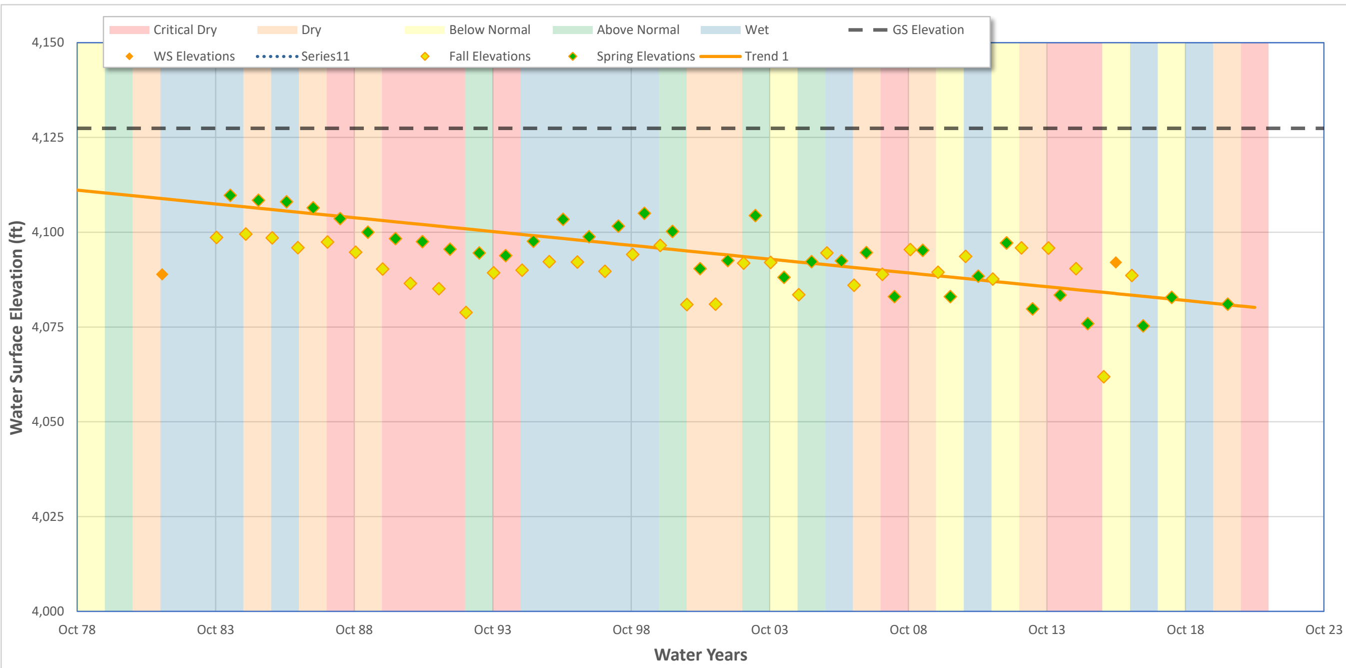
Date: 8/17/2021

Well Information	
Well ID	036667_37N07E13K002M
Well Name	13K2
State Number	37N07E13K002M
WCR Number	90029
Site Code	410413N1211147W001
Well Location	
County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services
Well Type Information	
Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.0413
	Long:	-121.1147
Well Depth		260.00 ft
Ground Surface Elevation		4127.40 ft
Ref. Point Elevation		4127.90 ft
Screen Depth Range		-
Screen Elevation Range		-
Well Period of Record		
Period-of-Record		1982..2021
WS Elev-Range	Min:	4061.9 ft
	Max	4109.7 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.728 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

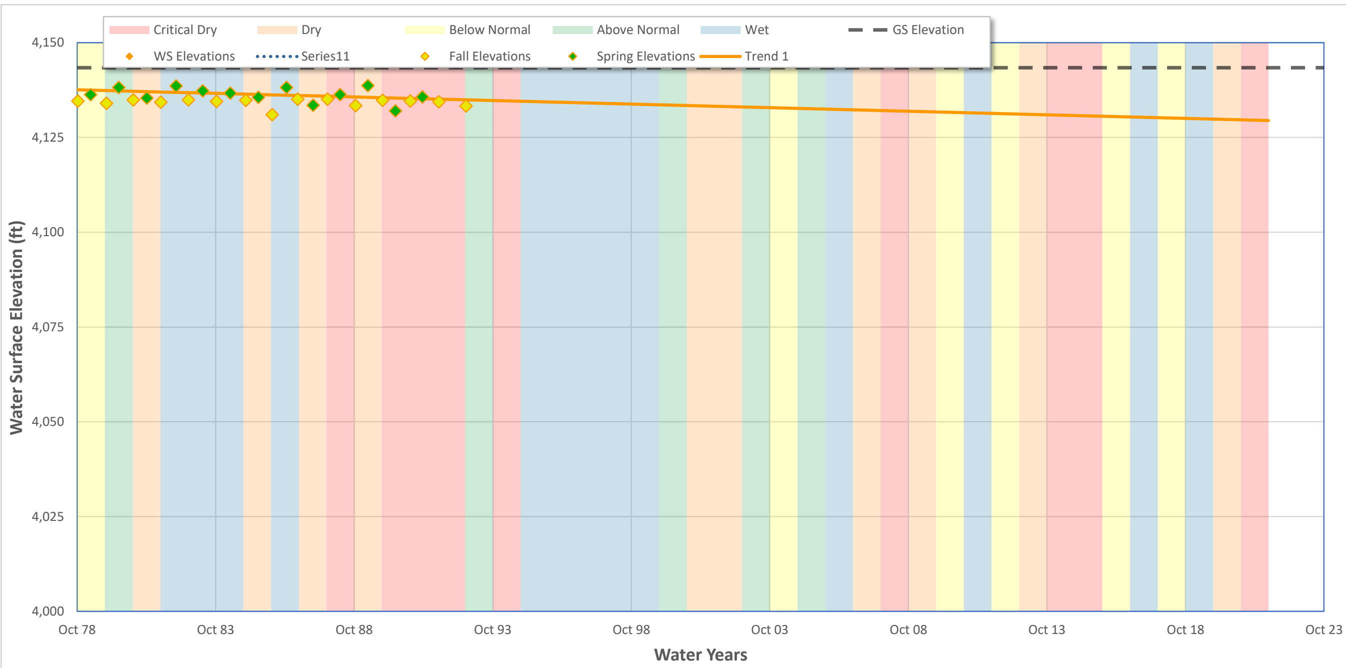
Date: 8/17/2021

Well Information	
Well ID	036669_38N07E12G001M
Well Name	12G1
State Number	38N07E12G001M
WCR Number	49866
Site Code	411467N1211110W001
Well Location	
County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services
Well Type Information	
Well Use	Residential
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.1467
	Long:	-121.1110
Well Depth		116.00 ft
Ground Surface Elevation		4143.38 ft
Ref. Point Elevation		4144.38 ft
Screen Depth Range		-
Screen Elevation Range		-
Well Period of Record		
Period-of-Record		1979..1994
WS Elev-Range	Min:	4131.0 ft
	Max	4138.7 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.189 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	036670_38N07E23E001M
Well Name	23E1
State Number	38N07E23E001M
WCR Number	38108
Site Code	411207N1211395W001

Well Location

County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Residential
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1207
	Long:	-121.1395
Well Depth		84.00 ft
Ground Surface Elevation		4123.40 ft
Ref. Point Elevation		4123.40 ft
Screen Depth Range		-
Screen Elevation Range		-

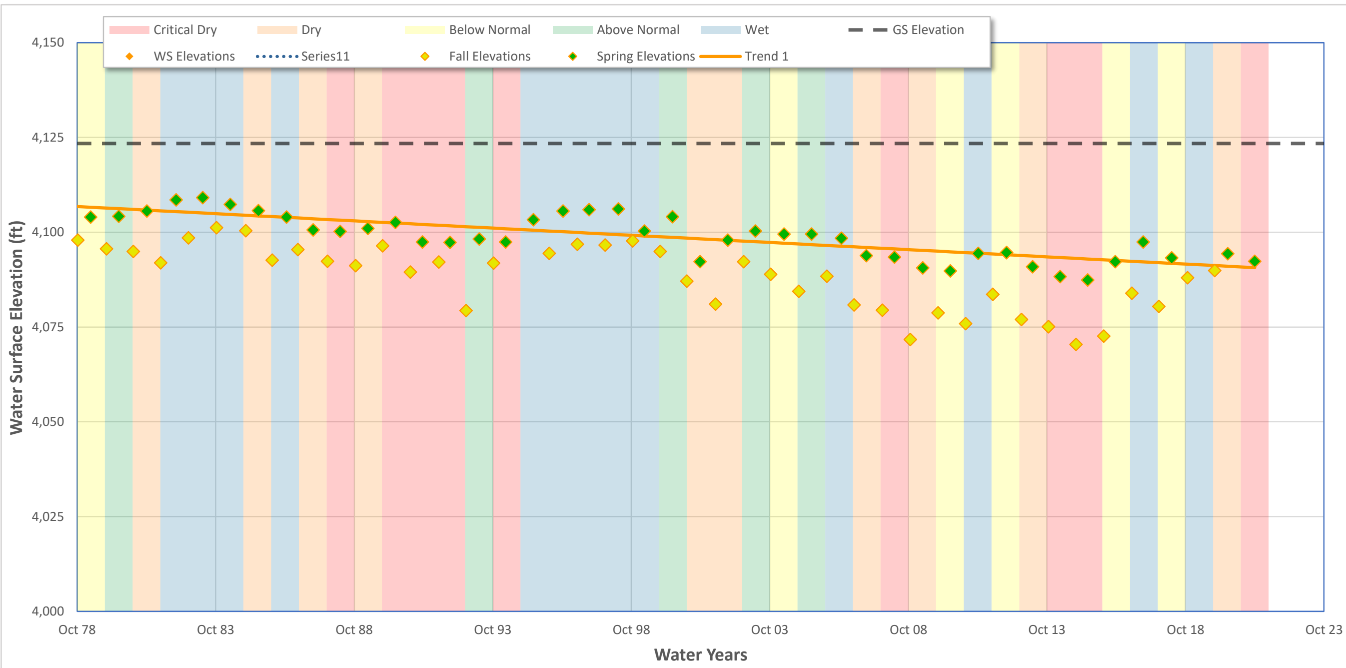
Well Period of Record

Period-of-Record		1979..2021
WS Elev-Range	Min:	4070.4 ft
	Max	4109.1 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.379 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	036671_38N08E03D001M
Well Name	03D1
State Number	38N08E03D001M
WCR Number	16564
Site Code	411647N1210358W001

Well Location

County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1646
	Long:	-121.0360
Well Depth		280.00 ft
Ground Surface Elevation		4163.40 ft
Ref. Point Elevation		4163.40 ft
Screen Depth Range		50 to 280 ft
Screen Elevation Range		4093 to 3863 ft

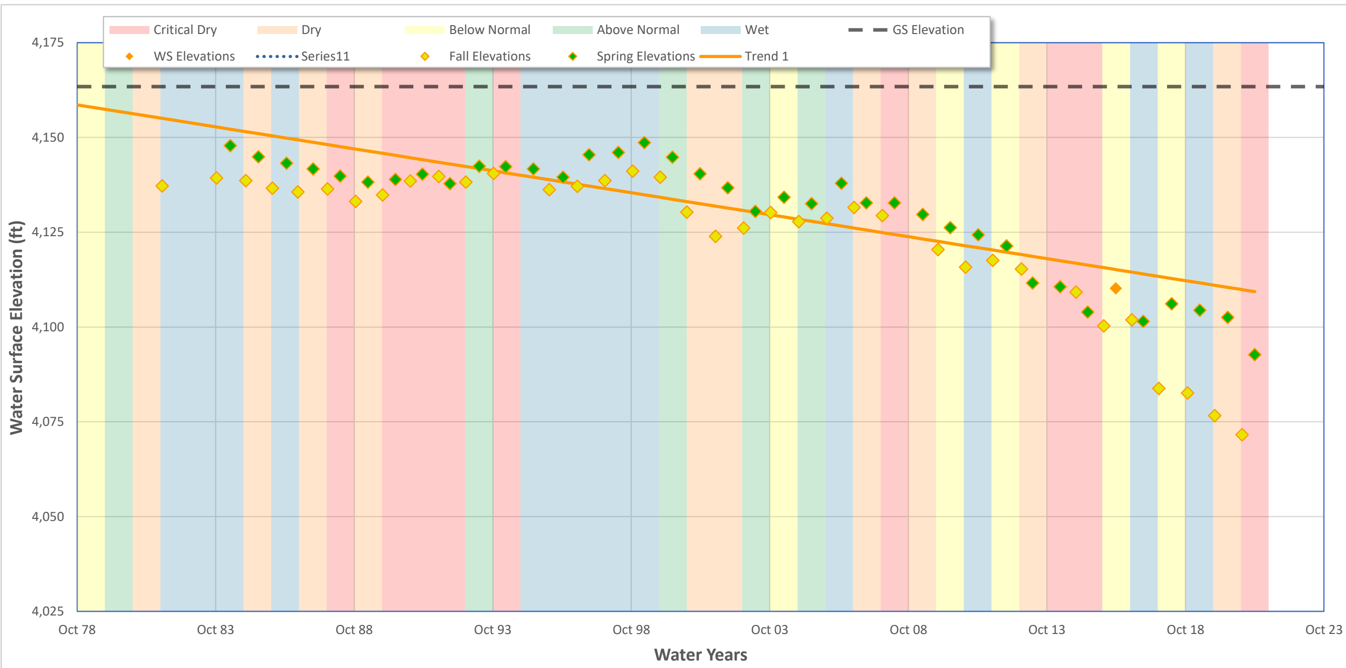
Well Period of Record

Period-of-Record		1982..2021
WS Elev-Range	Min:	4071.6 ft
	Max	4148.6 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(1.158 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

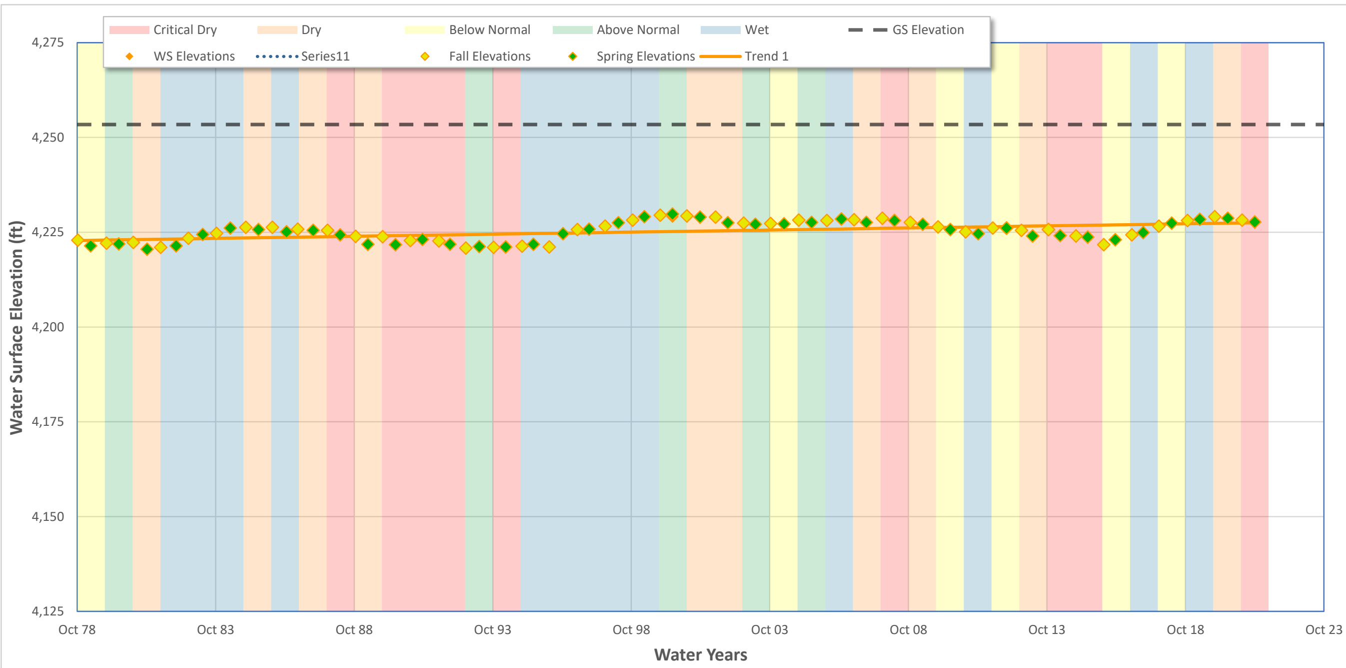
Date: 8/17/2021

Well Information	
Well ID	036672_38N09E08F001M
Well Name	08F1
State Number	38N09E08F001M
WCR Number	49934
Site Code	411493N1209656W001
Well Location	
County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services
Well Type Information	
Well Use	Other
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.1493
	Long:	-120.9656
Well Depth		217.00 ft
Ground Surface Elevation		4253.40 ft
Ref. Point Elevation		4255.40 ft
Screen Depth Range		-
Screen Elevation Range		-
Well Period of Record		
Period-of-Record		1979..2021
WS Elev-Range	Min:	4220.5 ft
	Max	4229.8 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	0.110 ft/yr
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	036673_39N07E01A001M
Well Name	01A1
State Number	39N07E01A001M
WCR Number	14565
Site Code	412539N1211050W001

Well Location

County	Modoc
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Modoc County Planning Department

Well Type Information

Well Use	Stockwatering
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.2539
	Long:	-121.1050
Well Depth		300.00 ft
Ground Surface Elevation		4183.40 ft
Ref. Point Elevation		4184.40 ft
Screen Depth Range		-
Screen Elevation Range		-

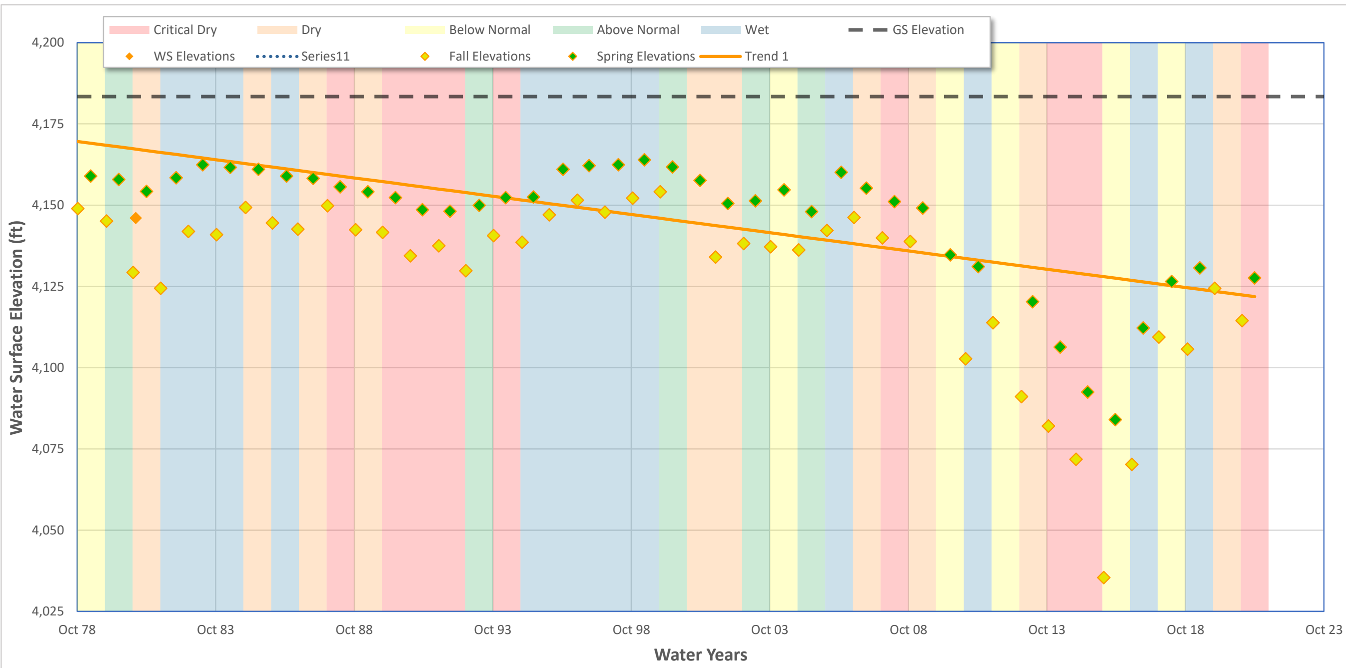
Well Period of Record

Period-of-Record		1979..2021
WS Elev-Range	Min:	4035.4 ft
	Max	4163.9 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(1.123 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

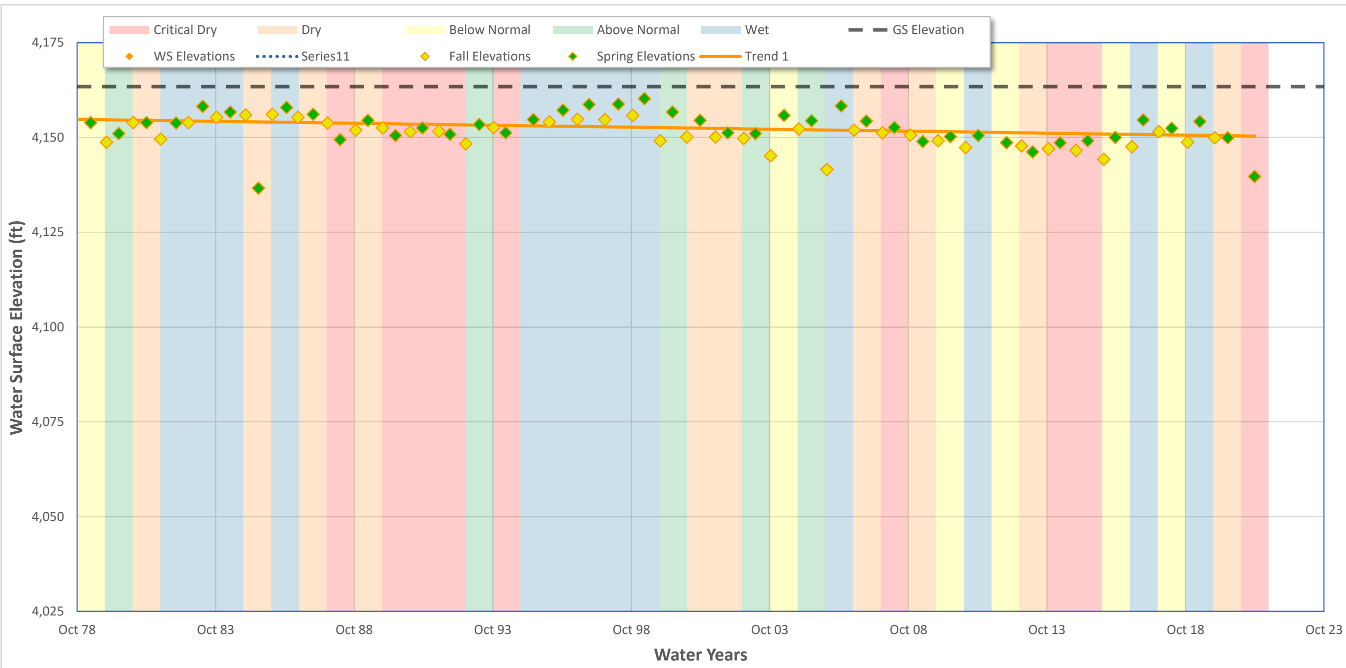
Date: 8/17/2021

Well Information	
Well ID	036754_39N08E18N002M
Well Name	18N2
State Number	39N08E18N002M
WCR Number	127457
Site Code	412144N1211013W001
Well Location	
County	Modoc
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Modoc County Planning Department
Well Type Information	
Well Use	Residential
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.2144
	Long:	-121.1013
Well Depth		250.00 ft
Ground Surface Elevation		4163.40 ft
Ref. Point Elevation		4164.40 ft
Screen Depth Range		-
Screen Elevation Range		-
Well Period of Record		
Period-of-Record		1979..2021
WS Elev-Range	Min:	4136.6 ft
	Max	4160.2 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.104 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	036757_39N09E32R001M
Well Name	32R1
State Number	39N09E32R001M
WCR Number	-
Site Code	411649N1209569W001

Well Location

County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1680
	Long:	-120.9570
Well Depth		-
Ground Surface Elevation		4243.40 ft
Ref. Point Elevation		4243.60 ft
Screen Depth Range		-
Screen Elevation Range		-

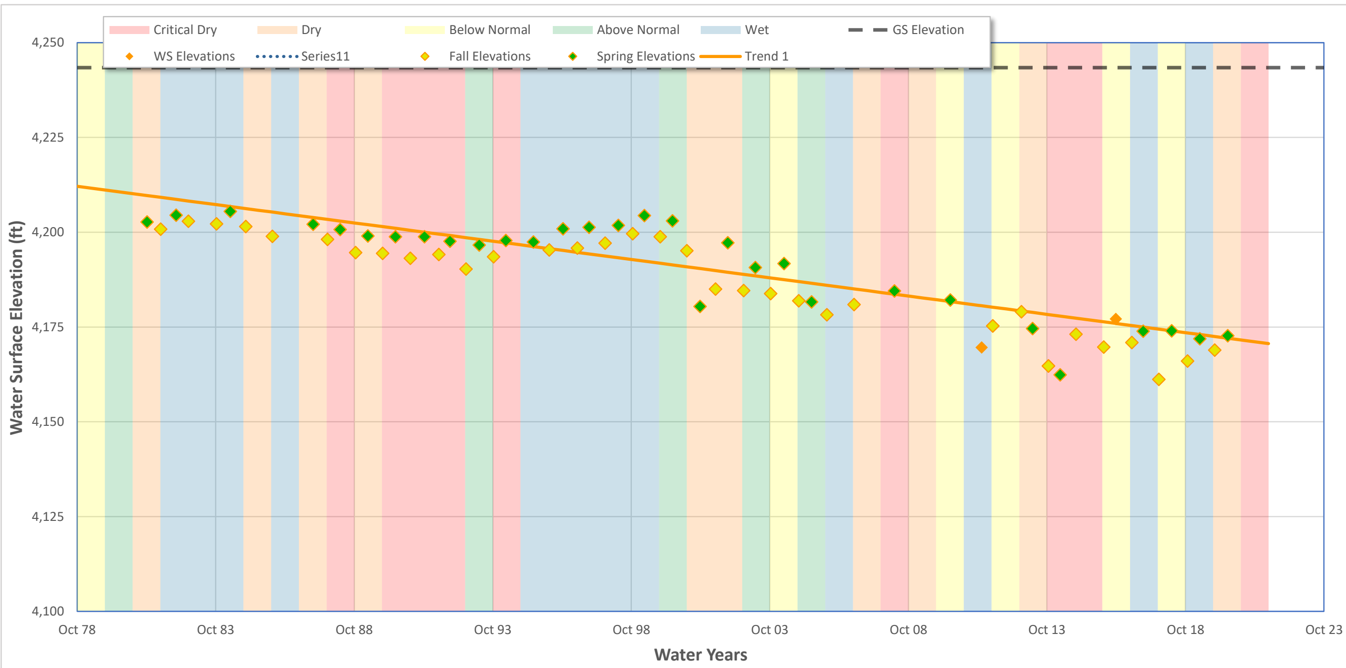
Well Period of Record

Period-of-Record		1981..2021
WS Elev-Range	Min:	4161.2 ft
	Max	4205.5 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(0.964 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

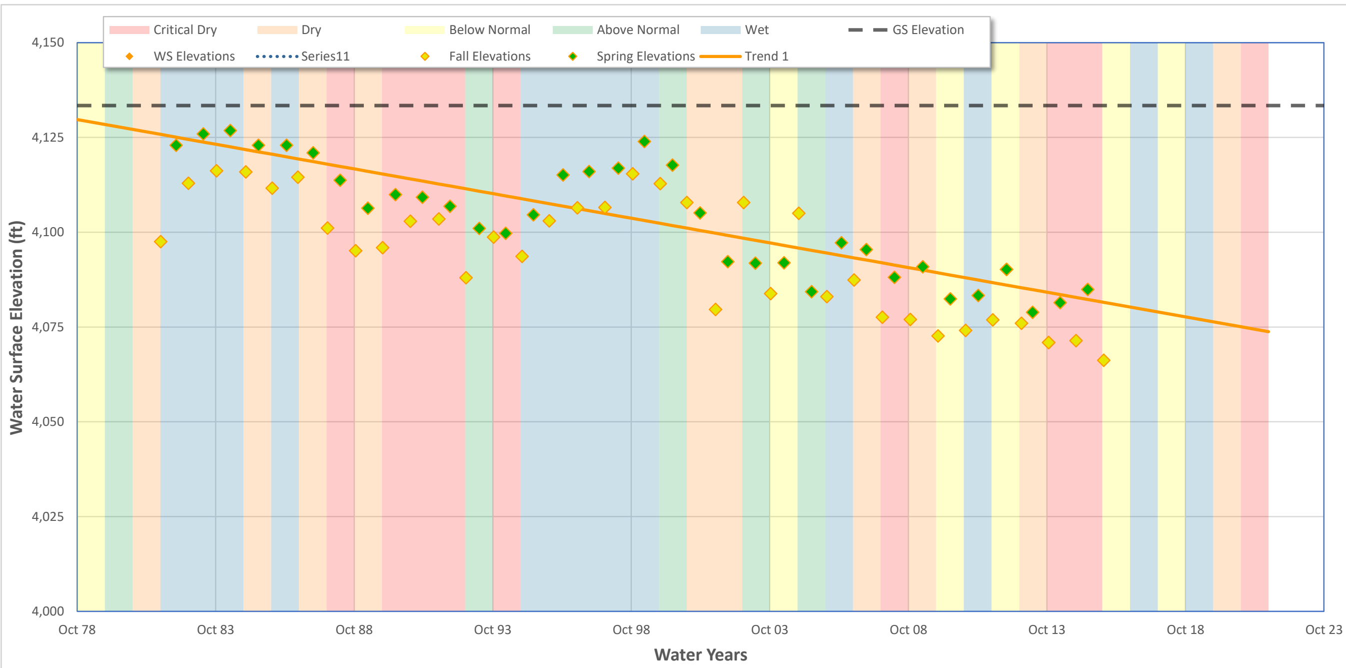
Date: 8/17/2021

Well Information	
Well ID	039199_37N08E06C001M
Well Name	06C1
State Number	37N08E06C001M
WCR Number	14580
Site Code	410777N1210986W001
Well Location	
County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services
Well Type Information	
Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.0777
	Long:	-121.0986
Well Depth		400.00 ft
Ground Surface Elevation		4133.40 ft
Ref. Point Elevation		4133.90 ft
Screen Depth Range		-
Screen Elevation Range		-
Well Period of Record		
Period-of-Record		1982..2016
WS Elev-Range	Min:	4066.2 ft
	Max	4126.8 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(1.301 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	051402_ACWA-1
Well Name	ACWA-1
State Number	38N08E07A001M
WCR Number	0962825
Site Code	411508N1210900W001

Well Location

County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1508
	Long:	-121.0900
Well Depth		780.00 ft
Ground Surface Elevation		4142.00 ft
Ref. Point Elevation		4142.75 ft
Screen Depth Range		60 to 780 ft
Screen Elevation Range		4083 to 3363 ft

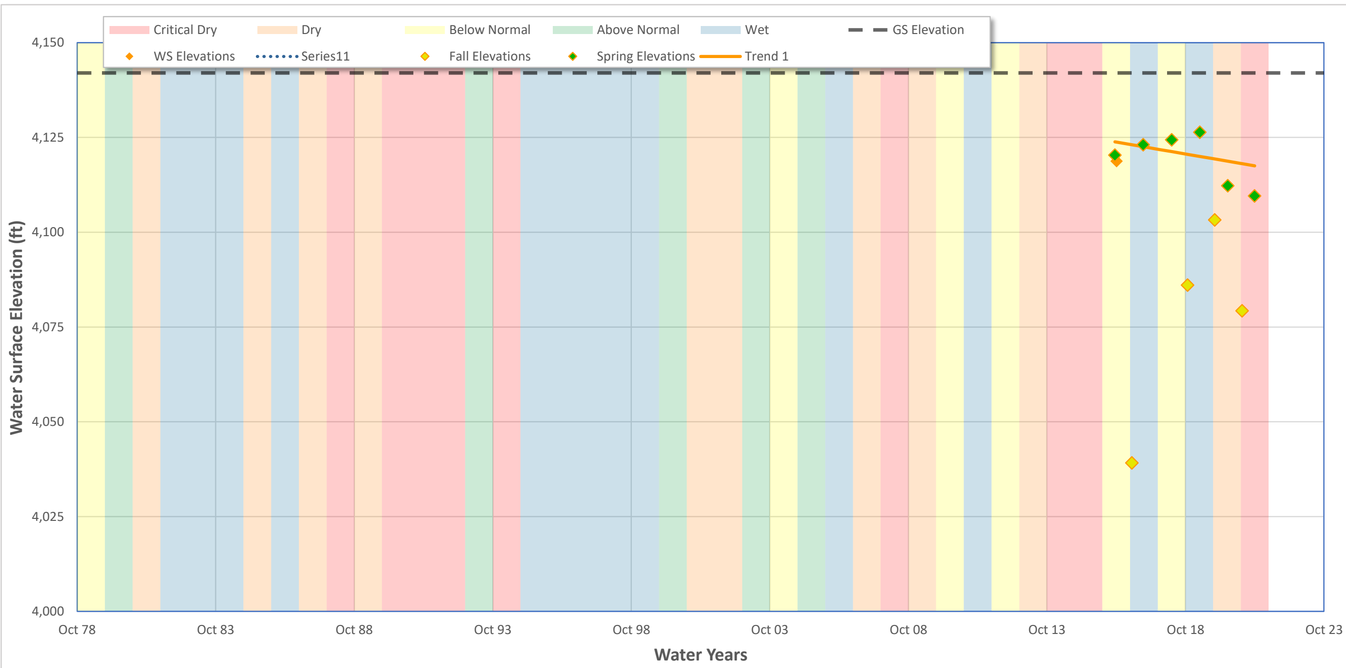
Well Period of Record

Period-of-Record		2016..2021
WS Elev-Range	Min:	4039.2 ft
	Max	4126.4 ft

Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	2016
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	(1.253 ft/yr)
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

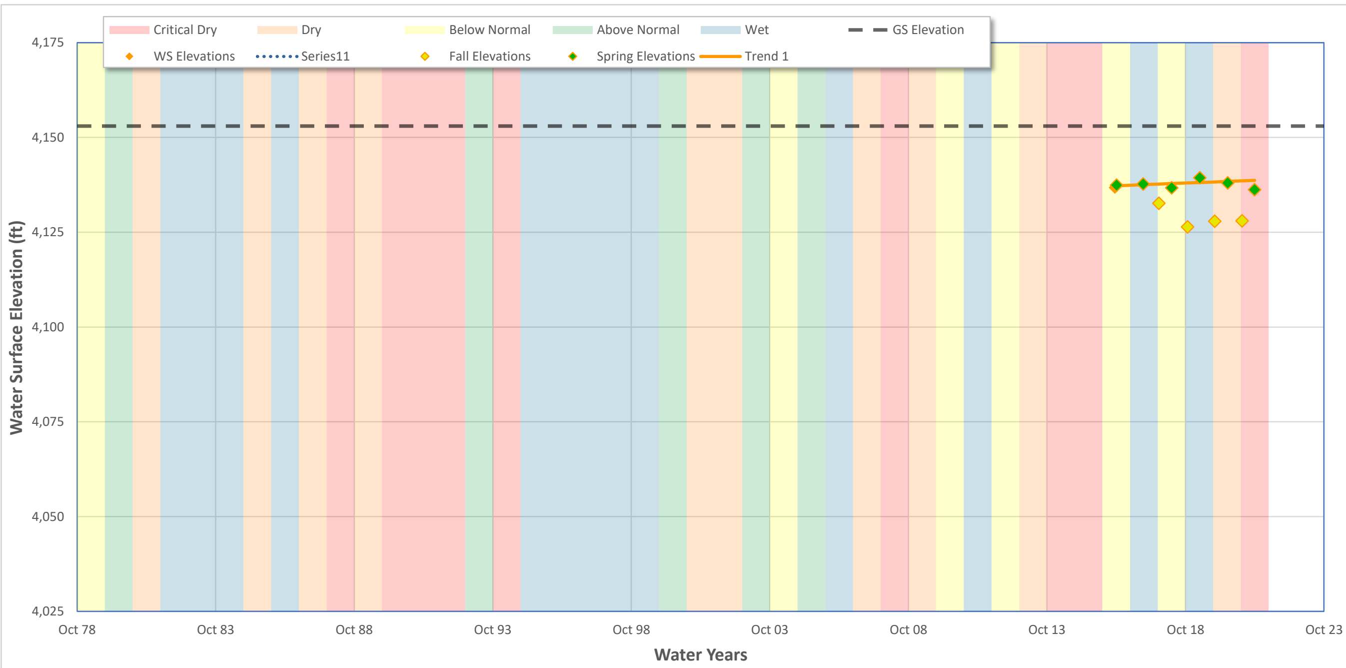
Date: 8/17/2021

Well Information	
Well ID	051403_ACWA-2
Well Name	ACWA-2
State Number	39N08E33P002M
WCR Number	484622
Site Code	411699N1210579W001
Well Location	
County	Lassen
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services
Well Type Information	
Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry		
Location	Lat:	41.1699
	Long:	-121.0579
Well Depth		800.00 ft
Ground Surface Elevation		4153.00 ft
Ref. Point Elevation		4153.20 ft
Screen Depth Range		50 to 800 ft
Screen Elevation Range		4093 to 3343 ft
Well Period of Record		
Period-of-Record		2016..2021
WS Elev-Range	Min:	4126.4 ft
	Max	4139.4 ft

Trend Analysis		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	2016
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	0.283 ft/yr
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Groundwater Level Report

Date: 8/17/2021

Well Information

Well ID	051537_ACWA-3
Well Name	ACWA-3
State Number	39N08E28A001M
WCR Number	0951365
Site Code	411938N1210478W001

Well Location

County	Modoc
Basin	Big Valley
Hydrologic Region	Sacramento River
Station Organization	Lassen County Department of Planning and Building Services

Well Type Information

Well Use	Irrigation
Completion Type	Single Well

Well Coordinates/Geometry

Location	Lat:	41.1938
	Long:	-121.0478
Well Depth		720.00 ft
Ground Surface Elevation		4159.00 ft
Ref. Point Elevation		4159.83 ft
Screen Depth Range		60 to 720 ft
Screen Elevation Range		4075 to 3415 ft

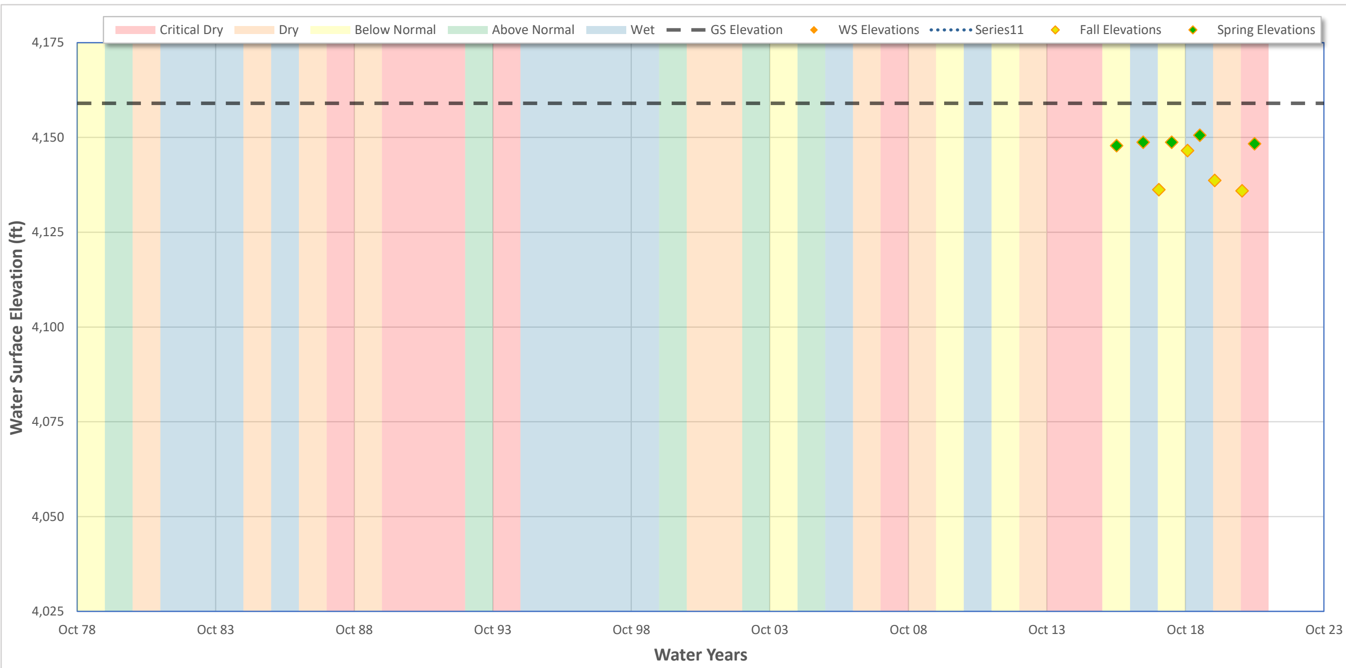
Well Period of Record

Period-of-Record		2016..2021
WS Elev-Range	Min:	4135.9 ft
	Max	4150.6 ft

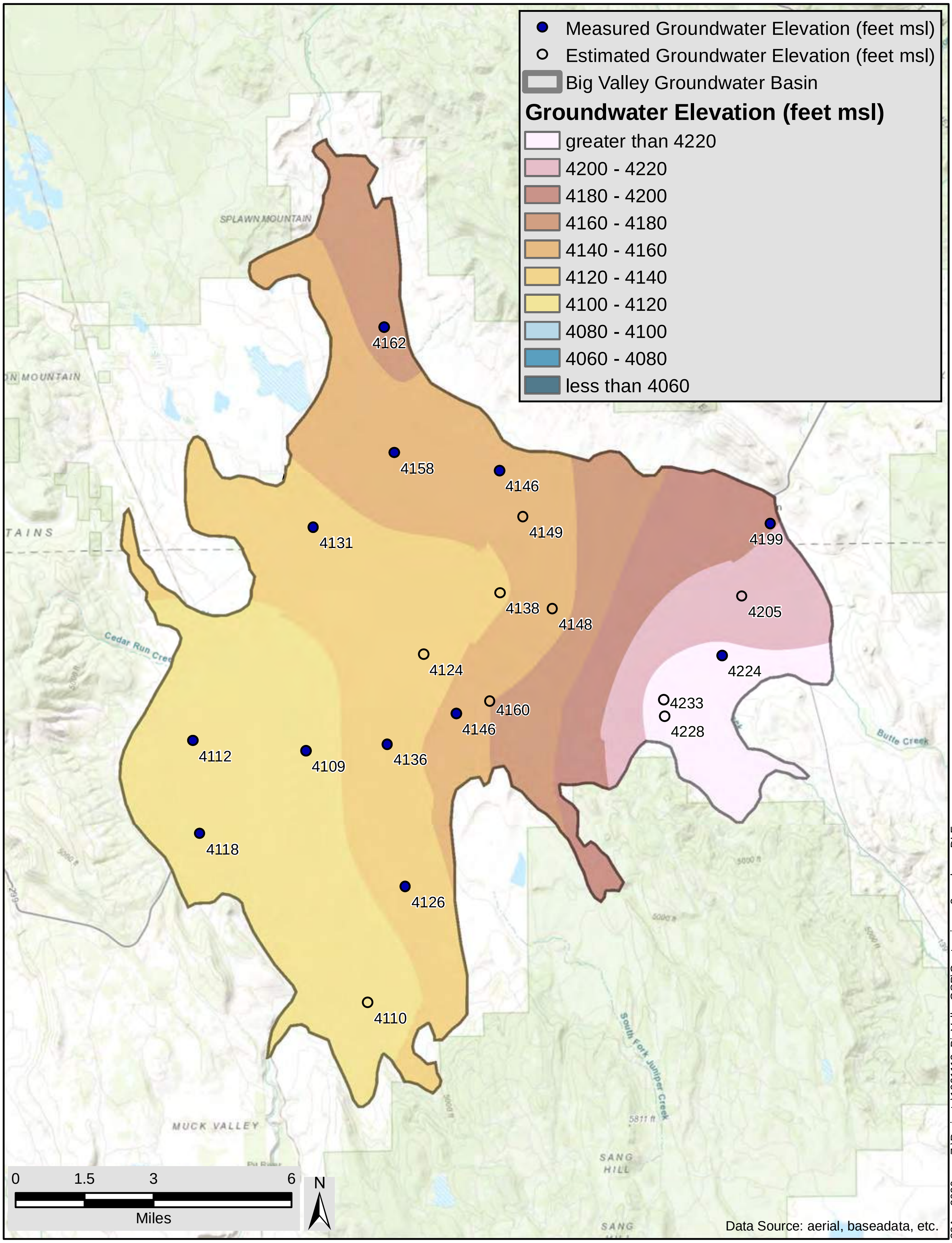
Trend Analysis

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range (Optional)	Start WY:	1979
	End WY:	2021
Extend Trend Line		No
Trend Results	Slope	0.821 ft/yr
Show Trend 2		None
Date Range (Optional)	Start WY:	
	End WY:	
Extend Trend Line		Yes
Trend Results	Slope	-

Water Surface Elevation (WSE) Hydrograph



Appendix 5B Groundwater Elevation Contours 1983 to 2018



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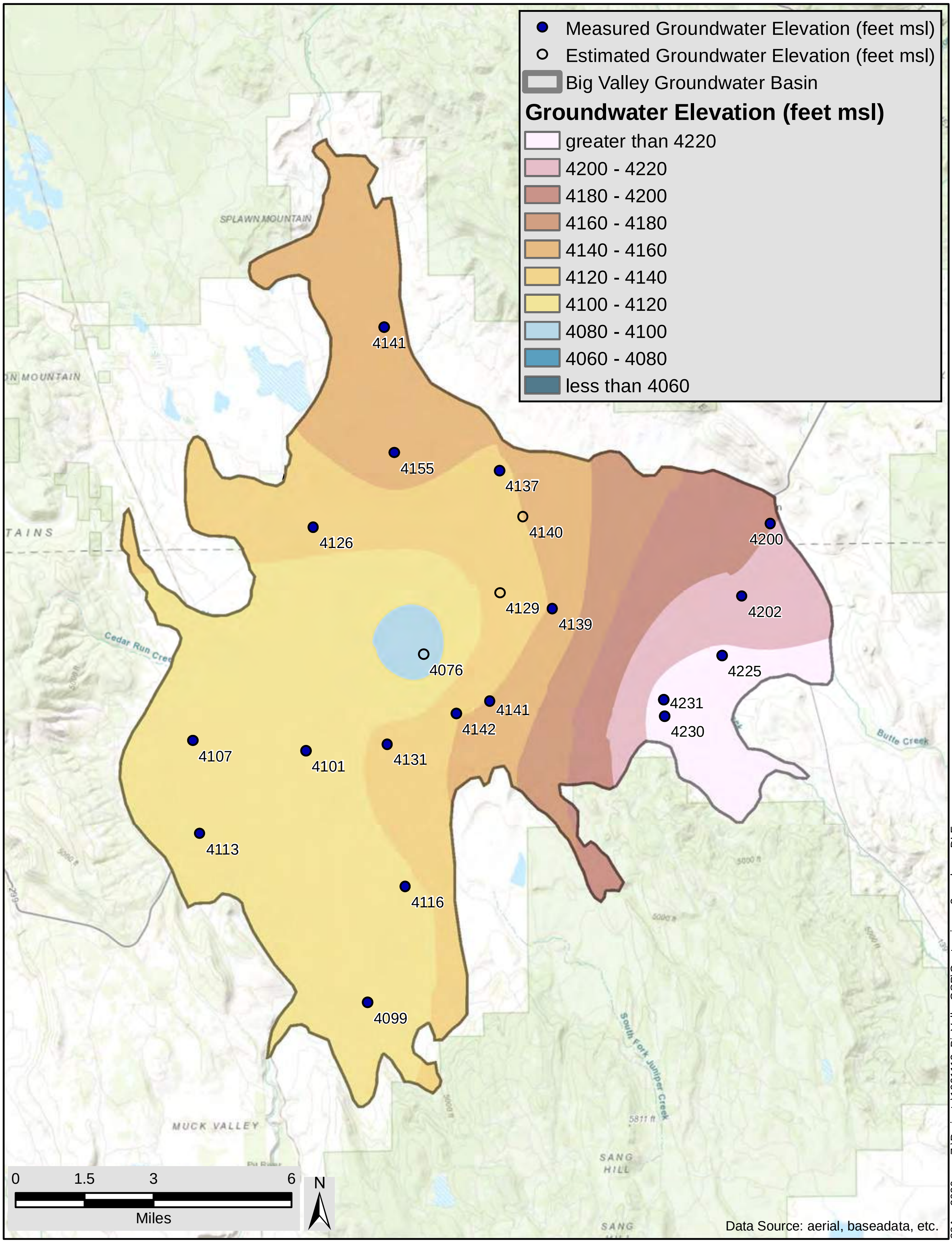
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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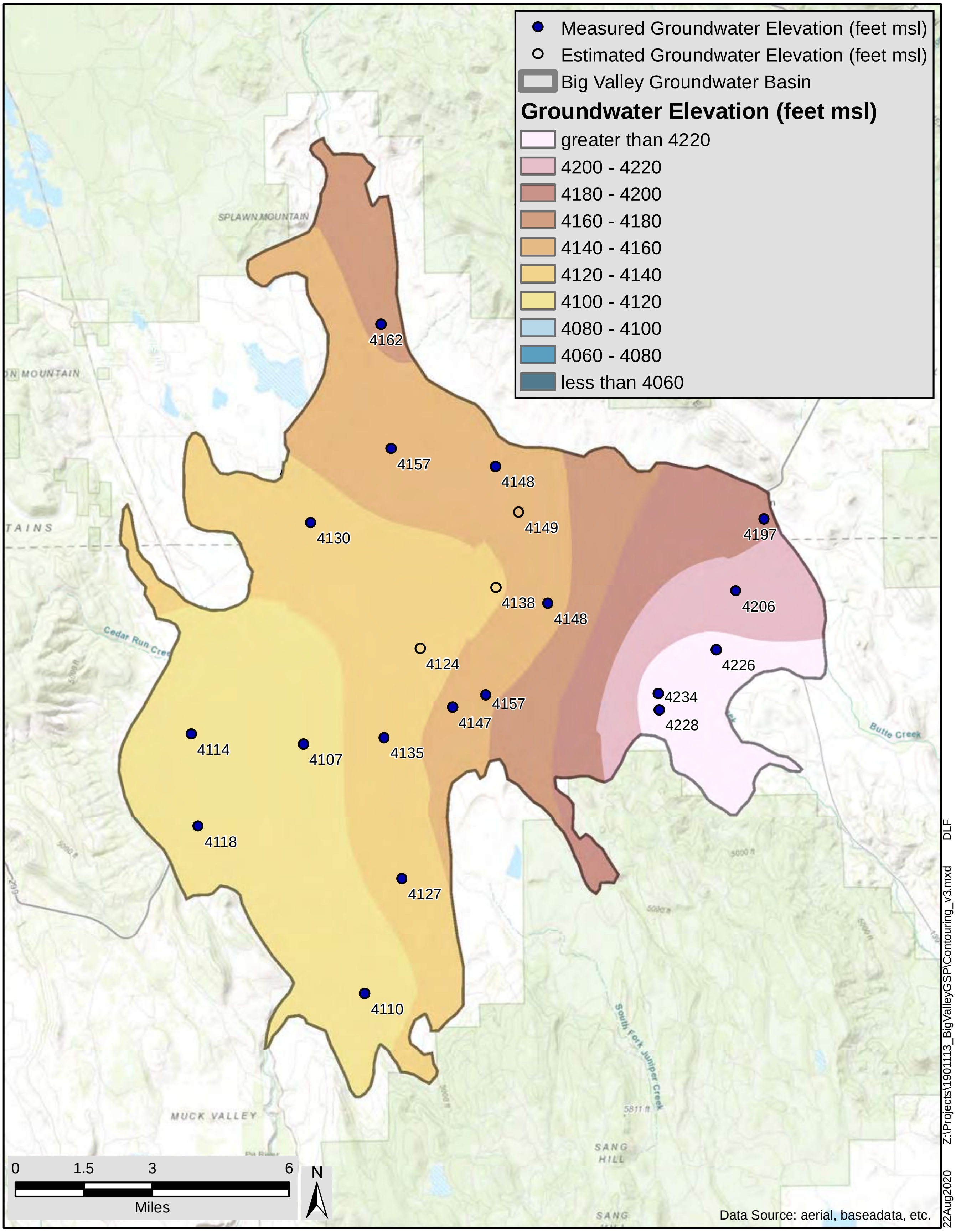

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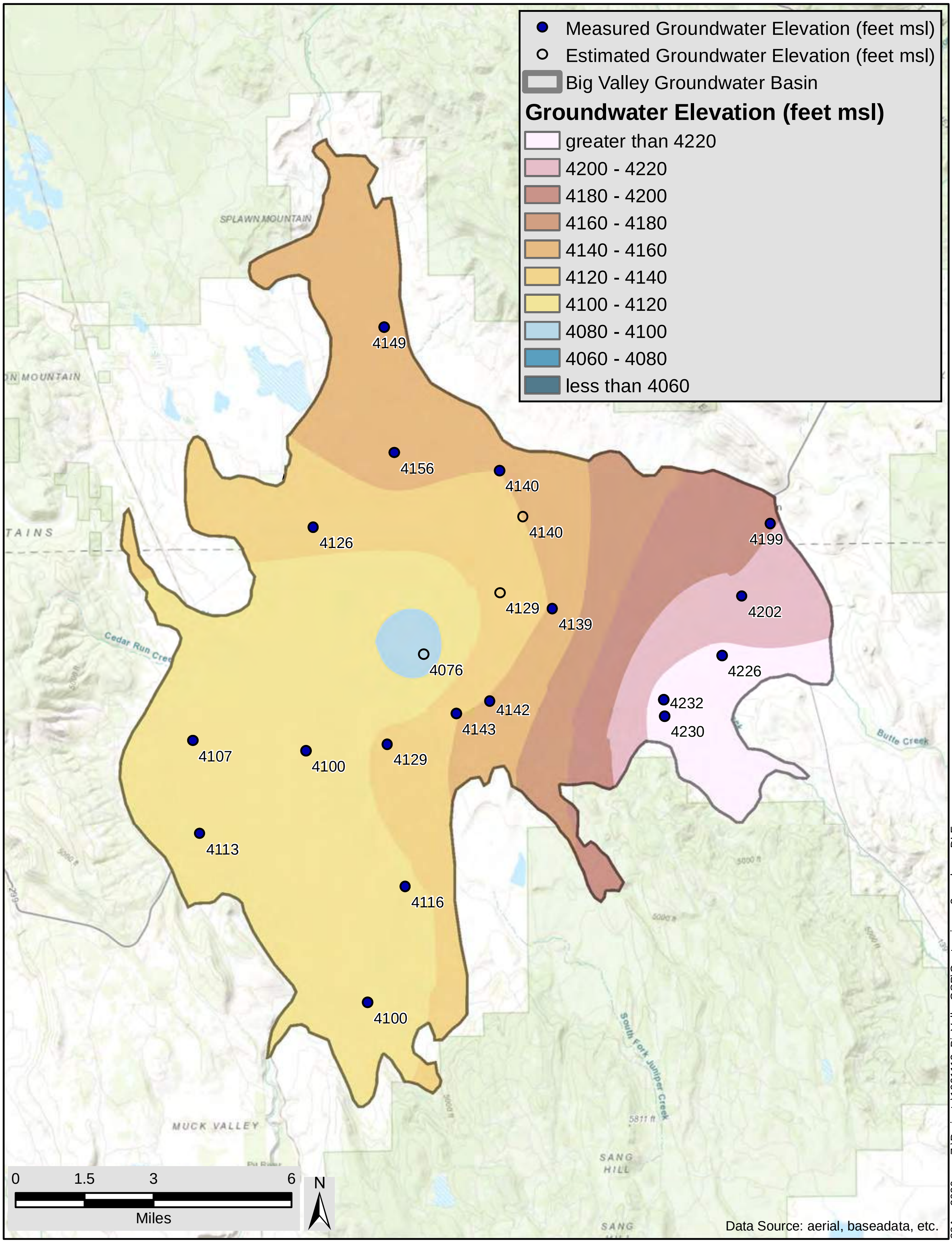

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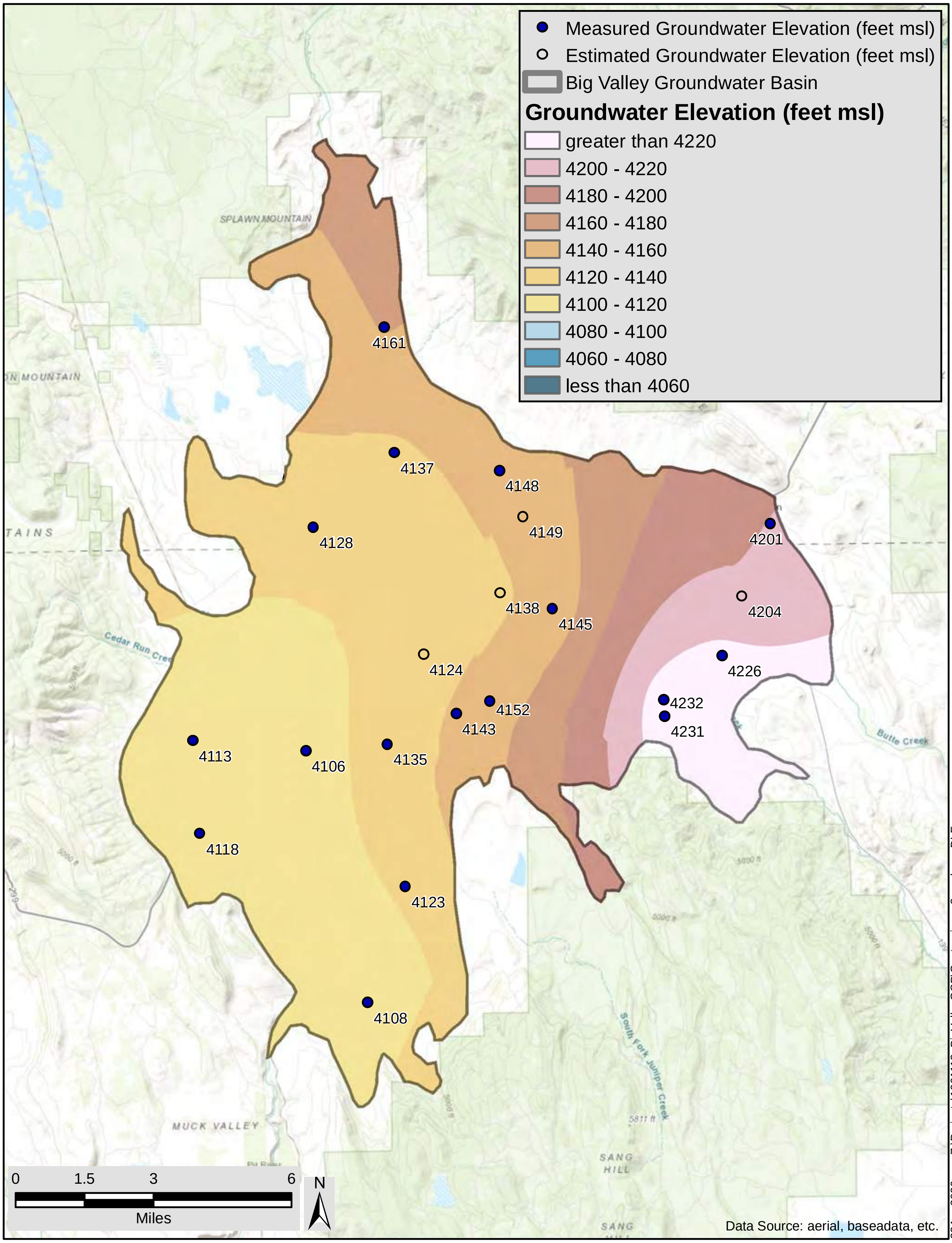

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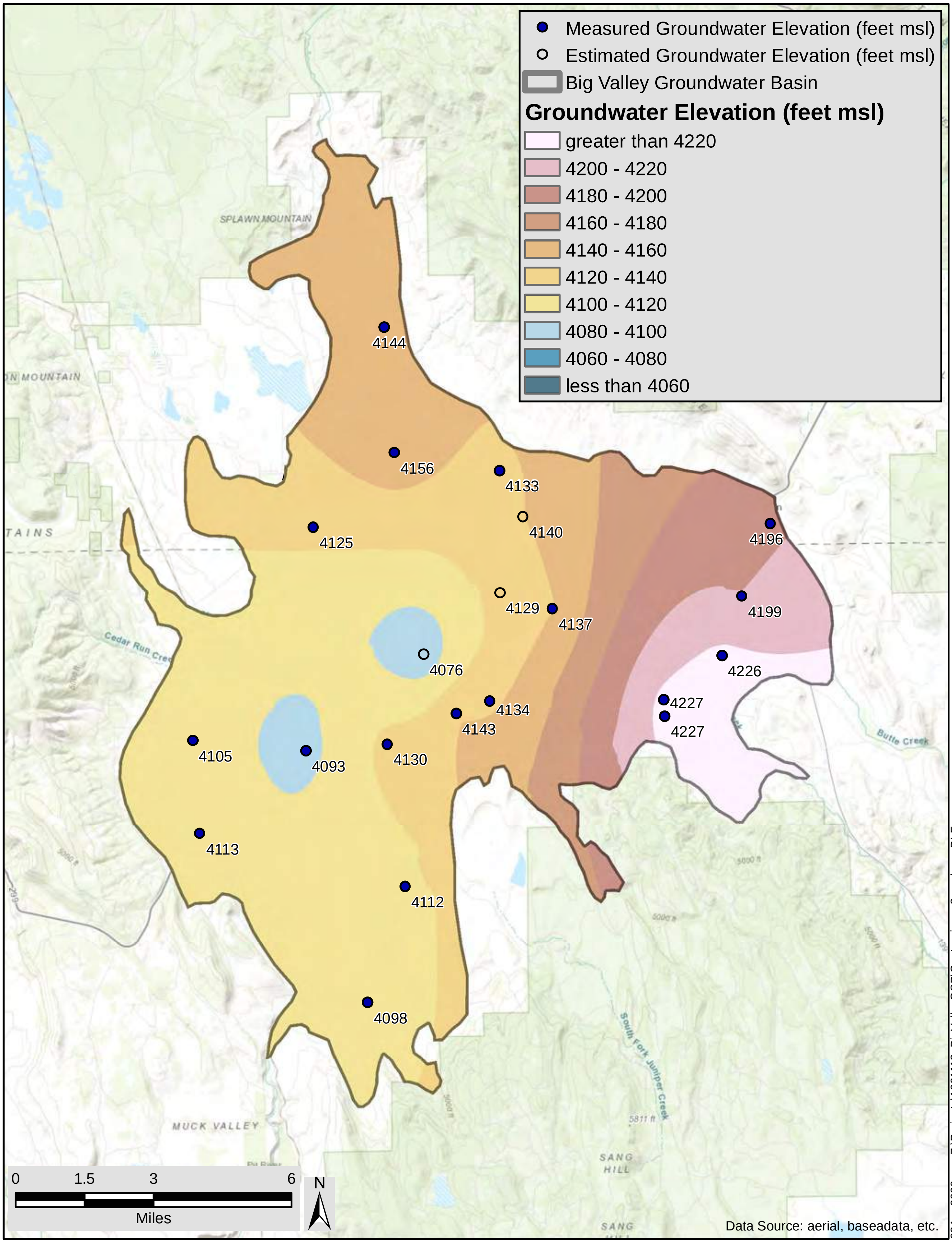
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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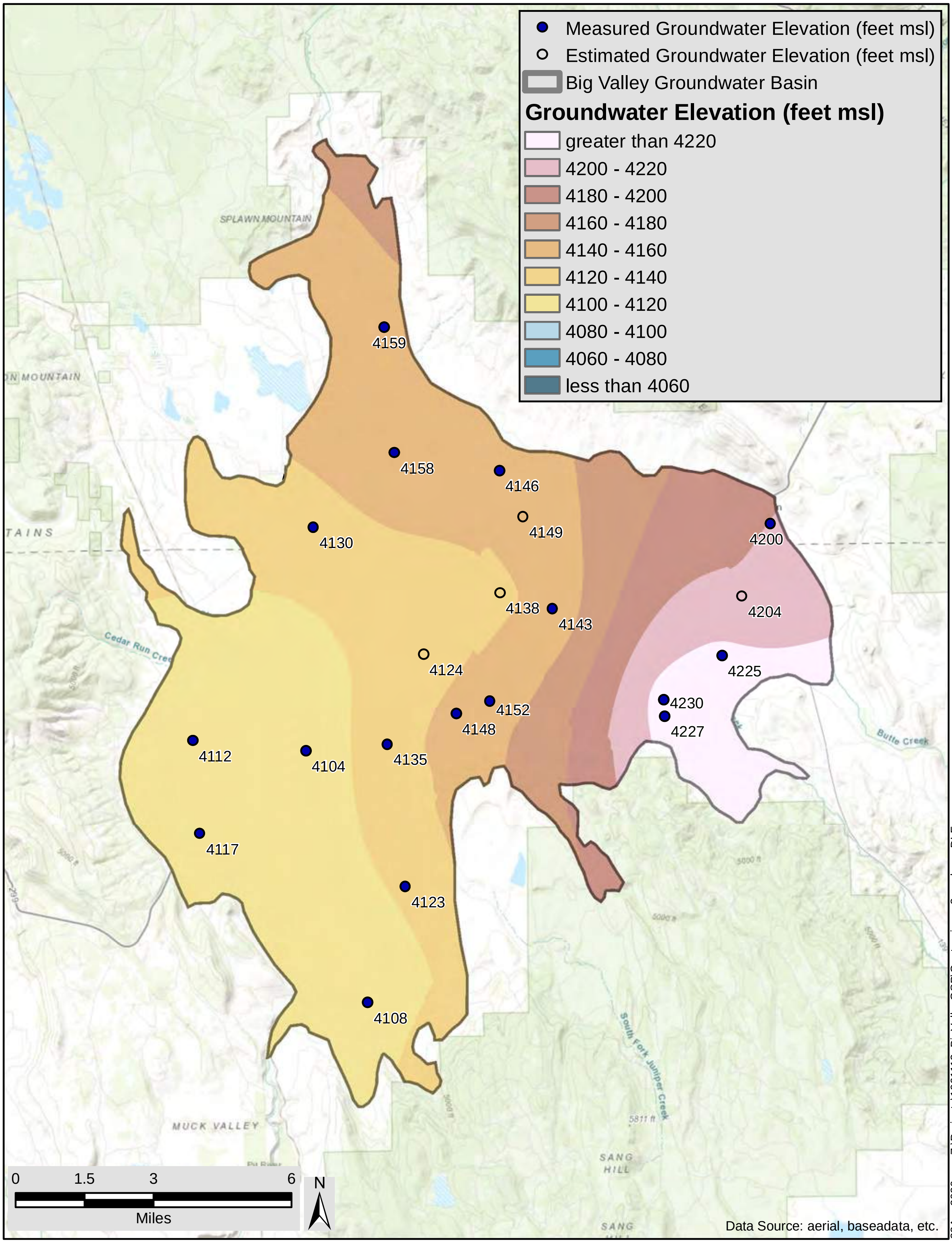

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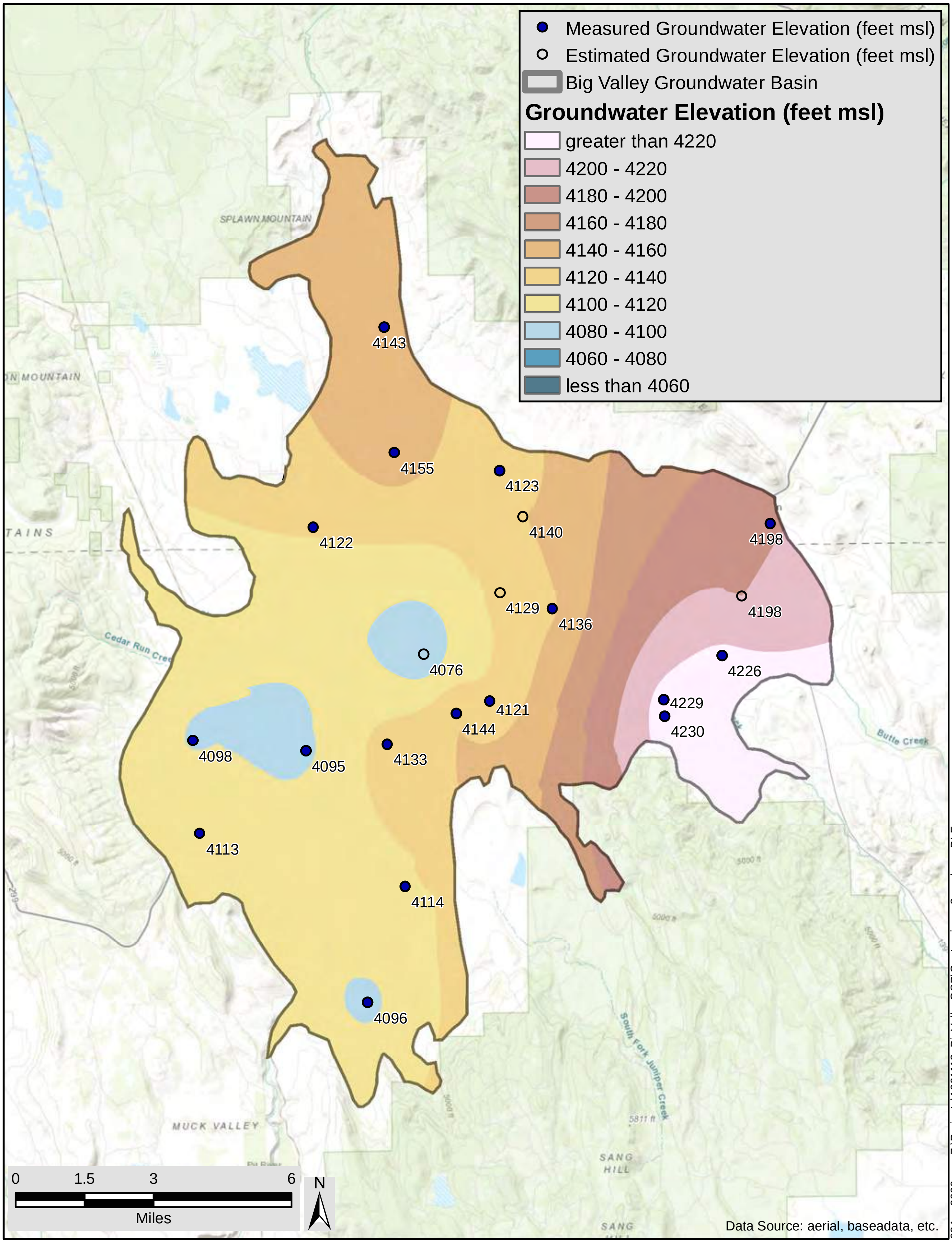

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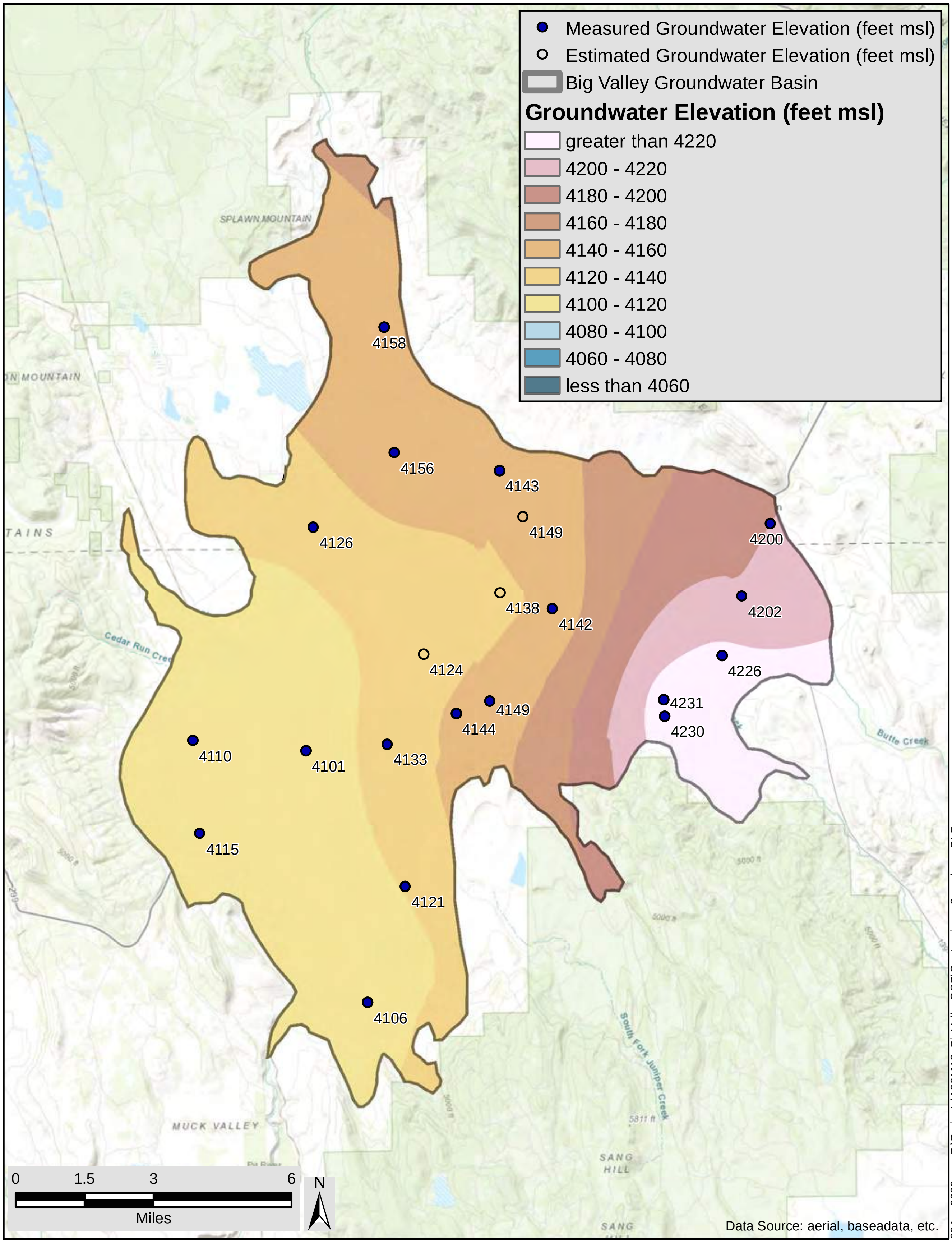

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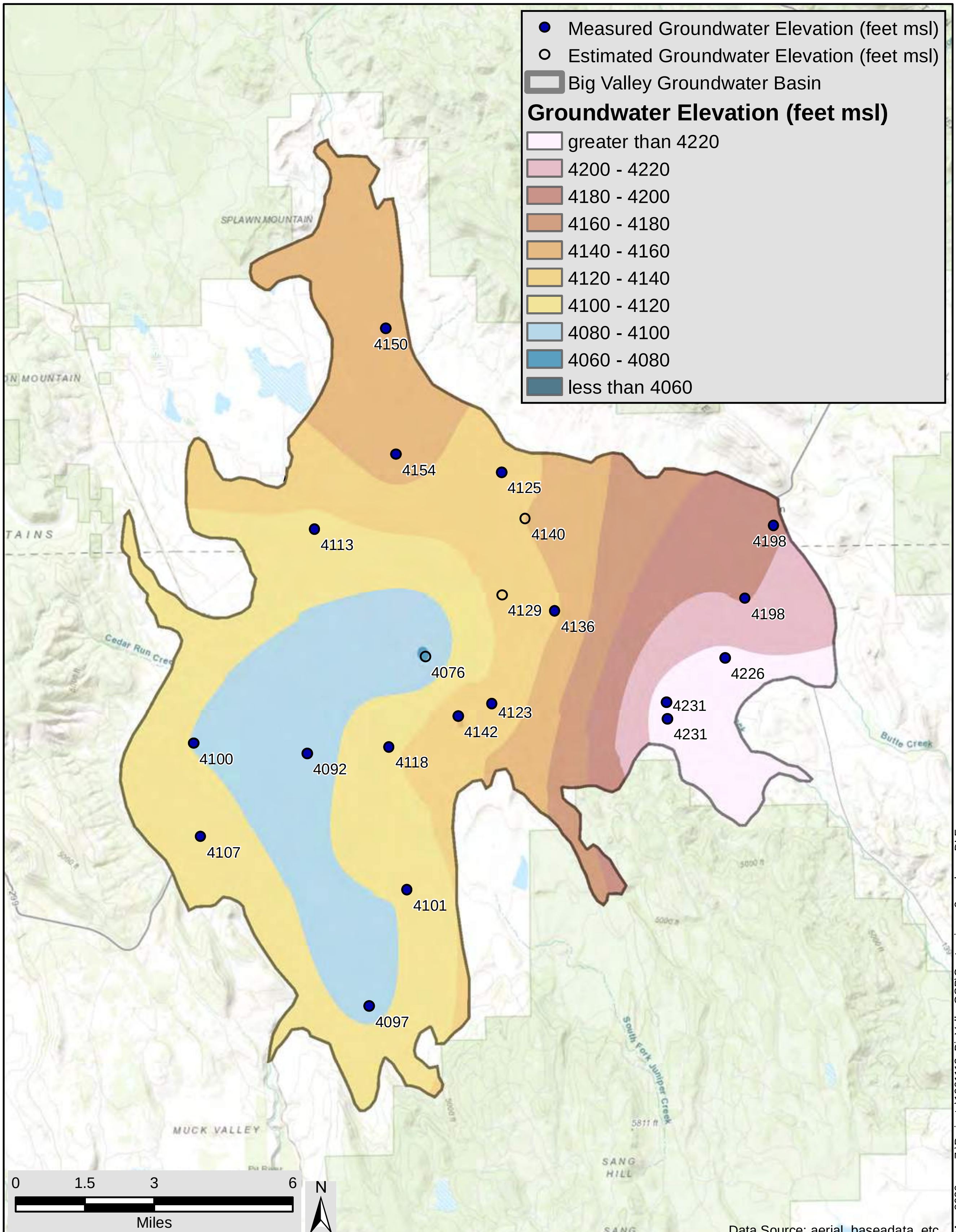
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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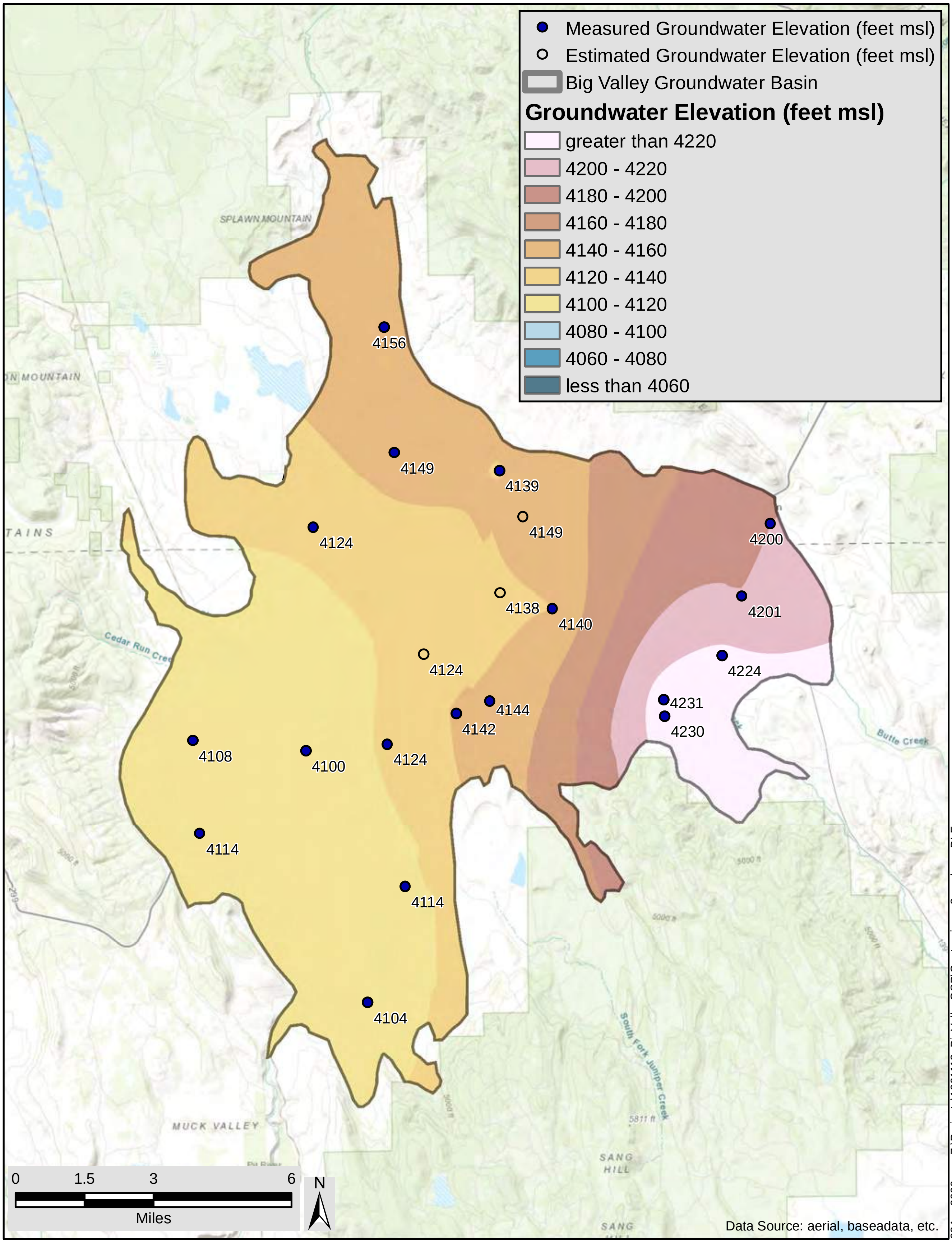

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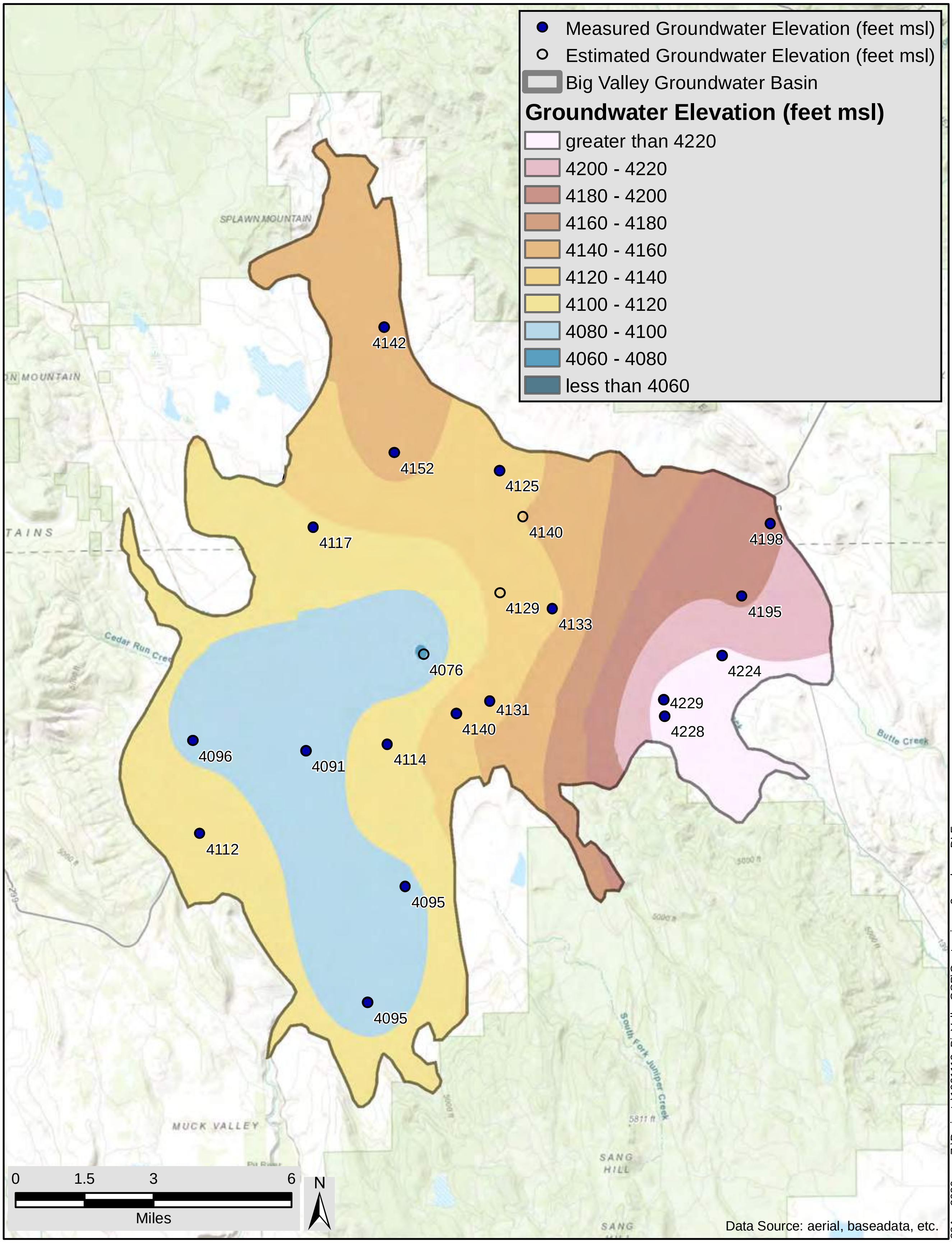

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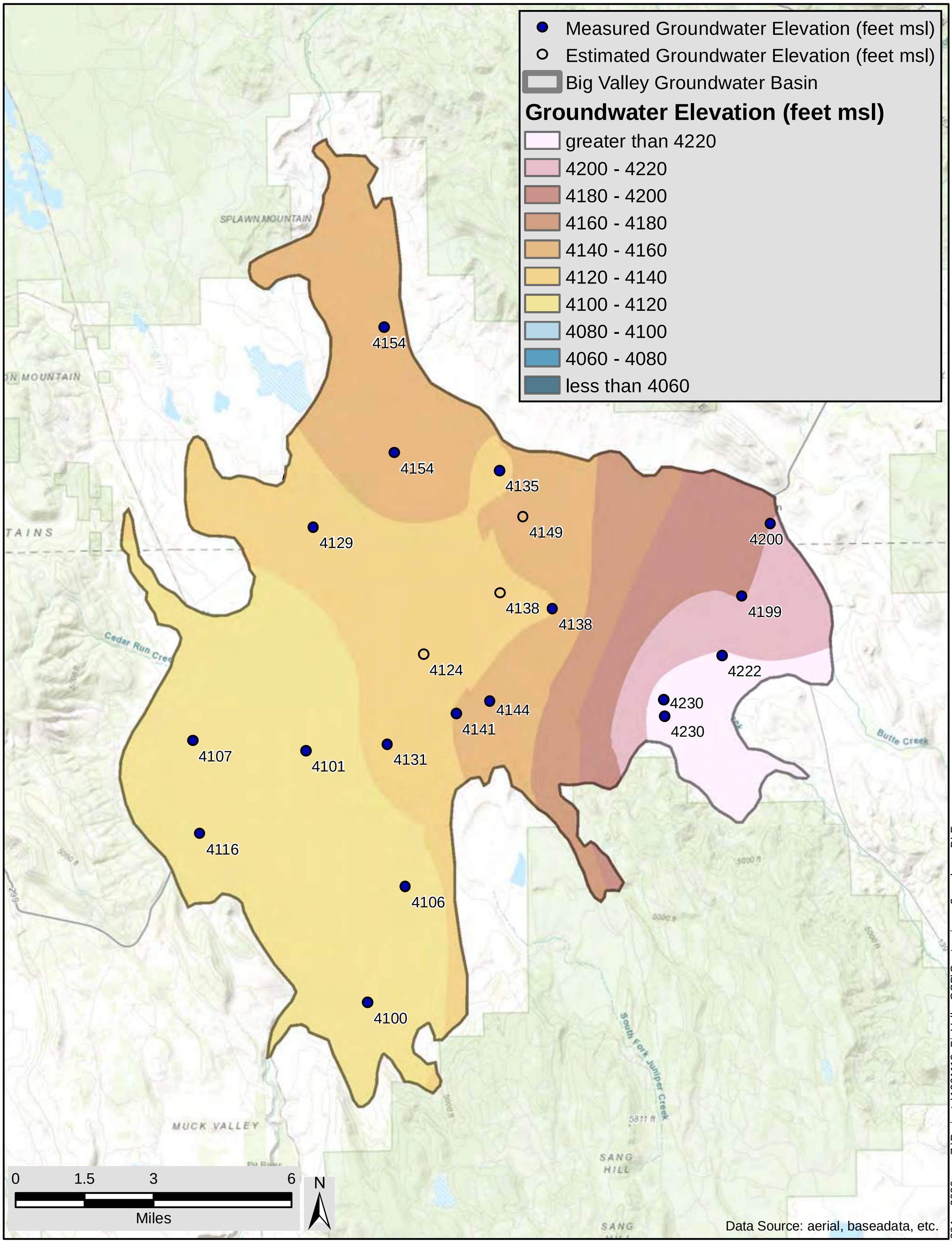

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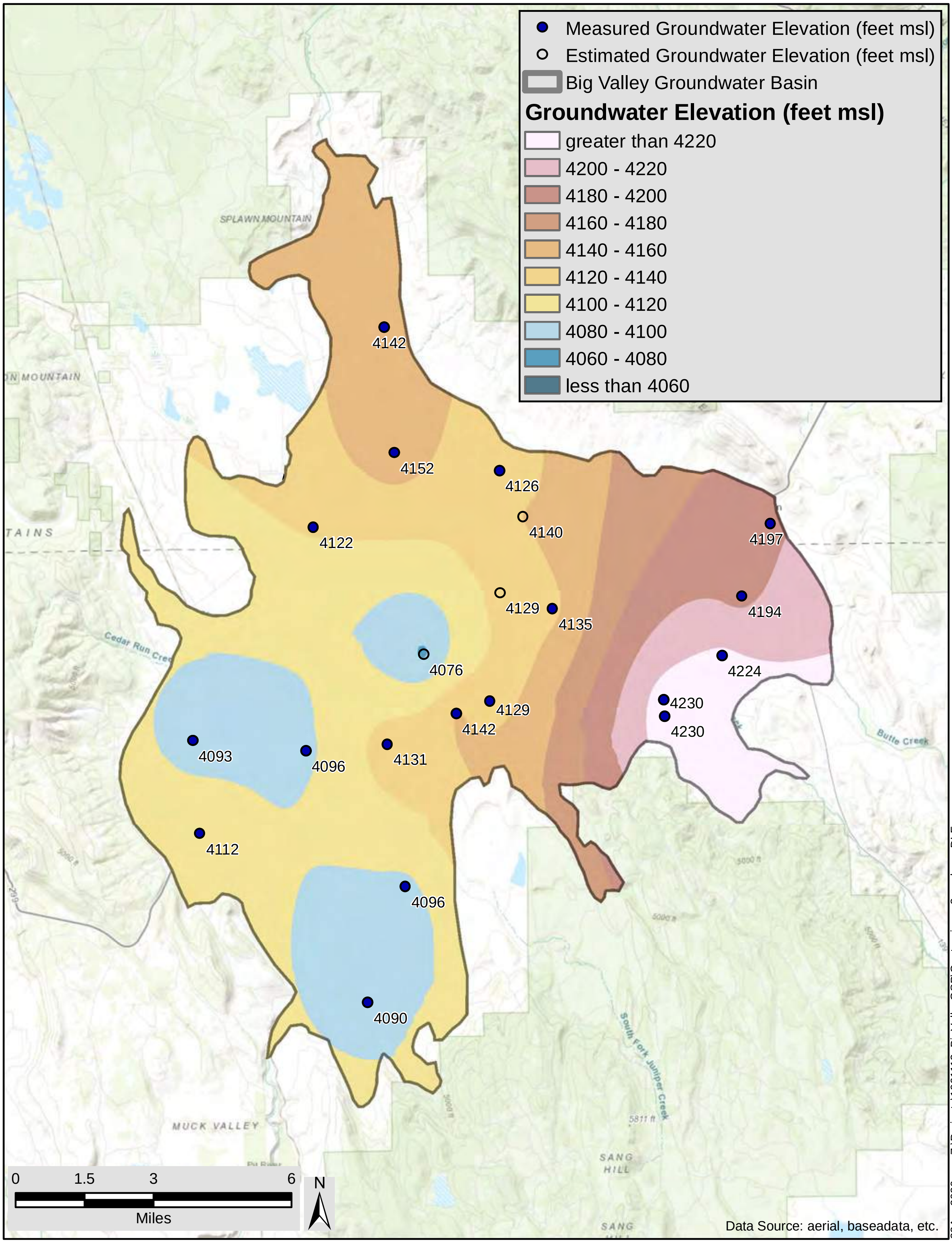

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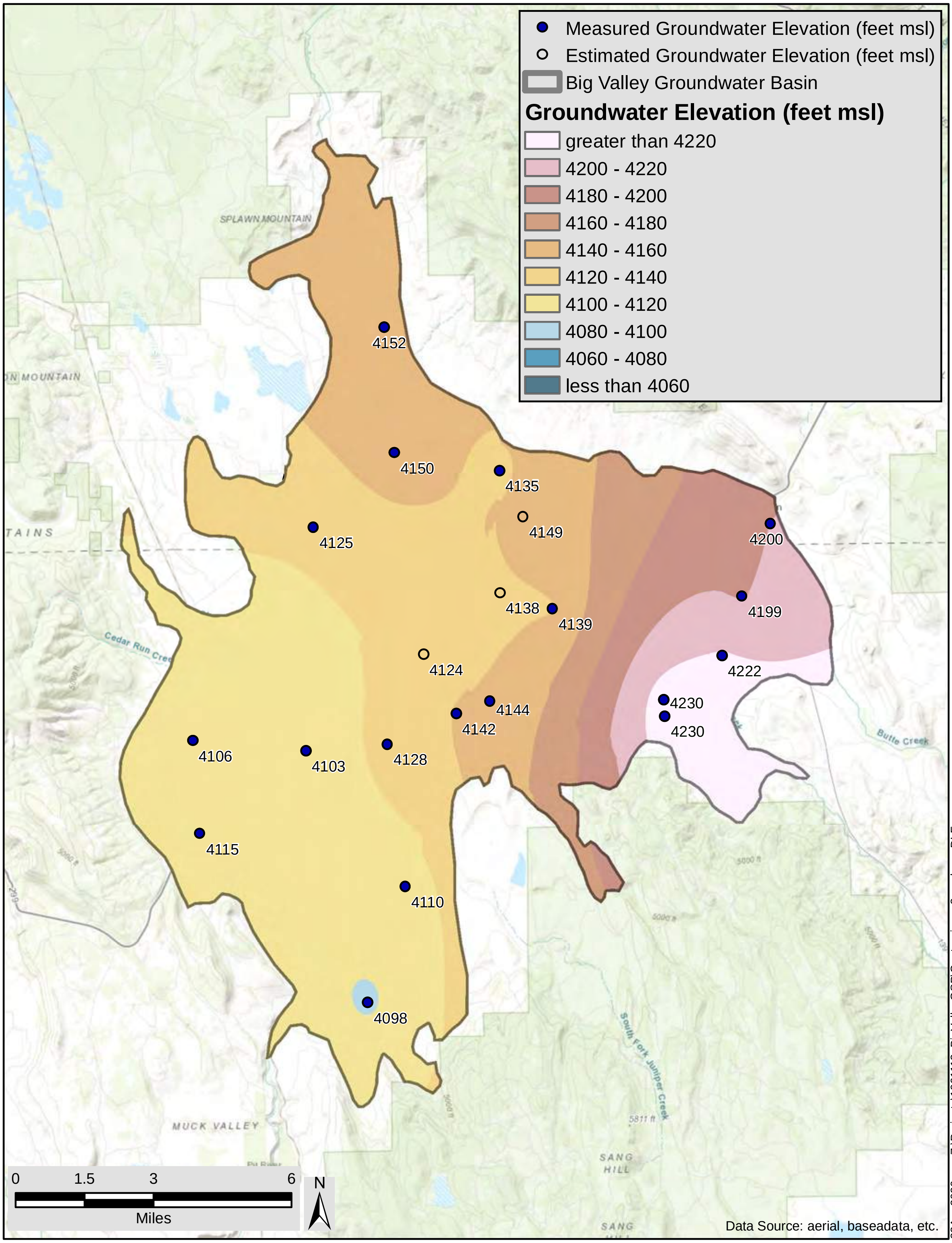
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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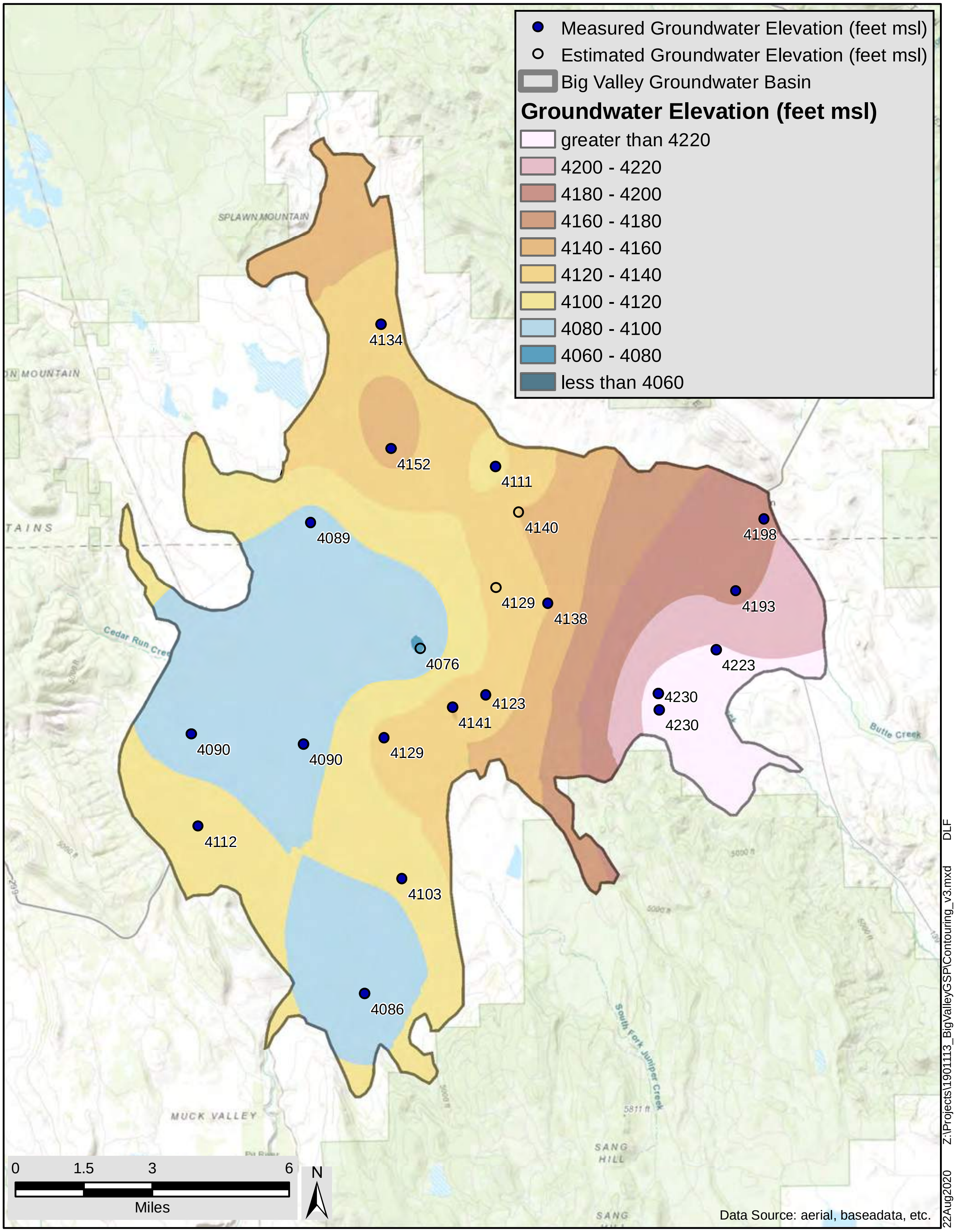
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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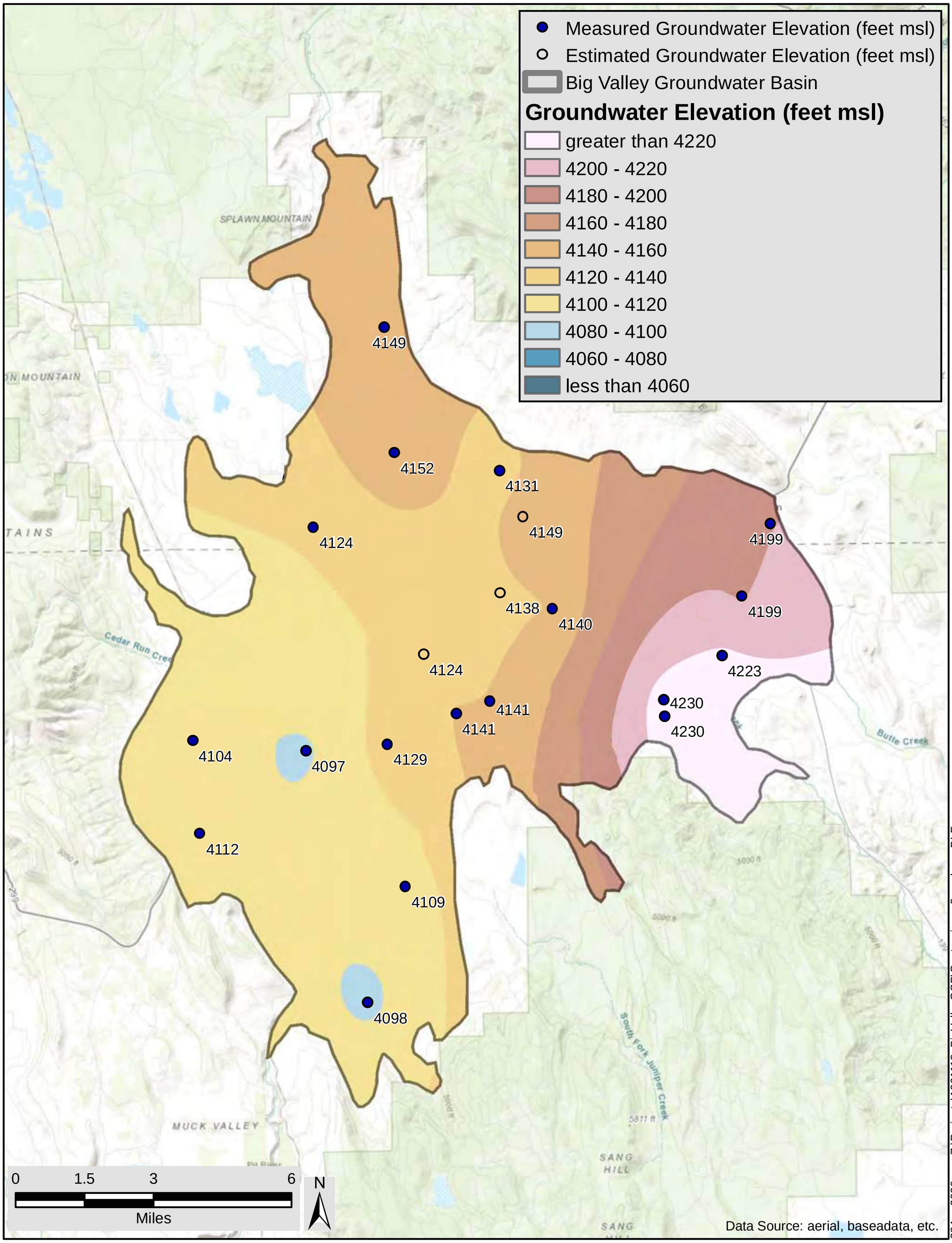

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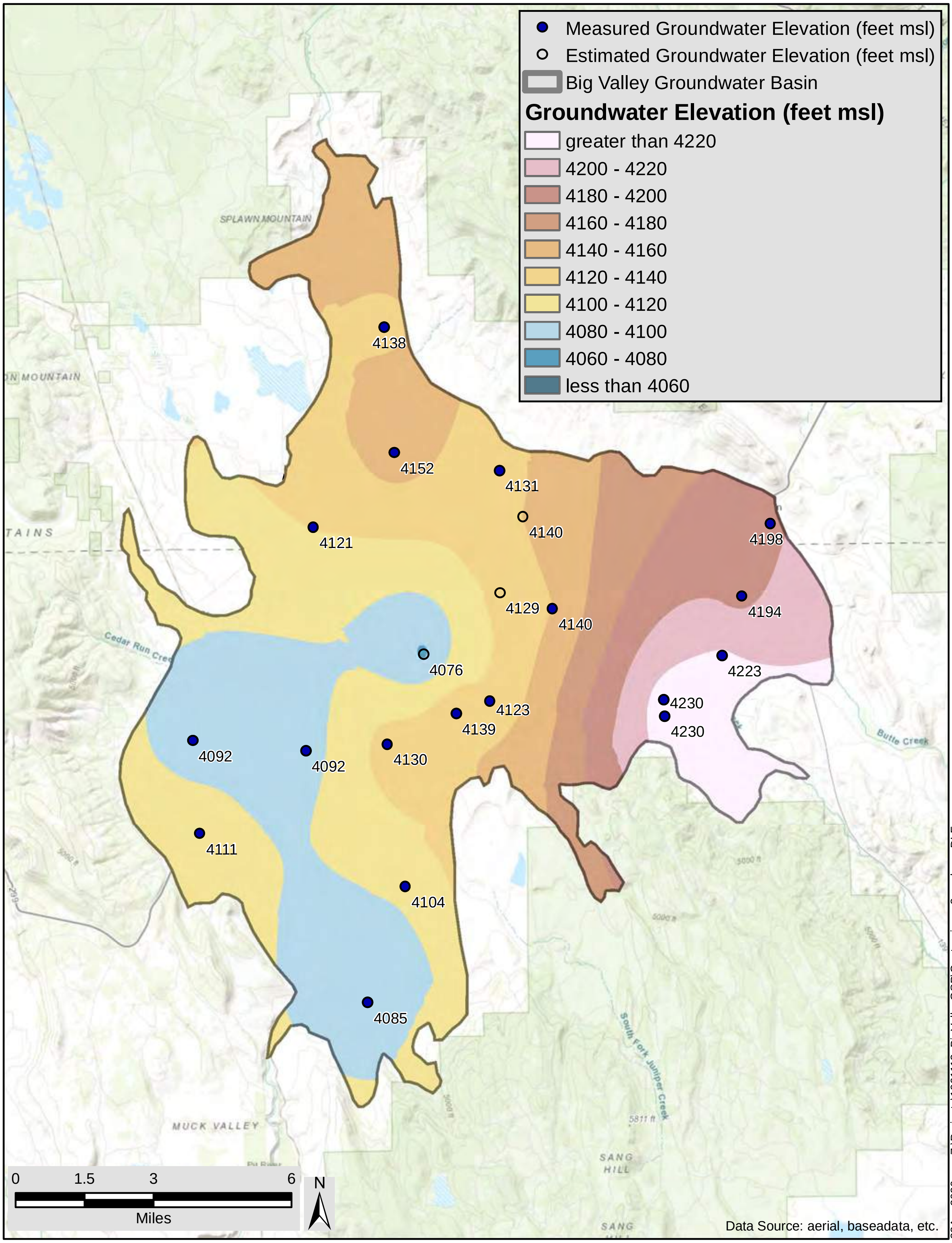

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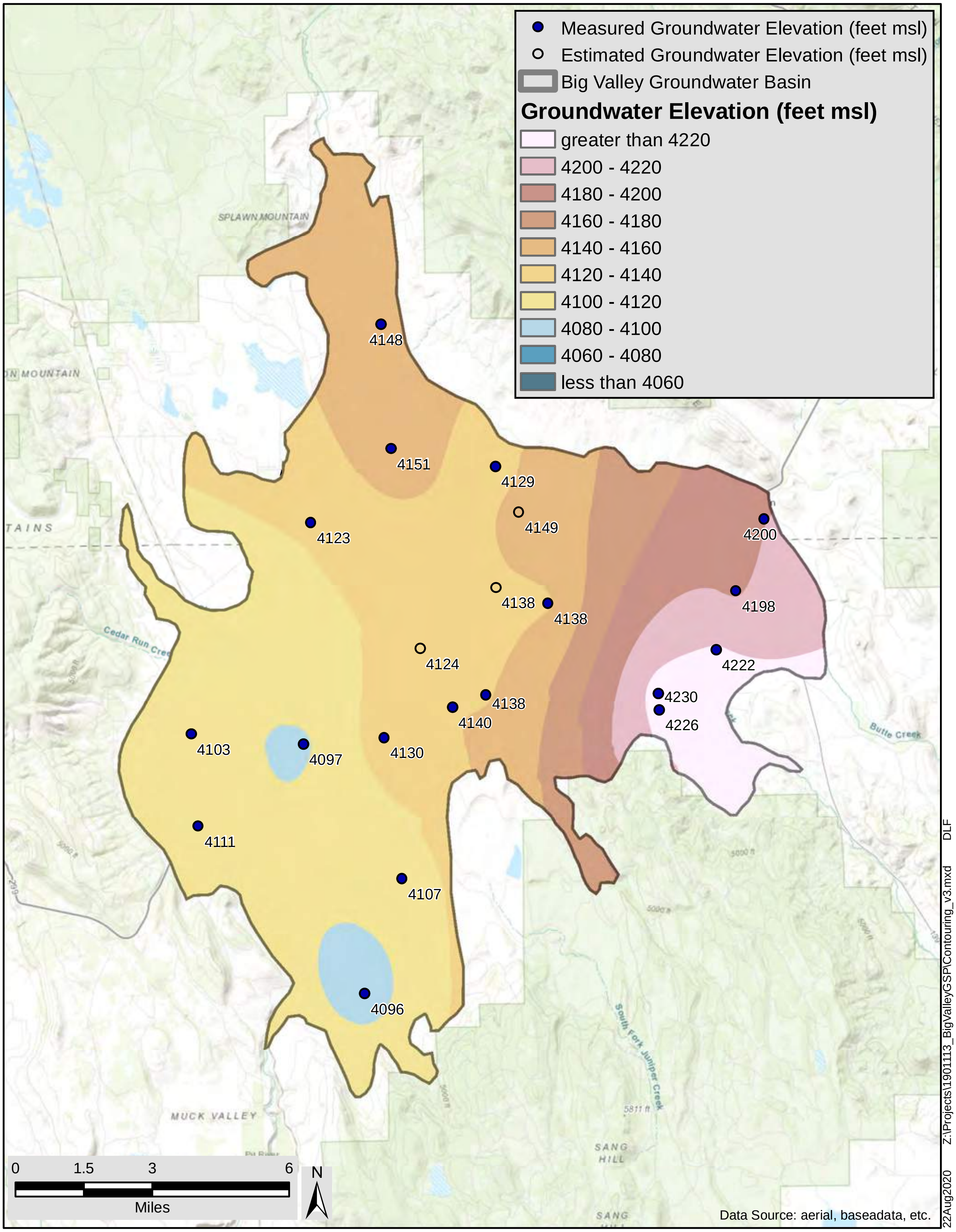

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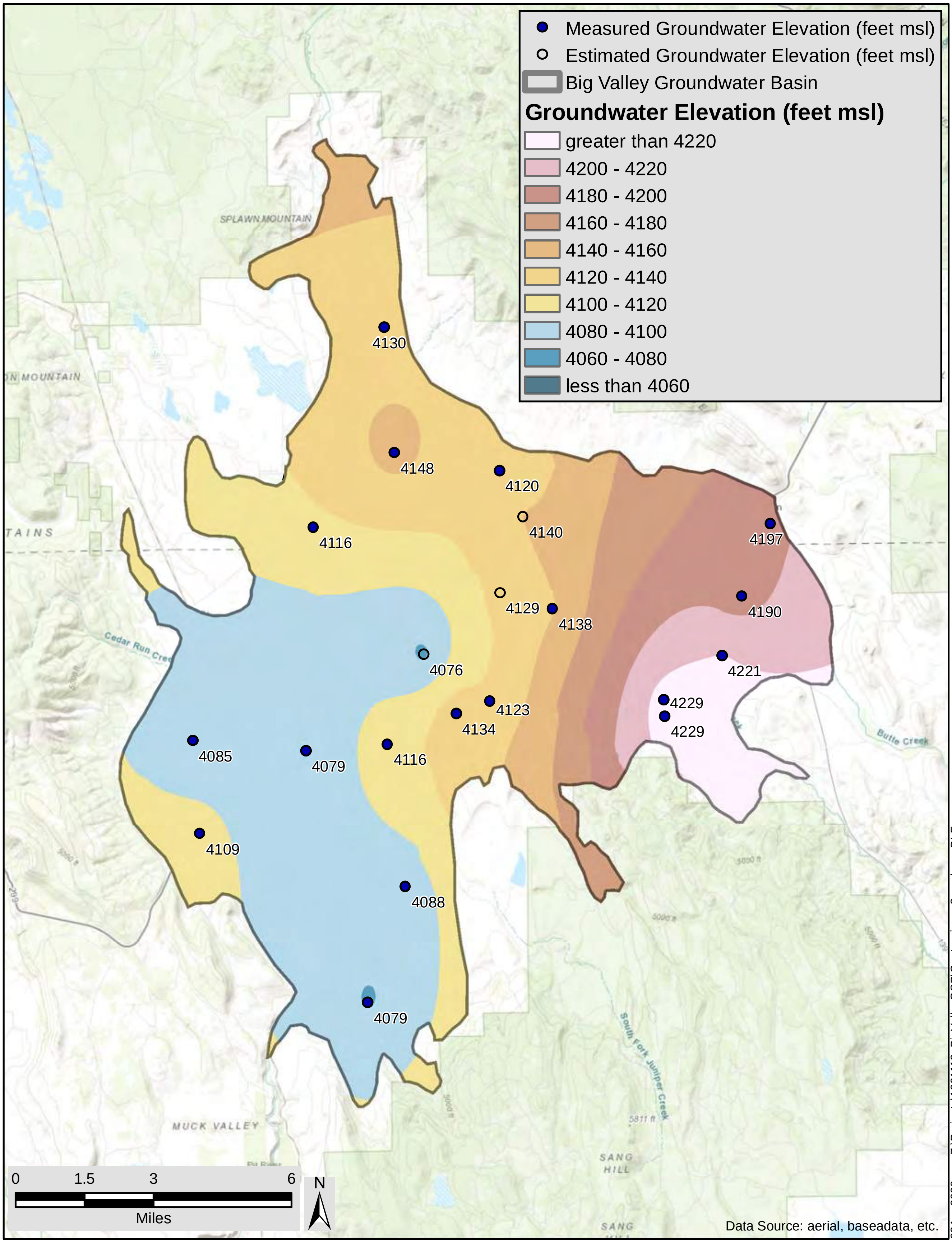

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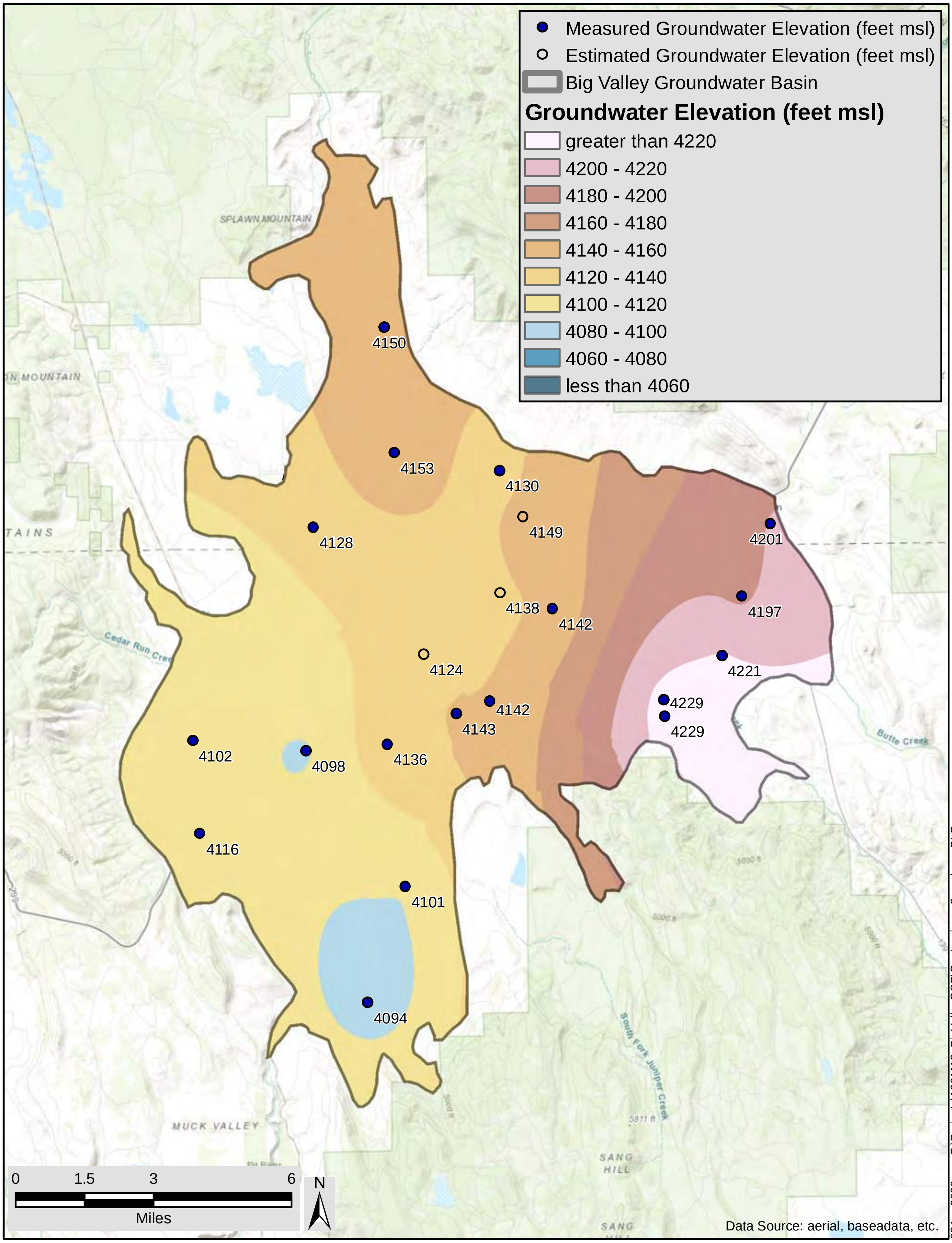

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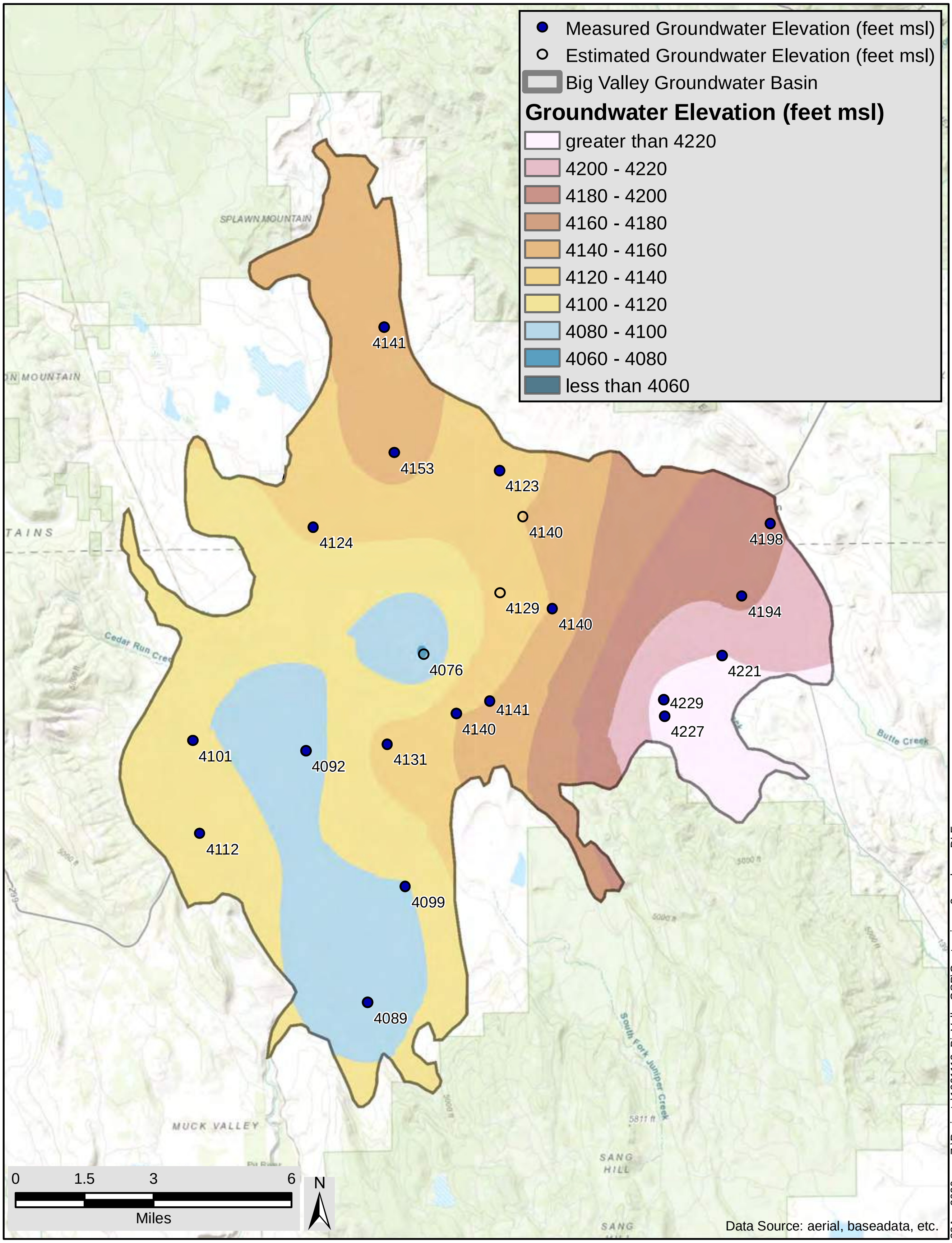

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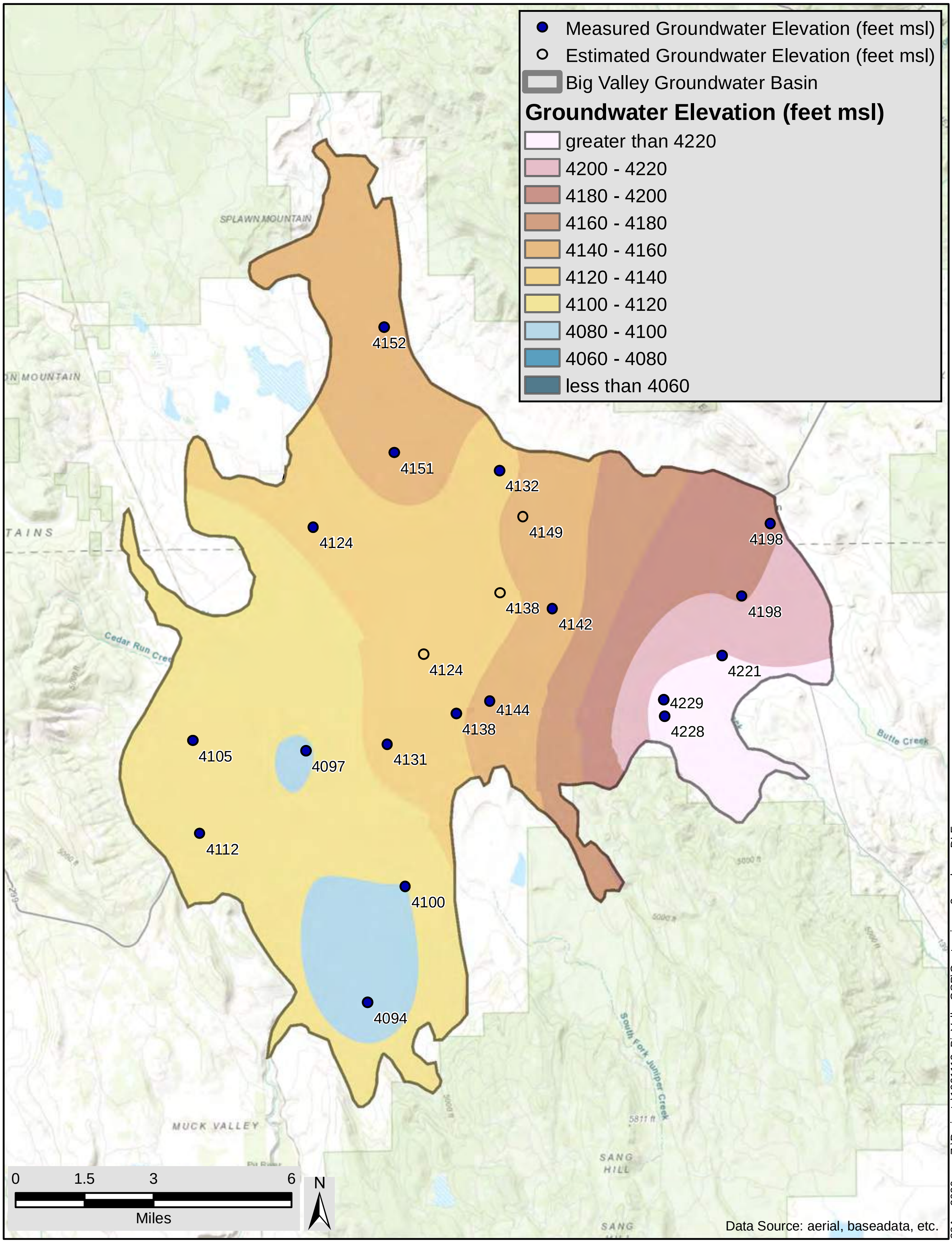

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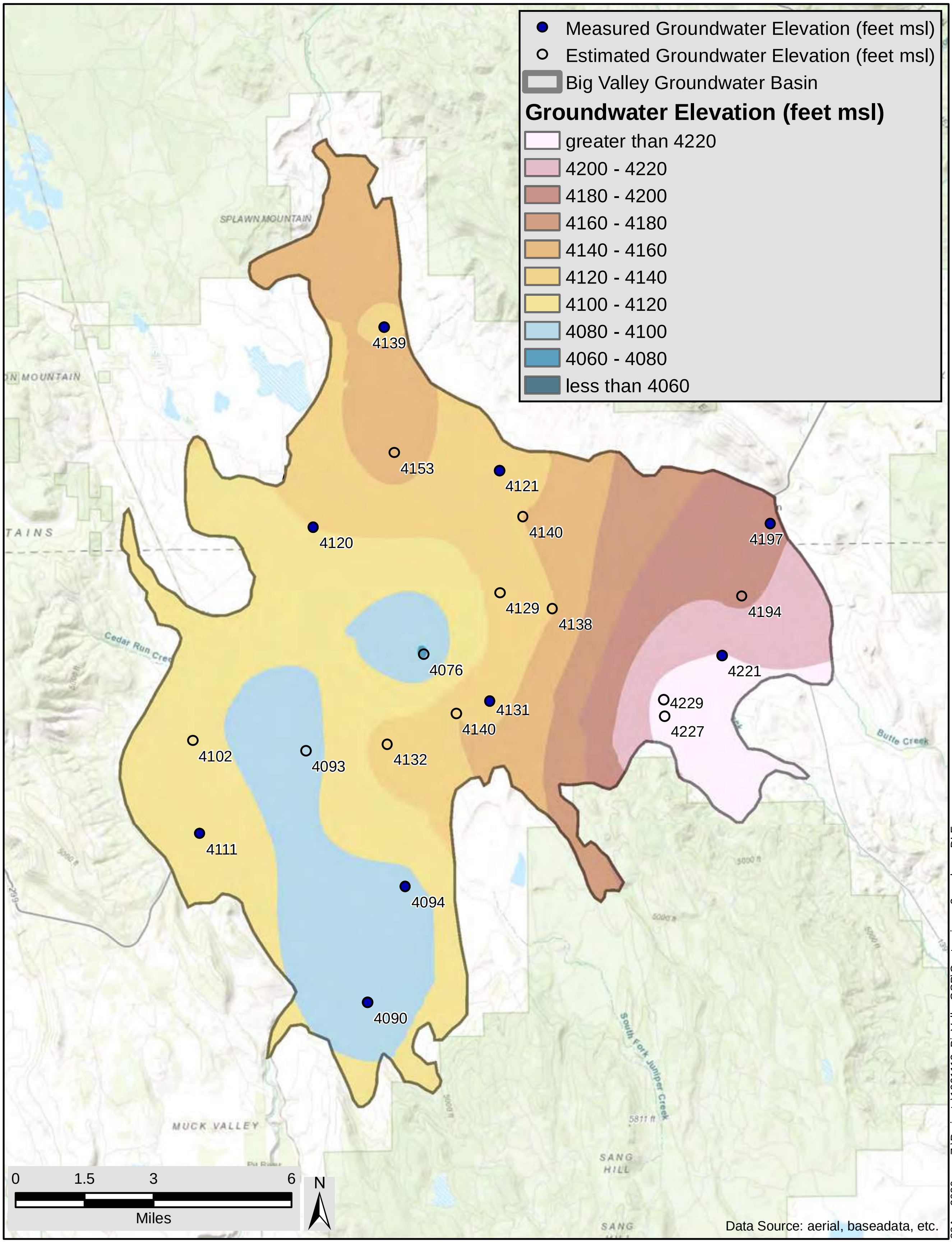

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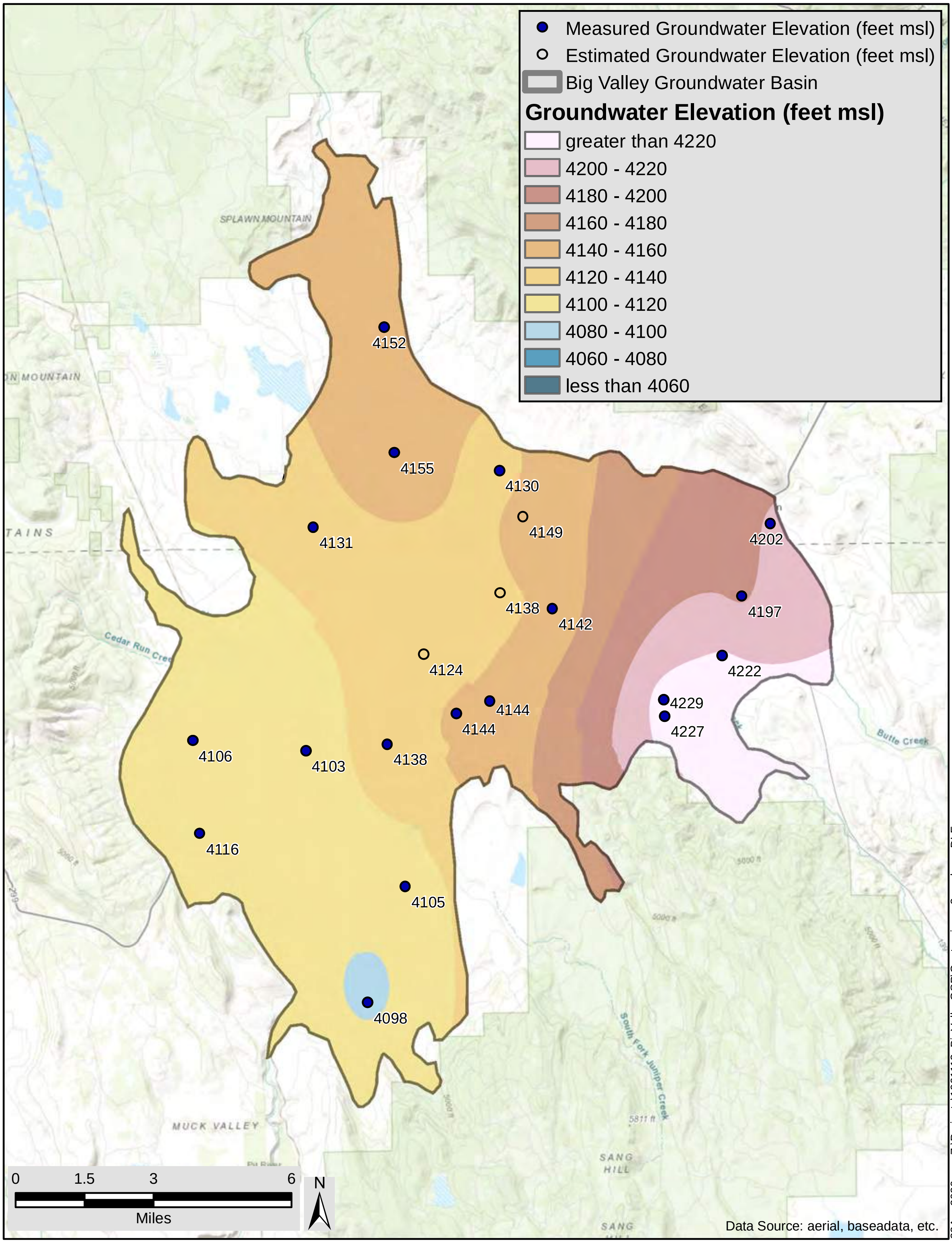
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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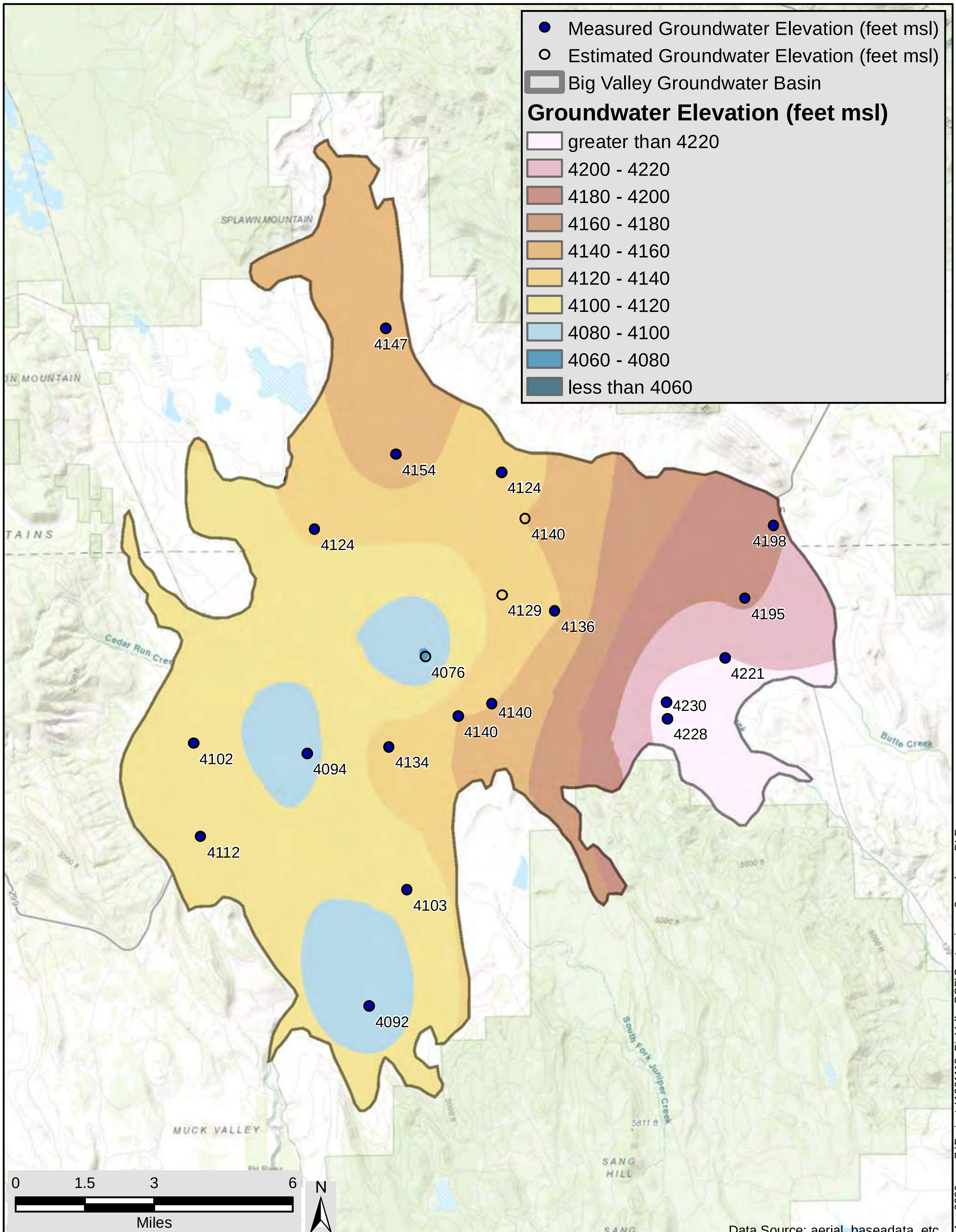
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



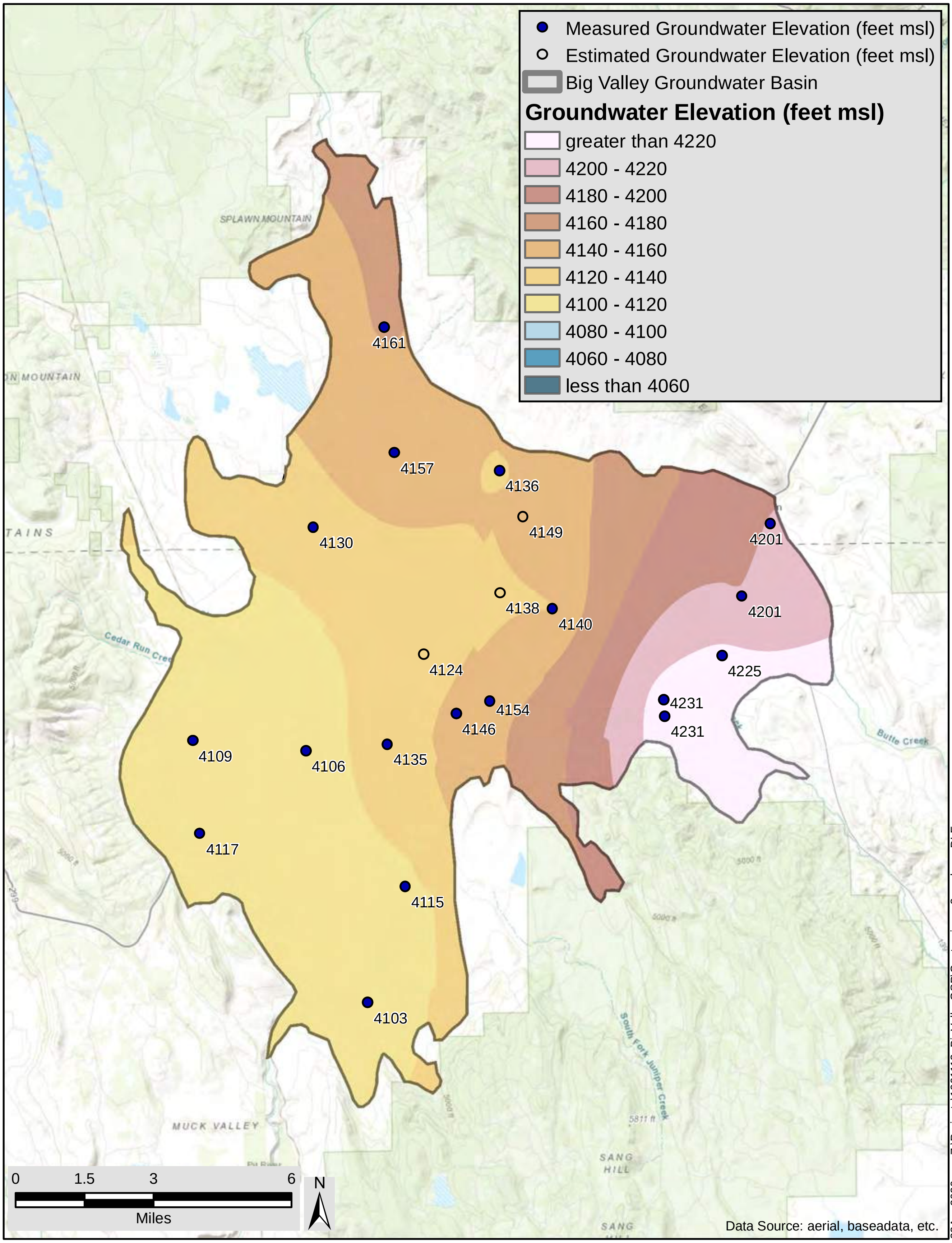
Big Valley Basin Groundwater Sustainability Plan
Modoc and Lassen Counties, California

Big Valley Groundwater Basin GSAs

GEI Consultants

Groundwater Elevations
Fall 1995

AUGUST 2020 DRAFT FIGURE



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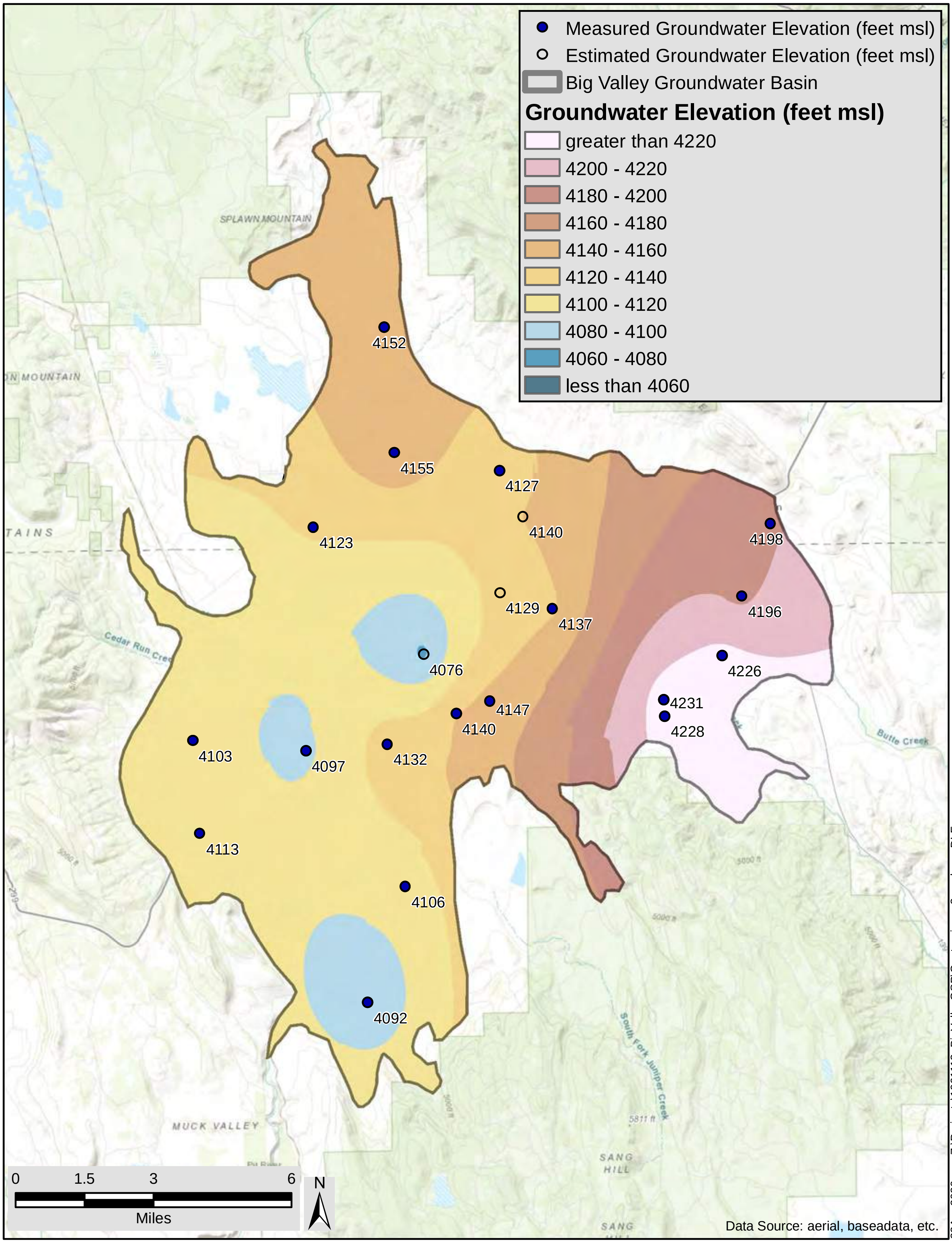
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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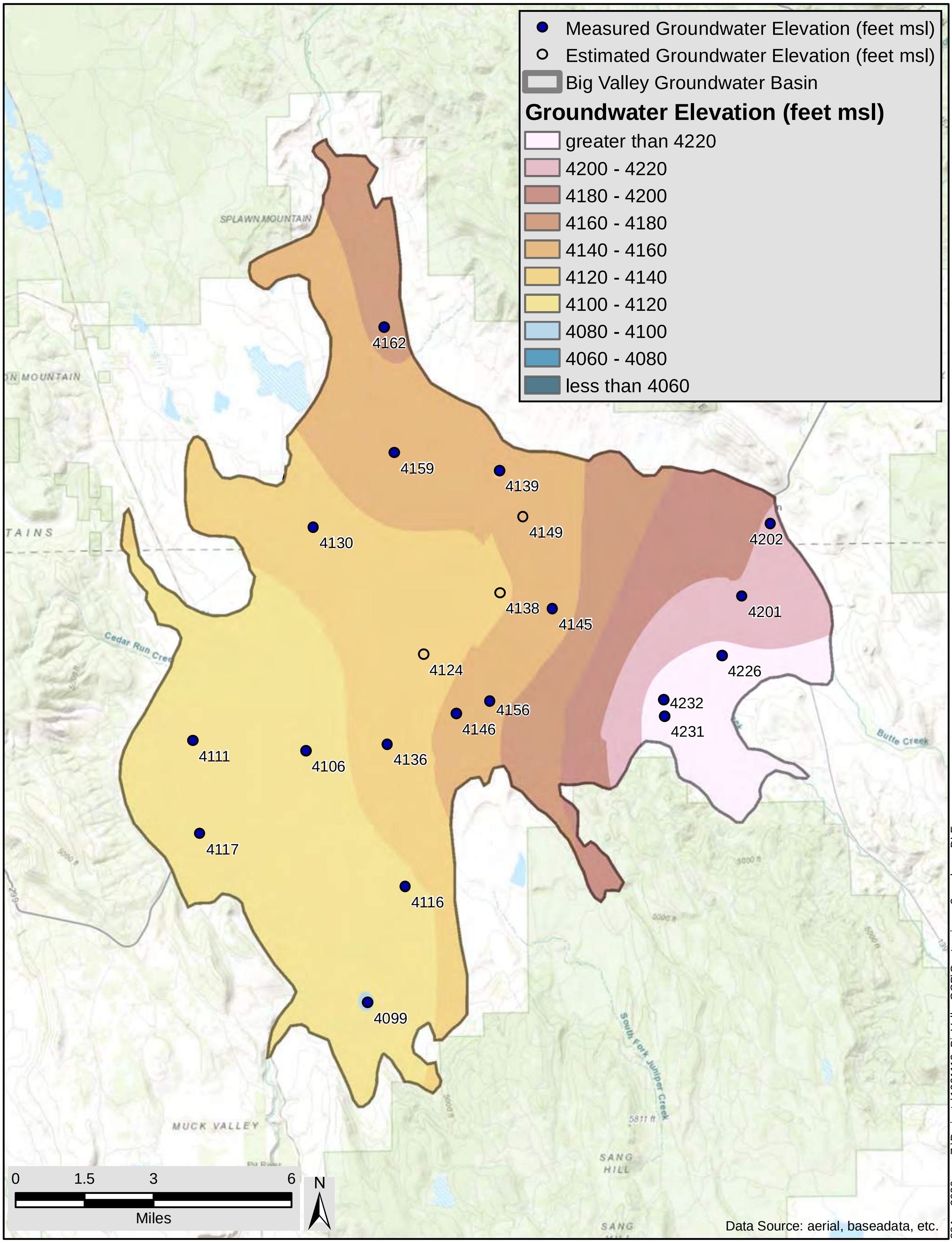

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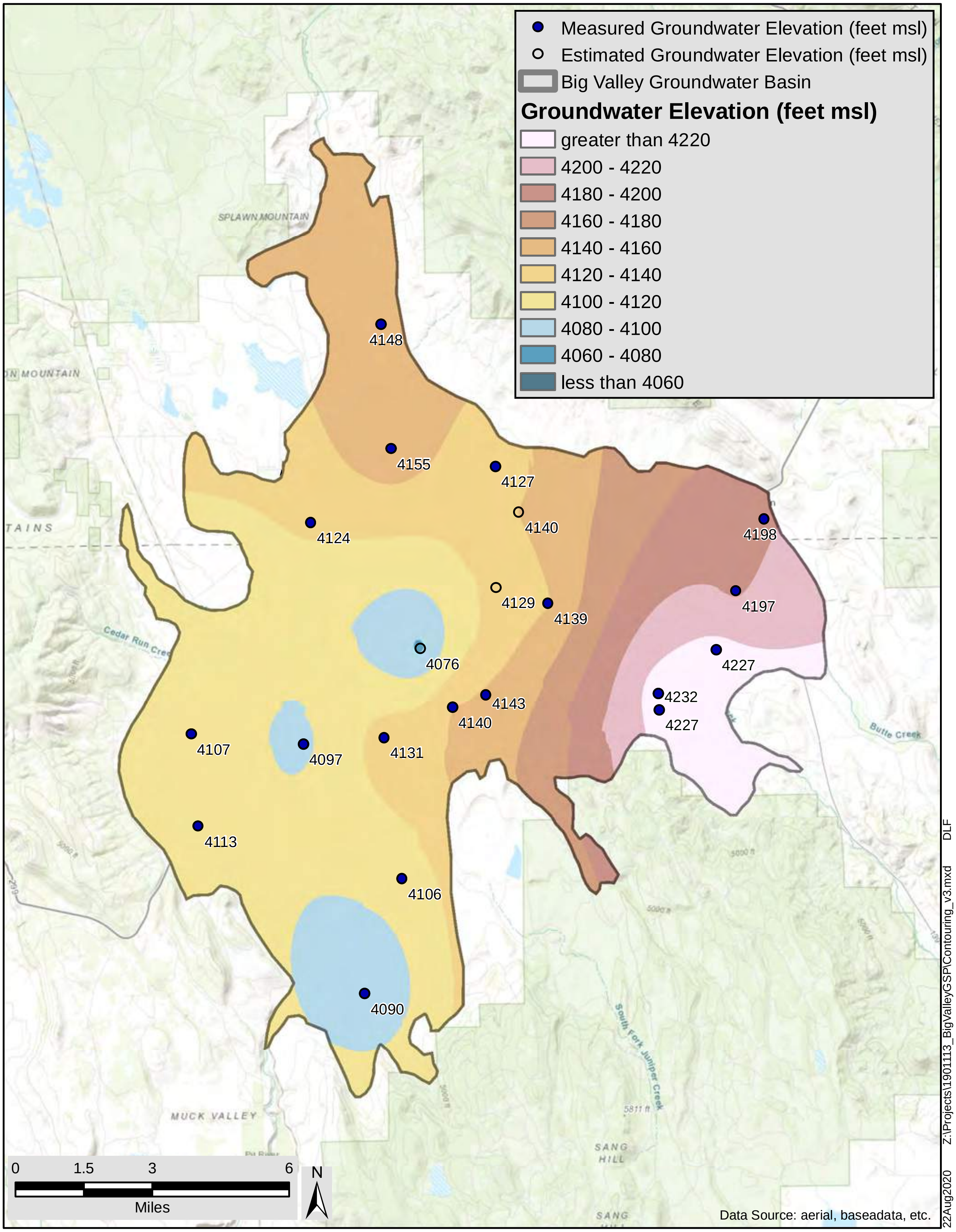

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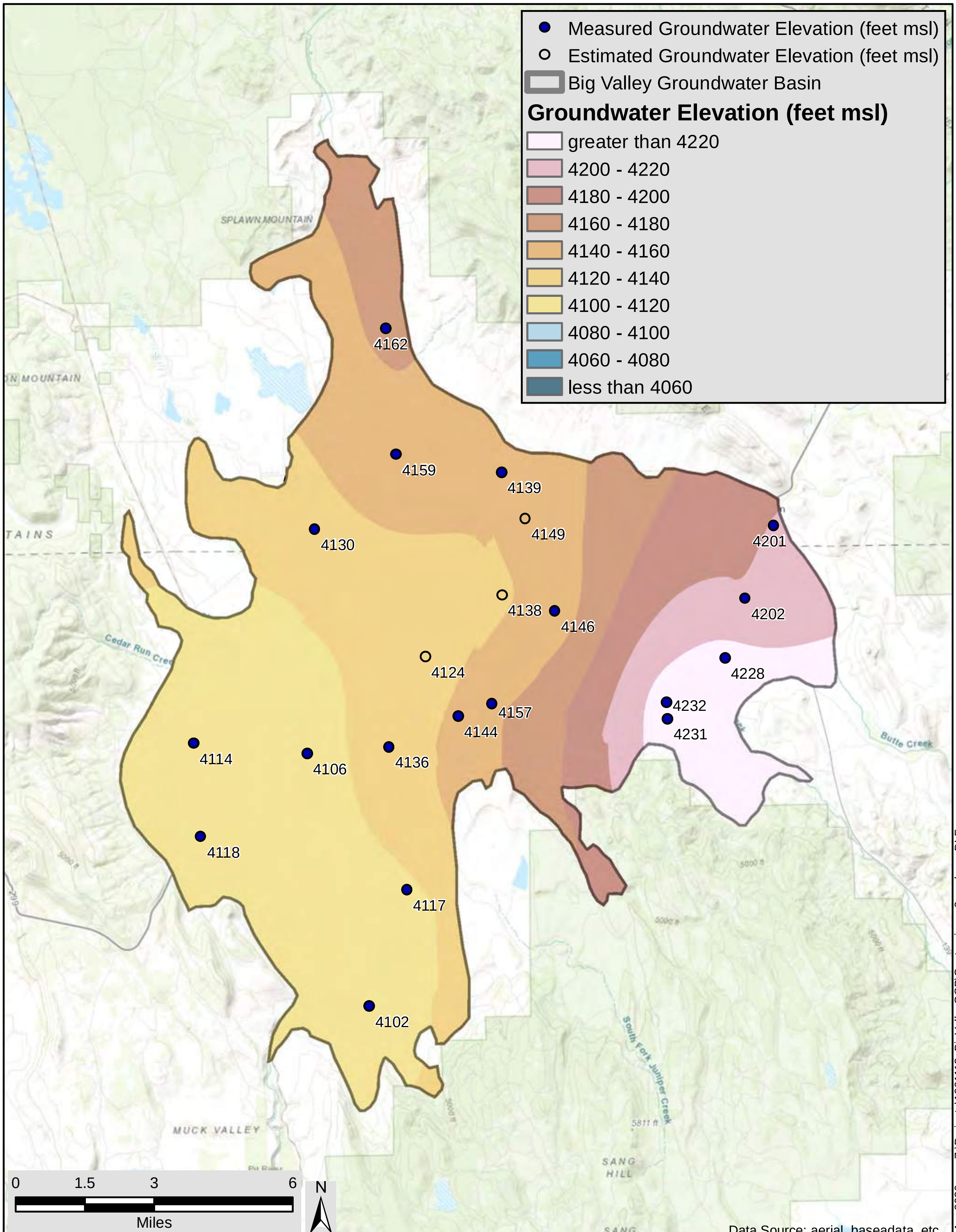

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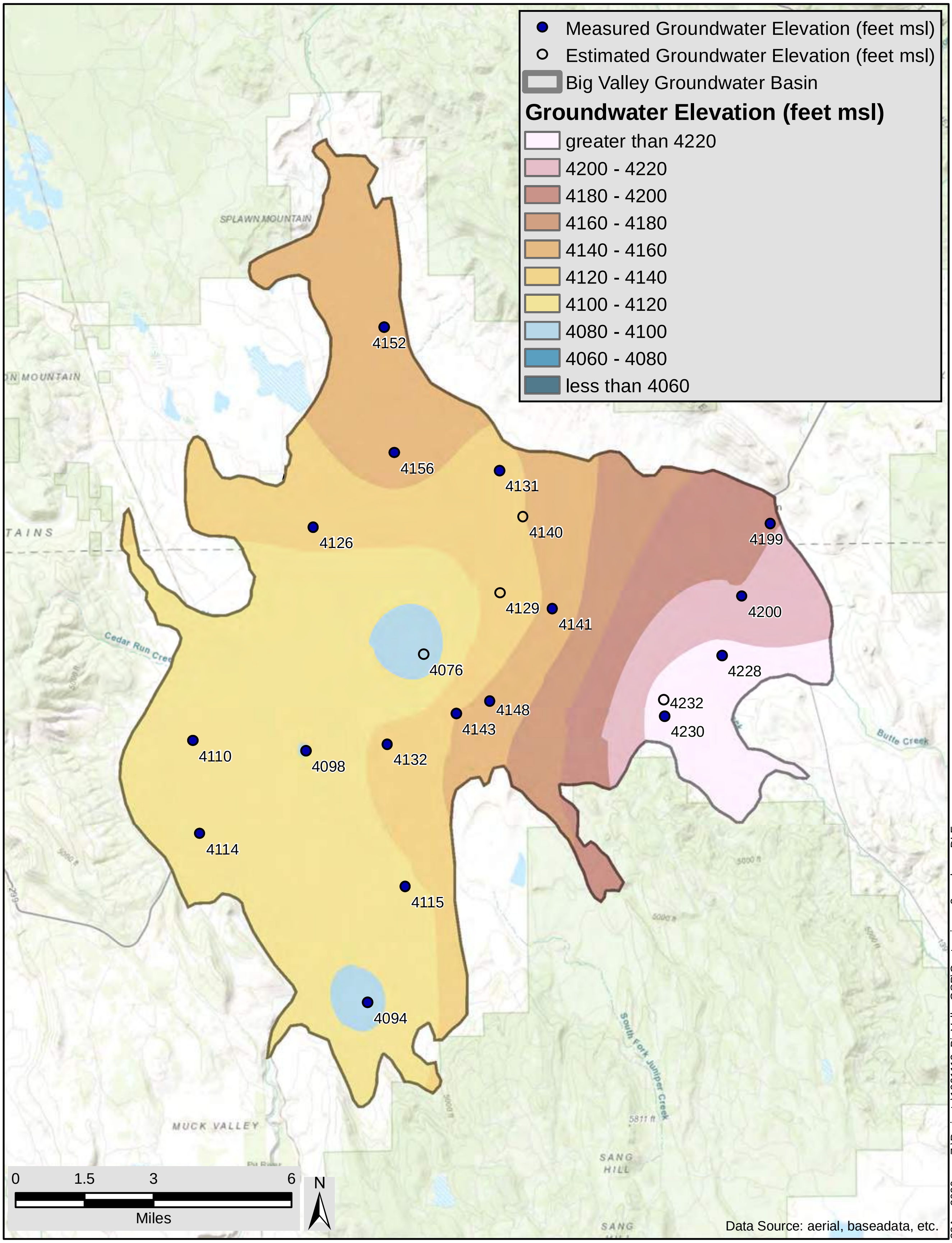
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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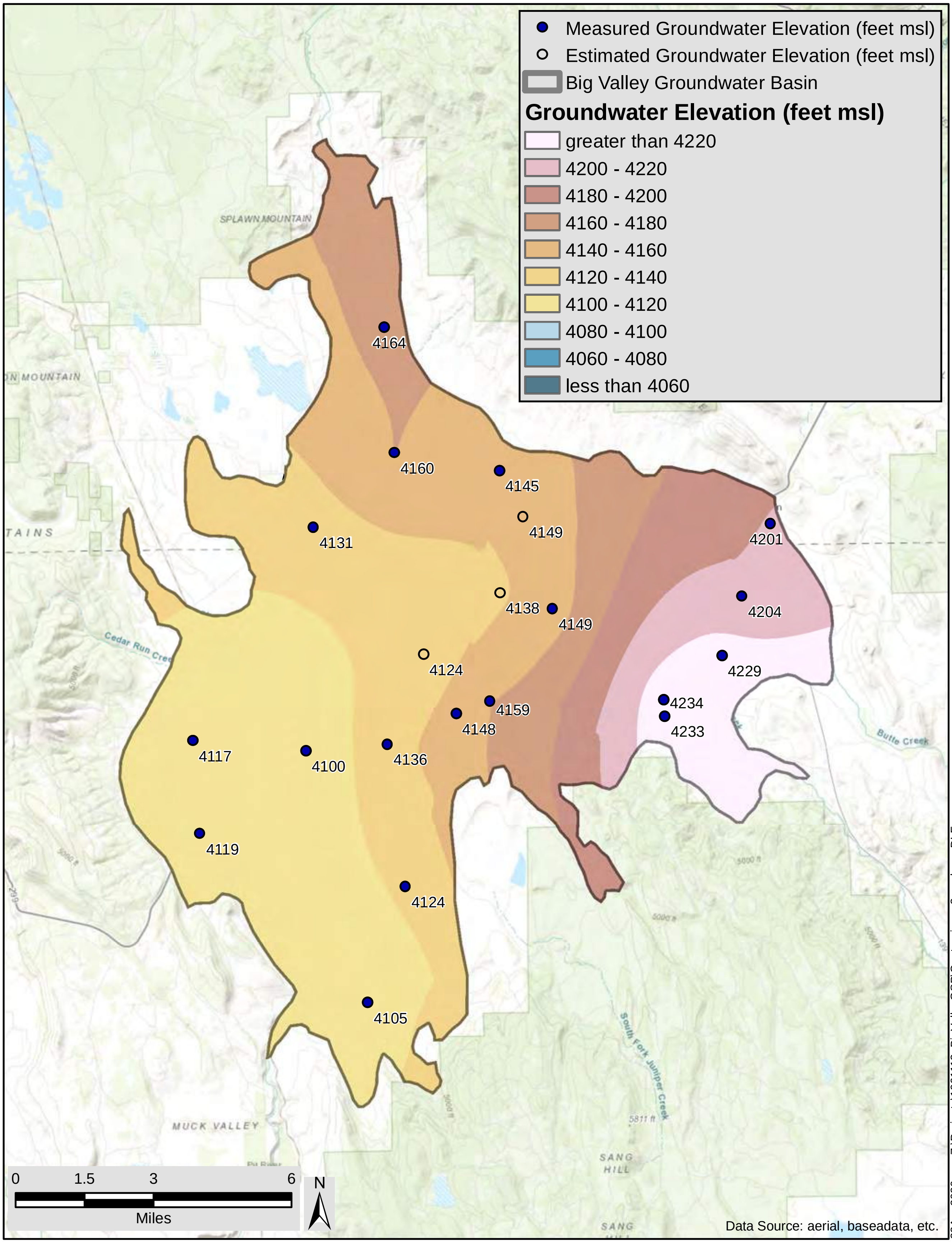

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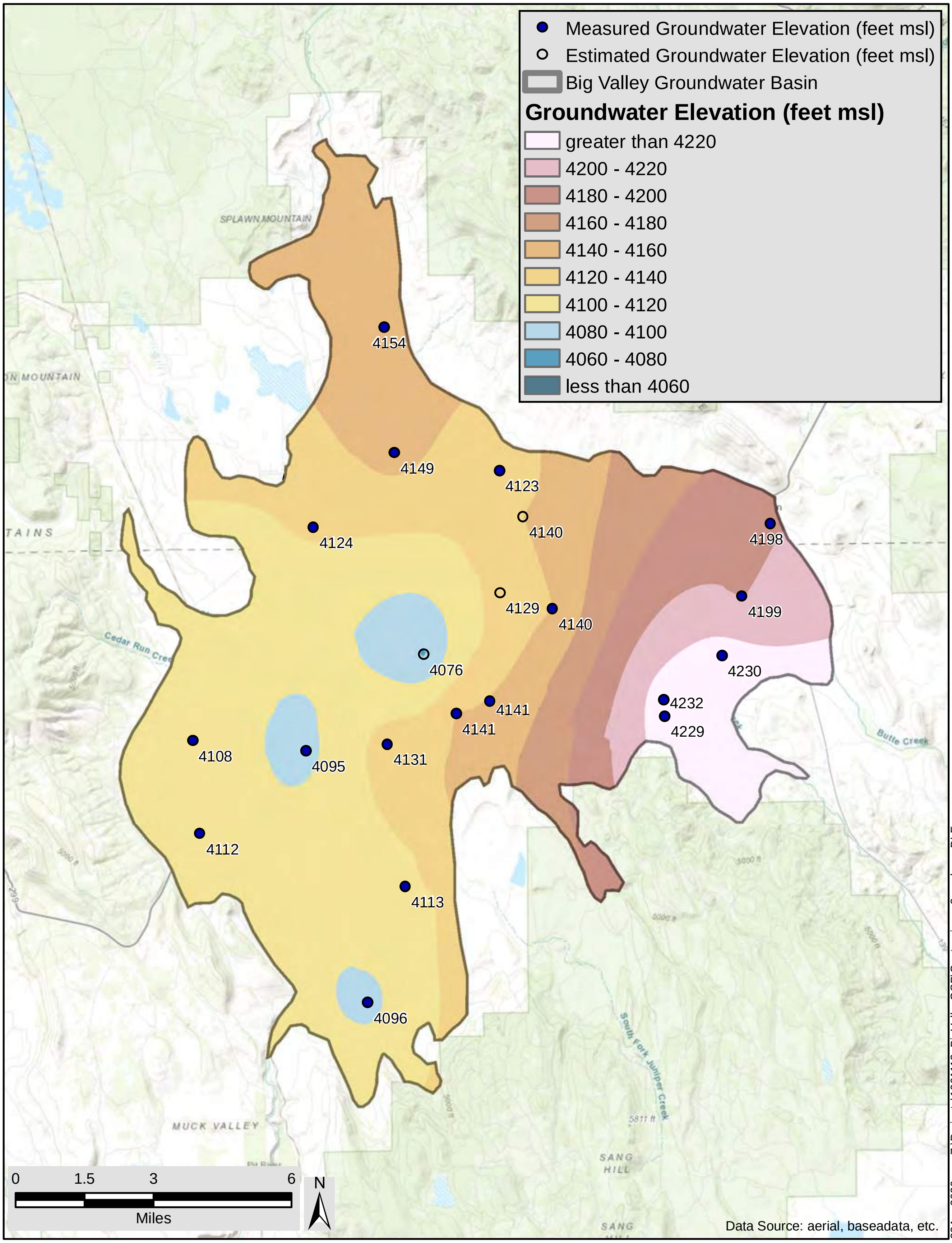

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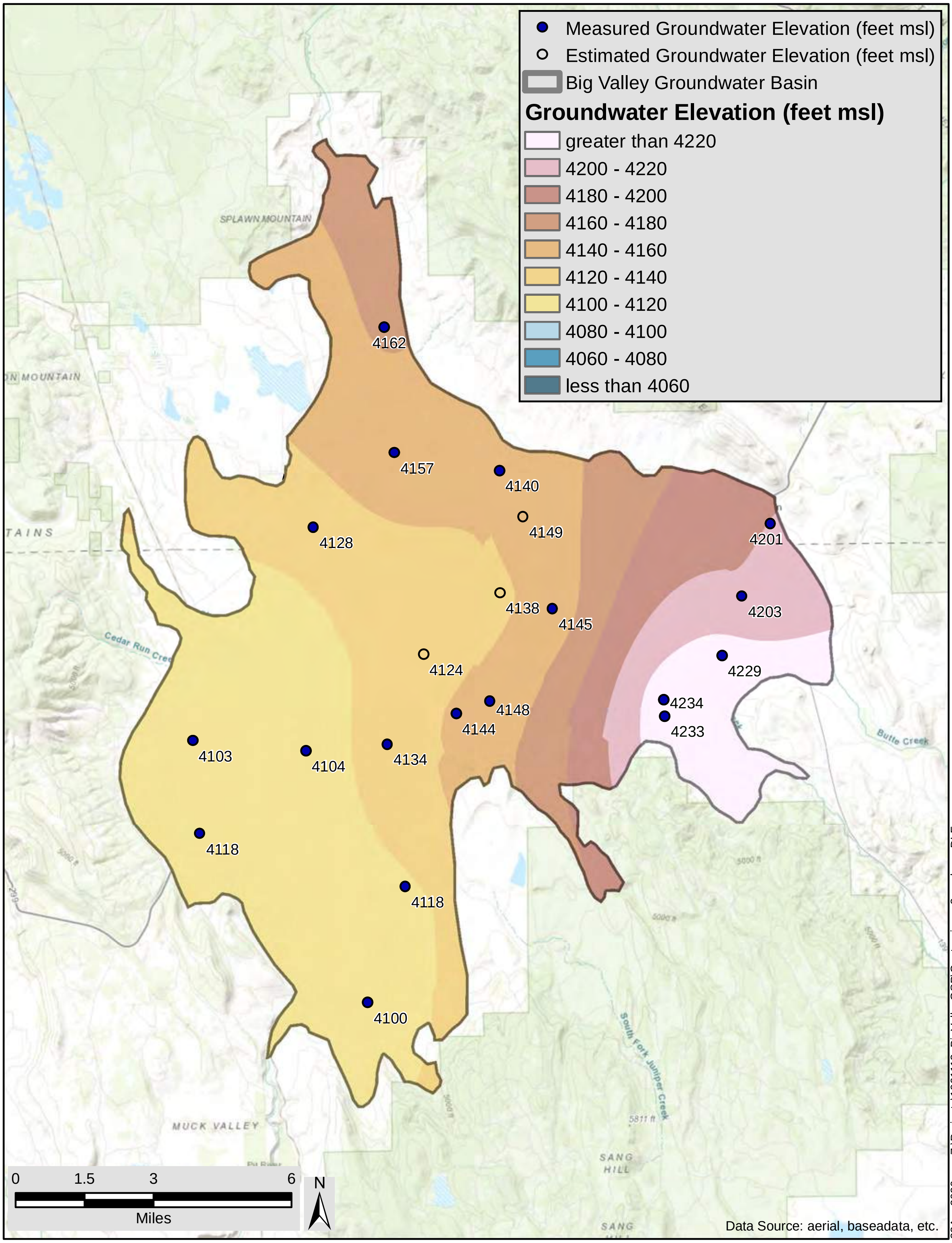

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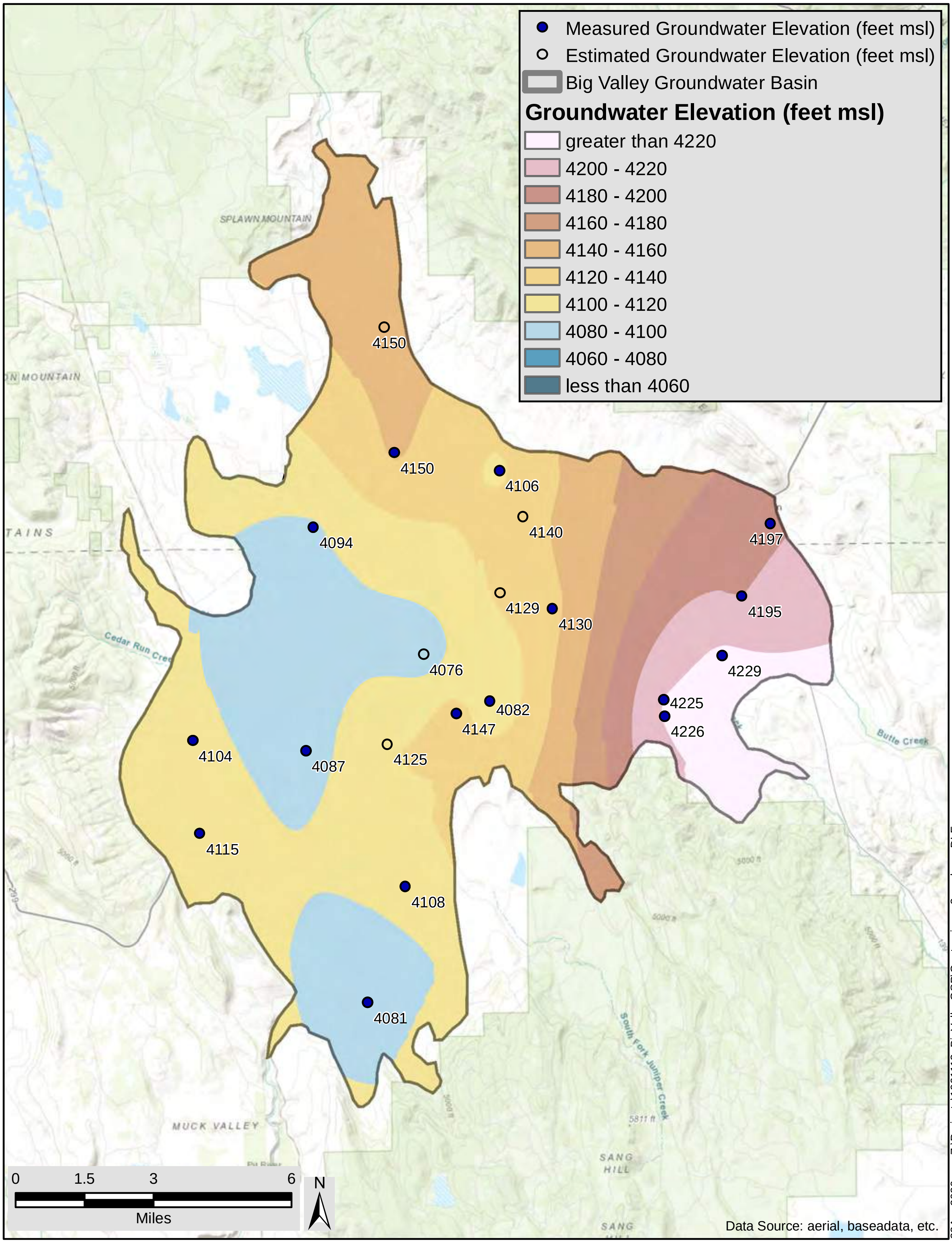
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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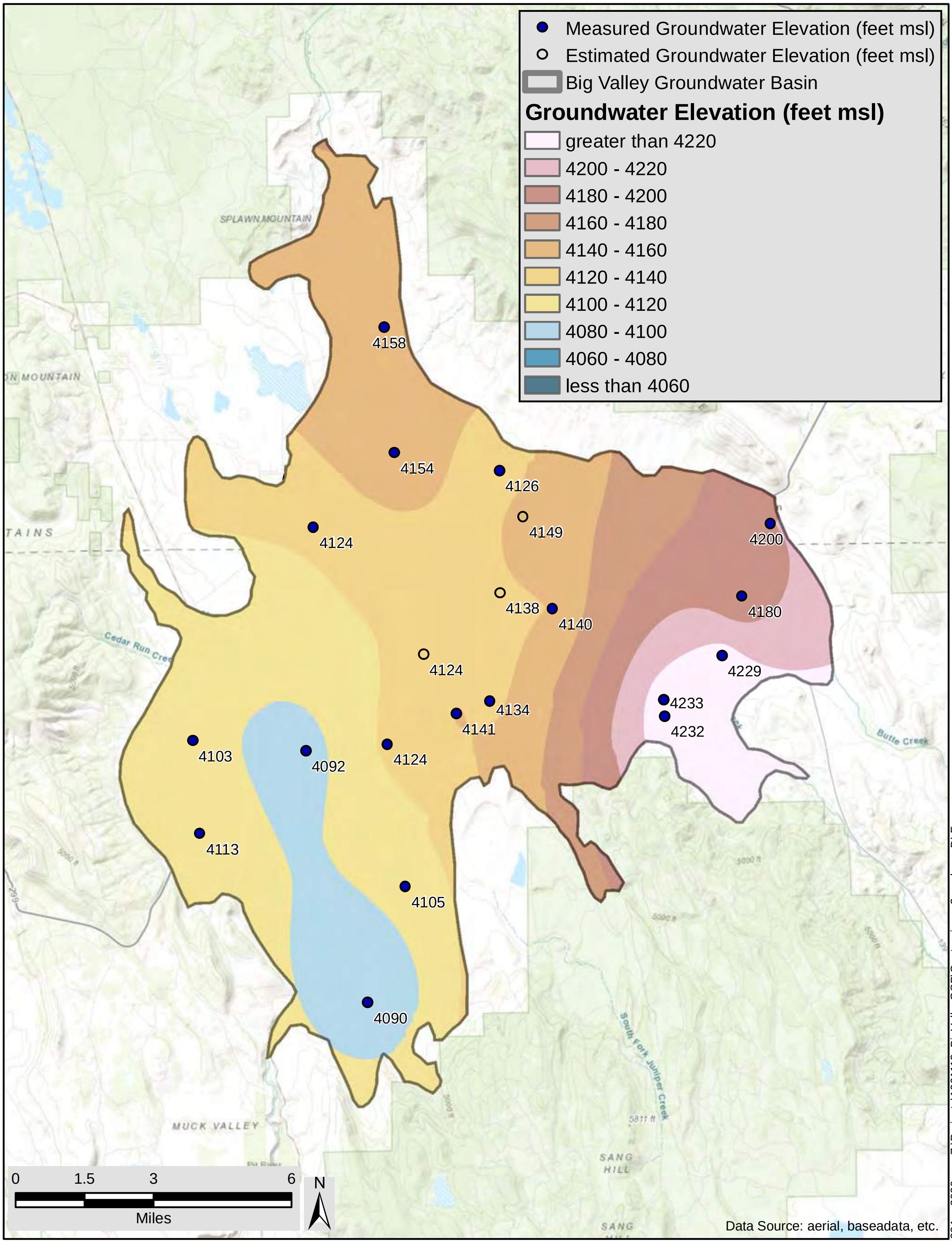
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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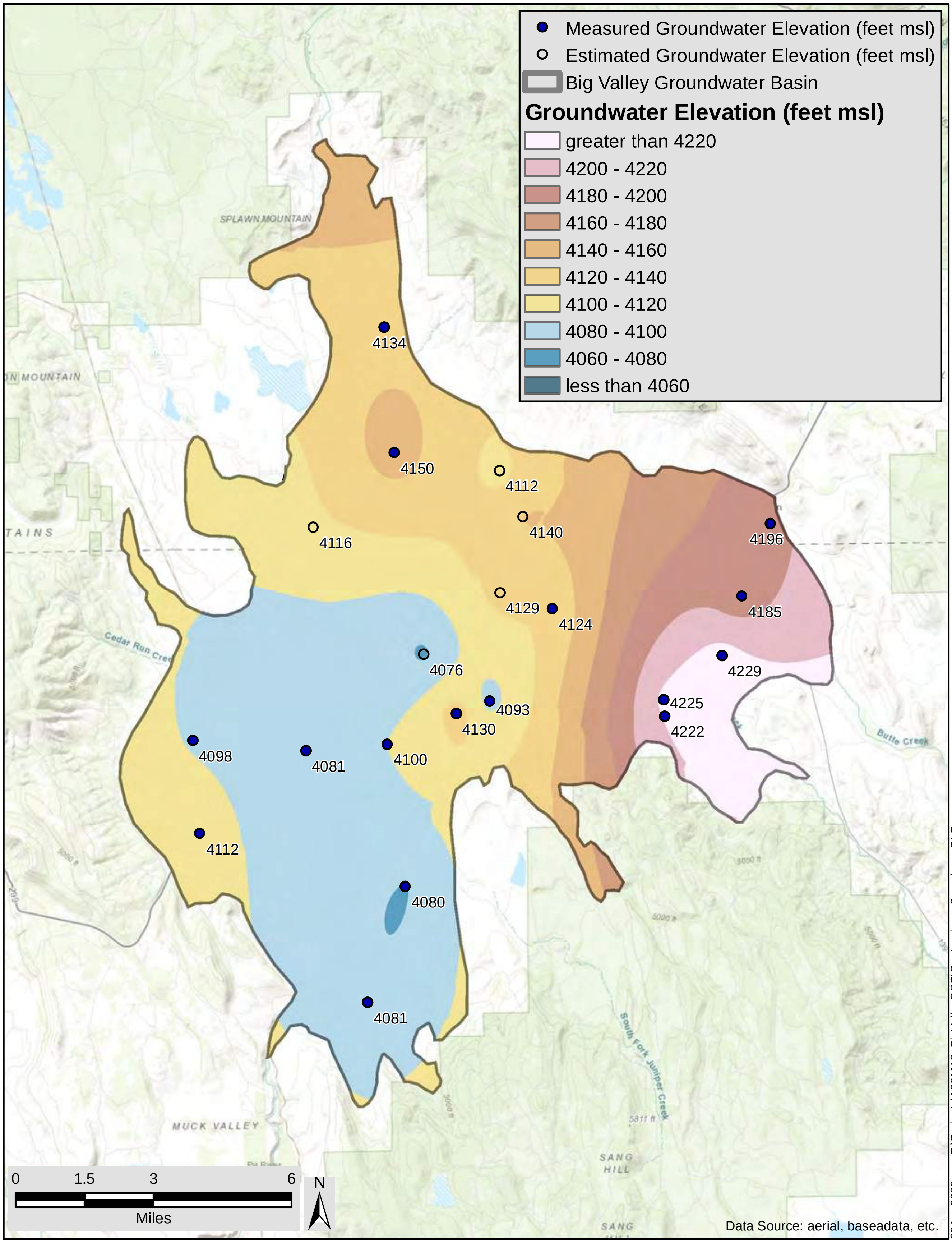
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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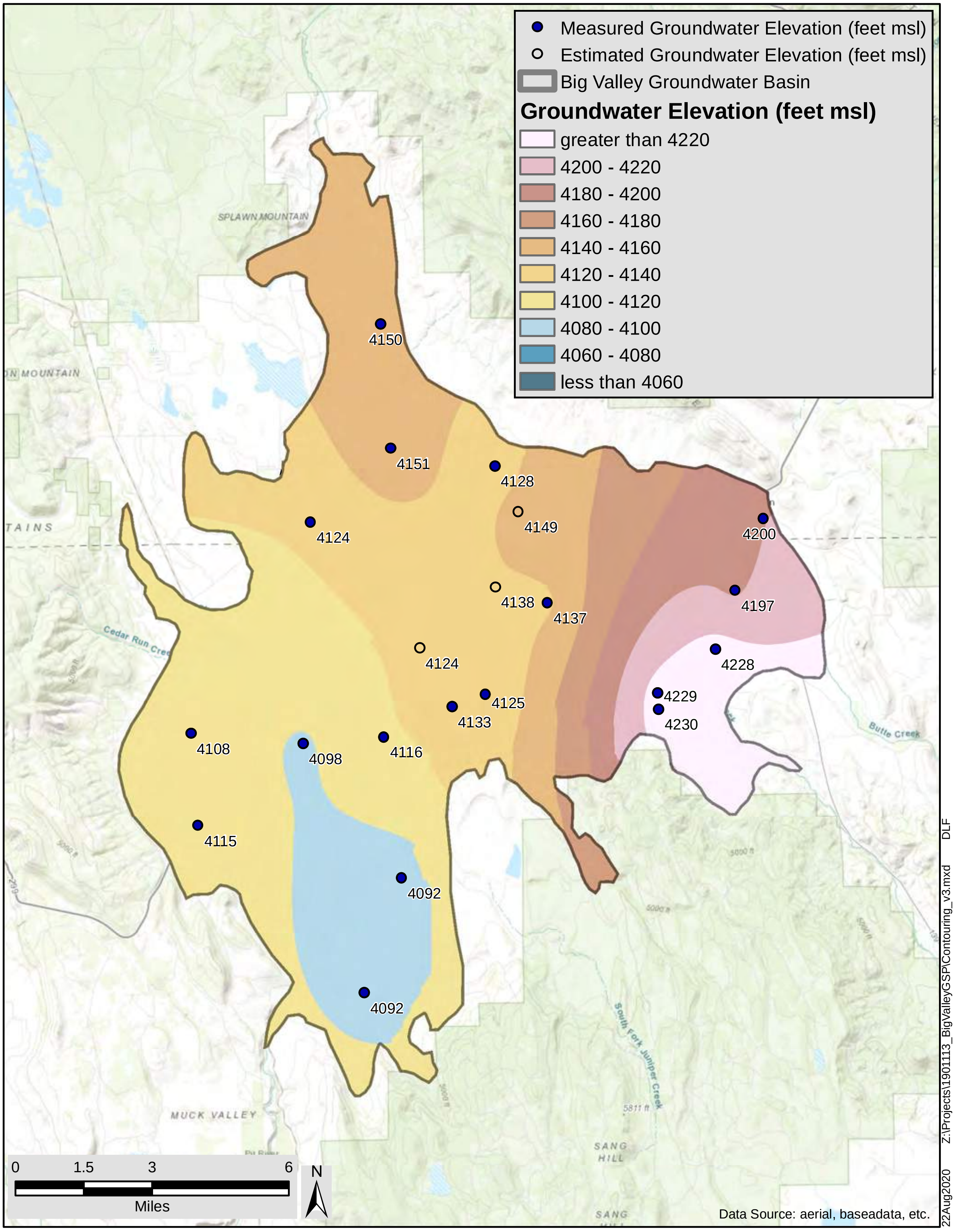
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



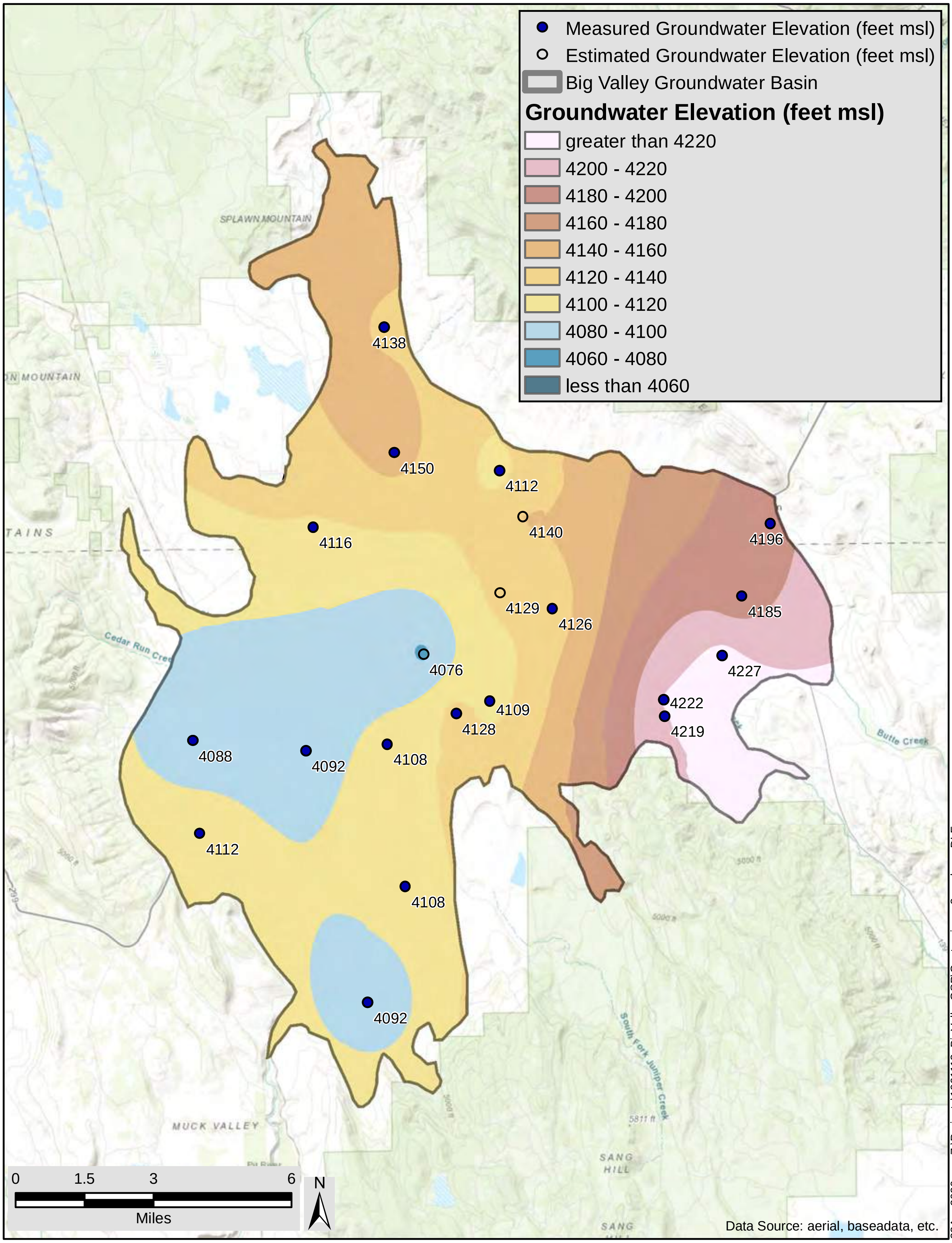
Big Valley Basin Groundwater Sustainability Plan
Modoc and Lassen Counties, California

Big Valley Groundwater Basin GSAs

GEI Consultants

Groundwater Elevations
Spring 2002

AUGUST 2020 DRAFT FIGURE



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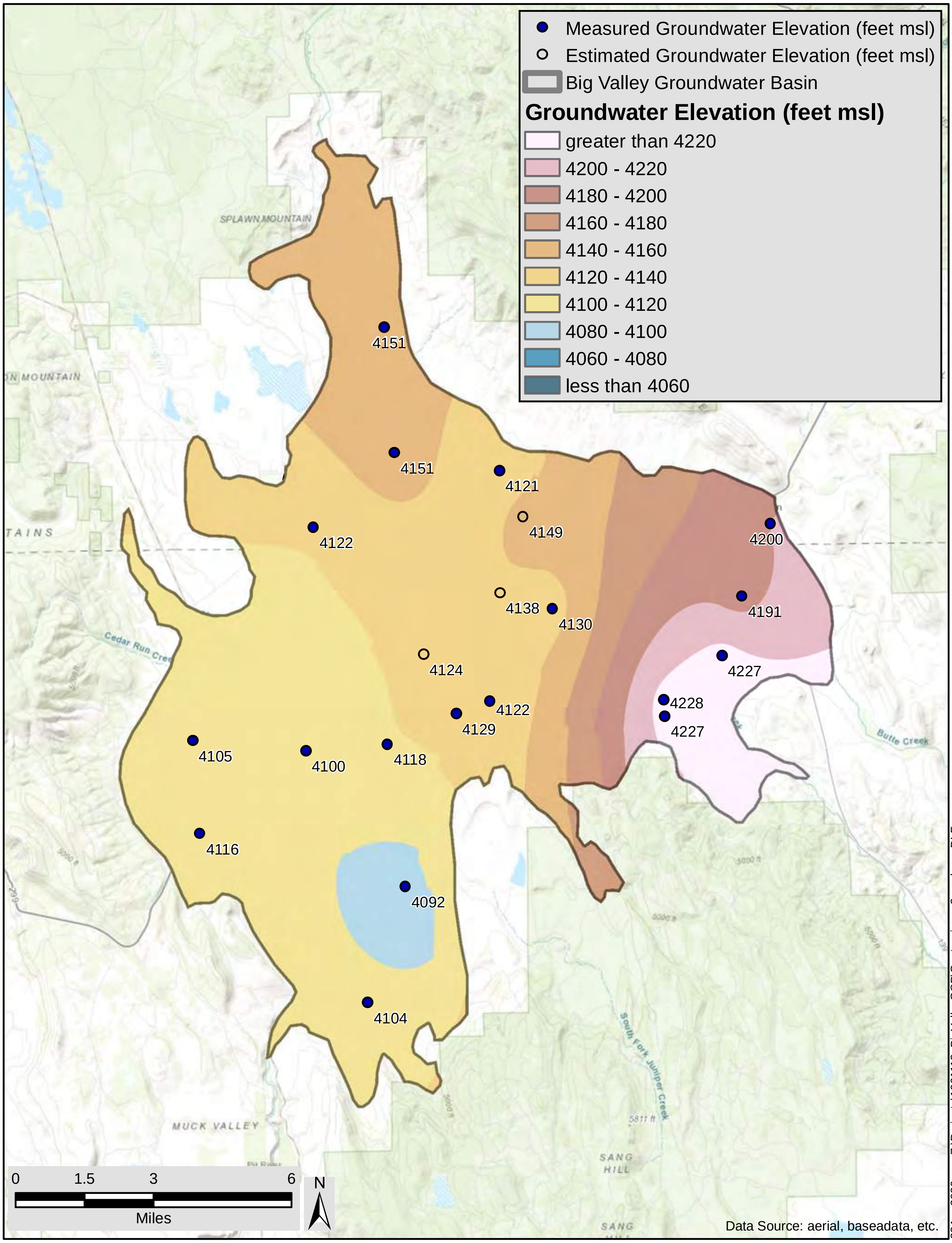
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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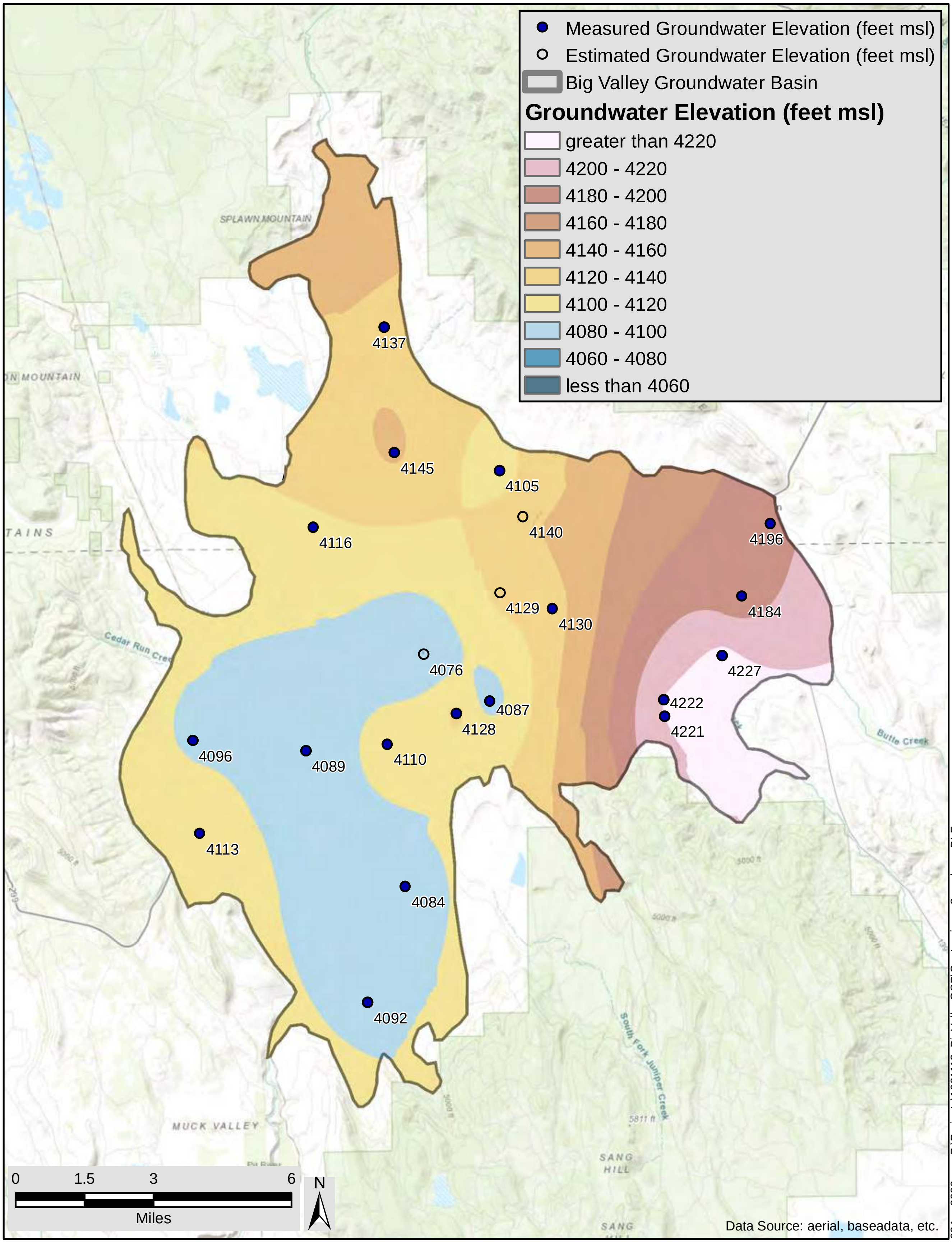
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Spring 2003		
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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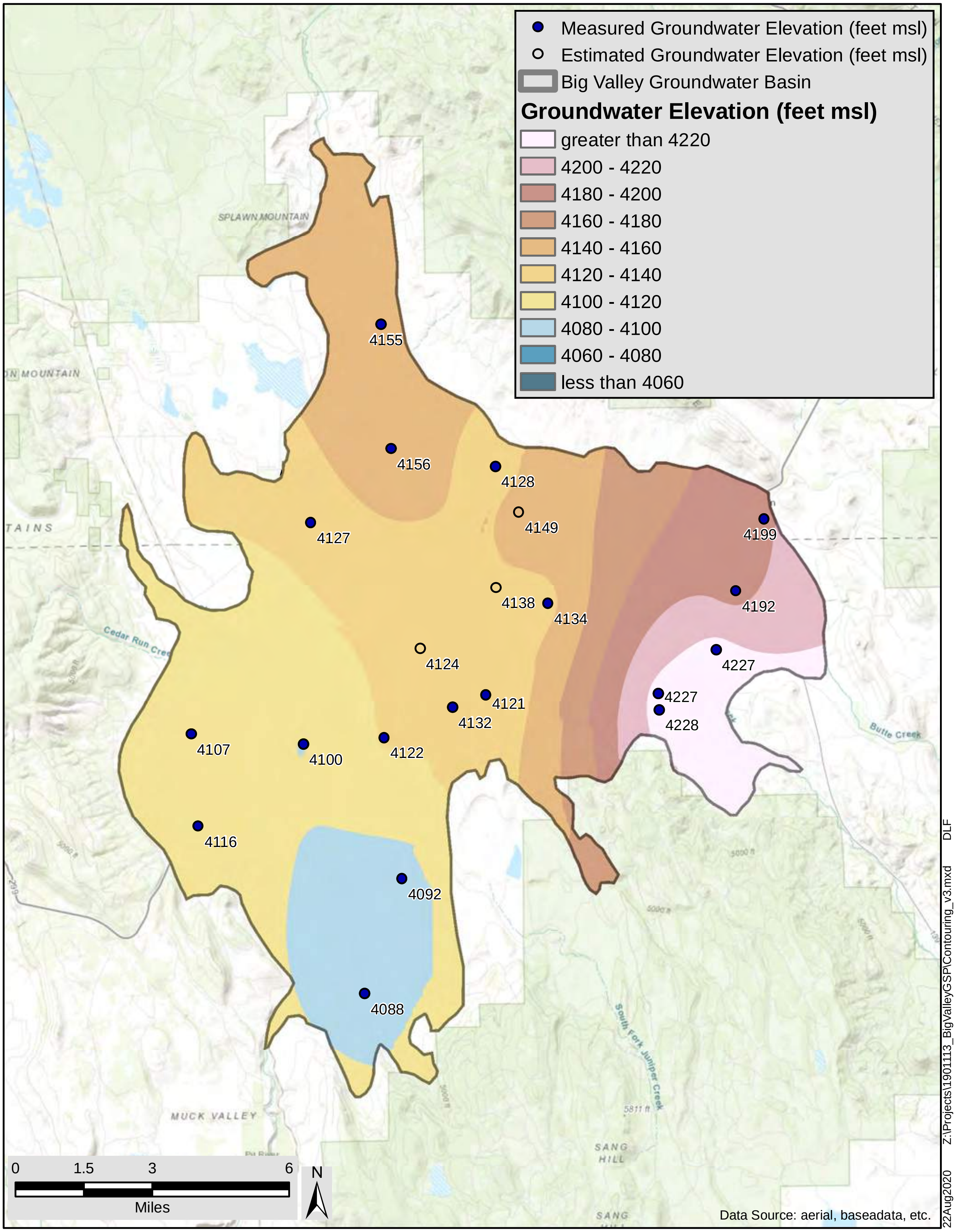

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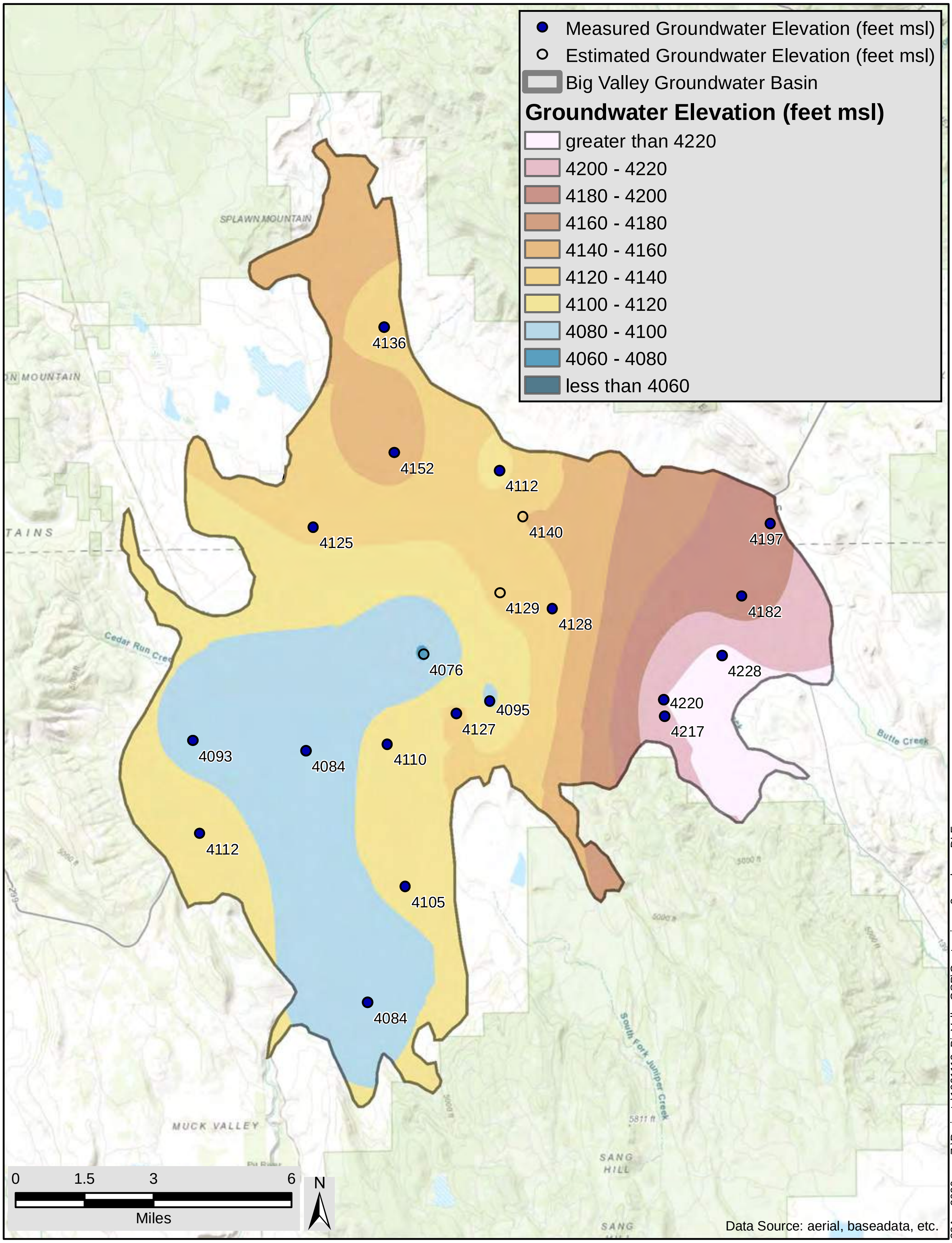

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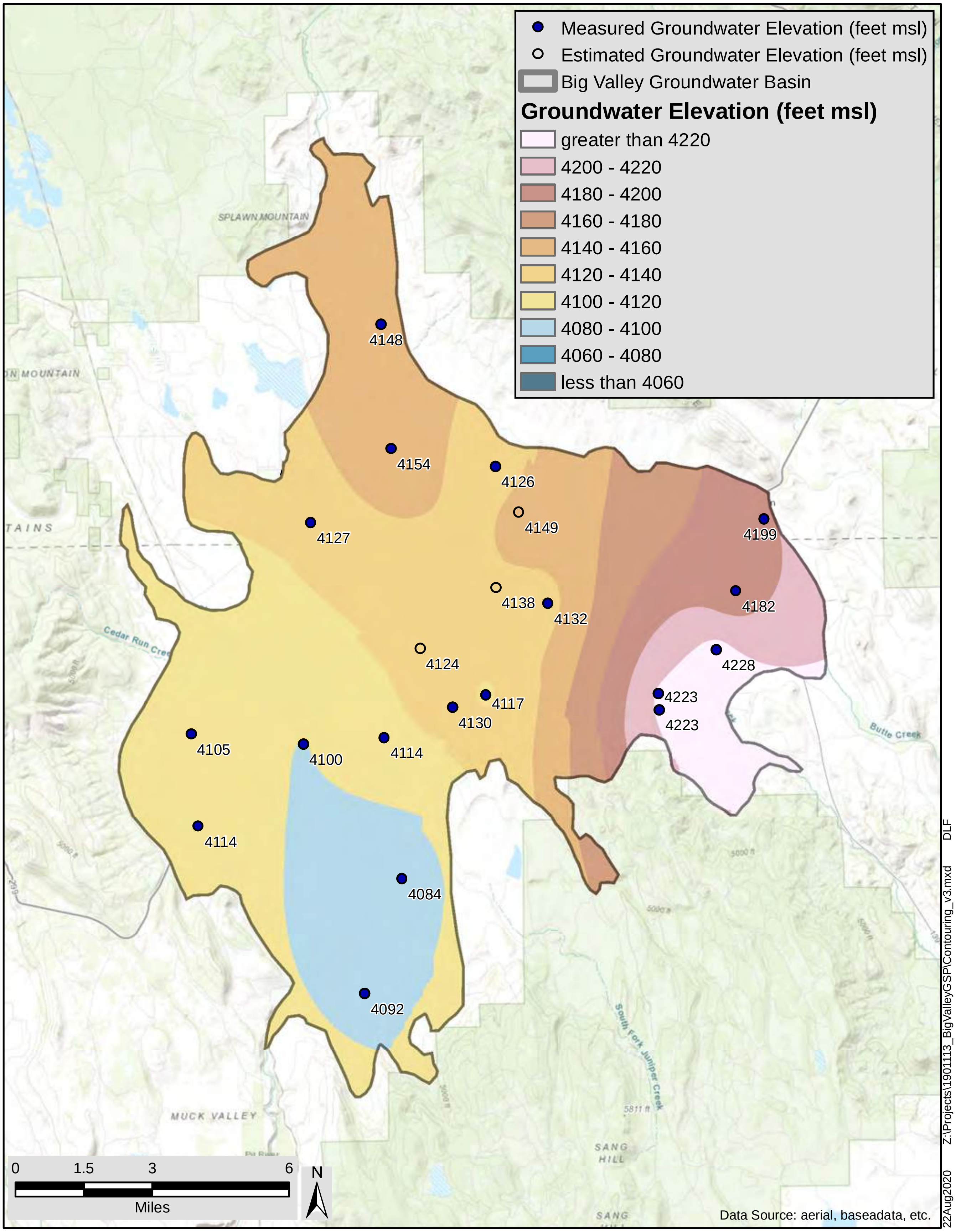
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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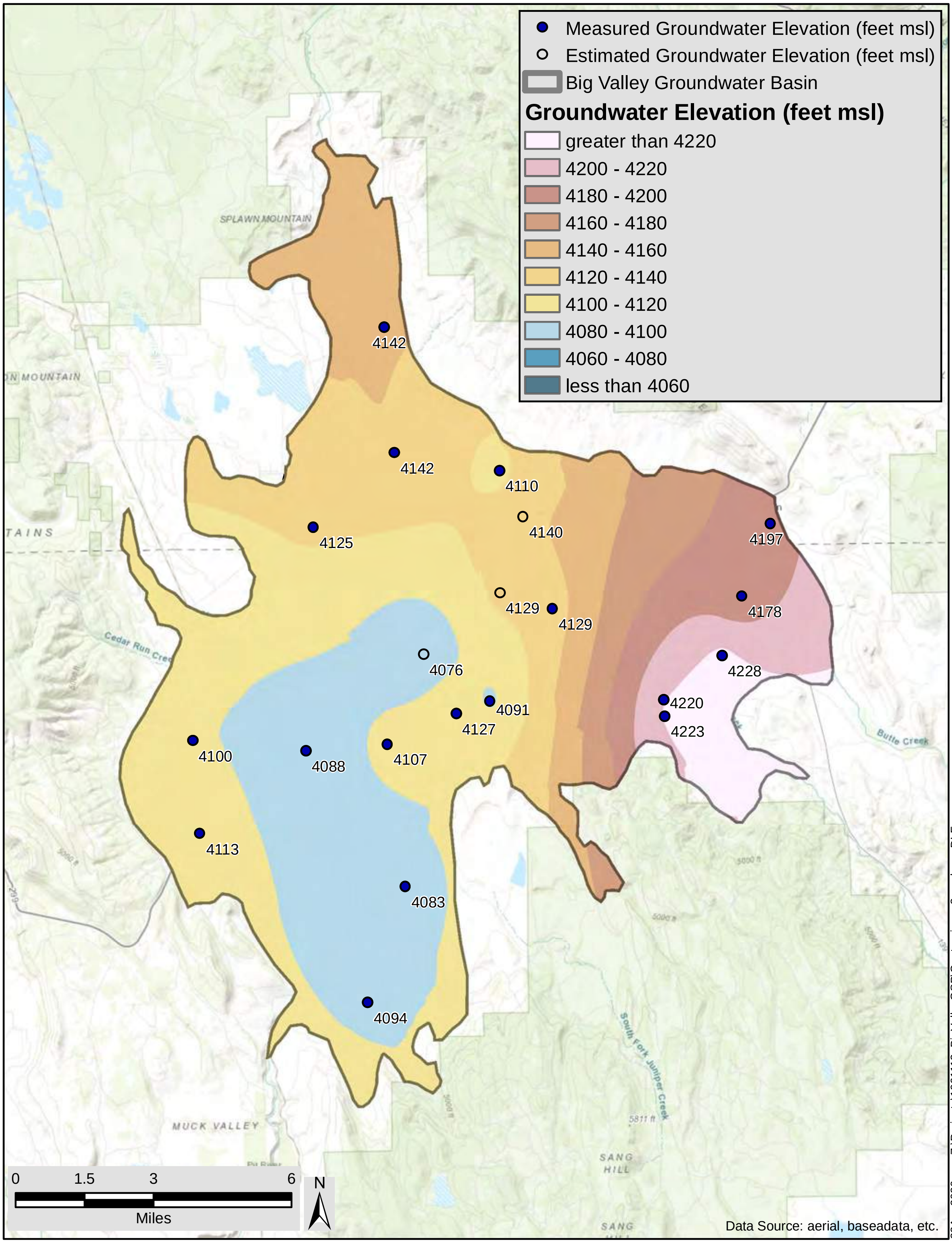
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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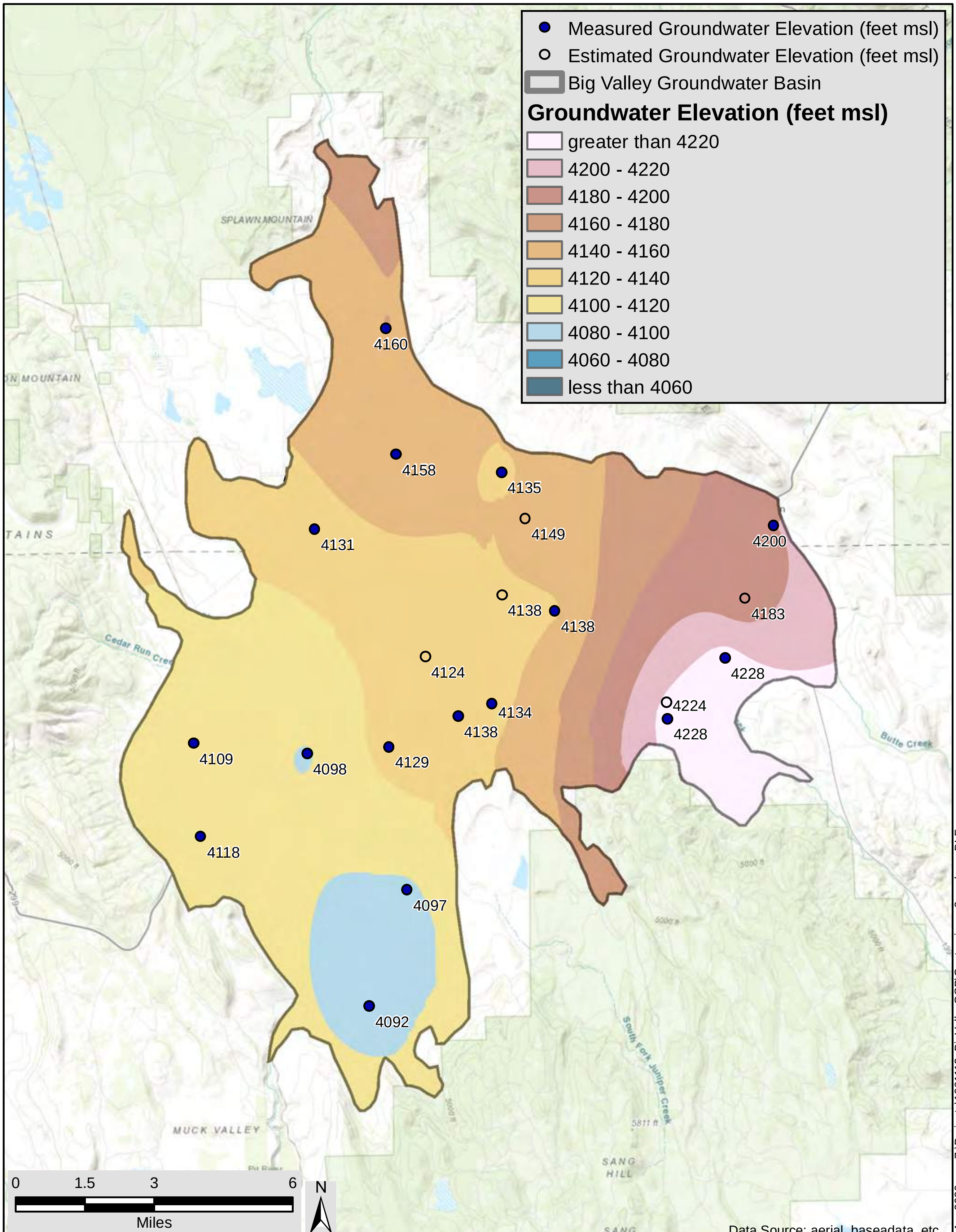
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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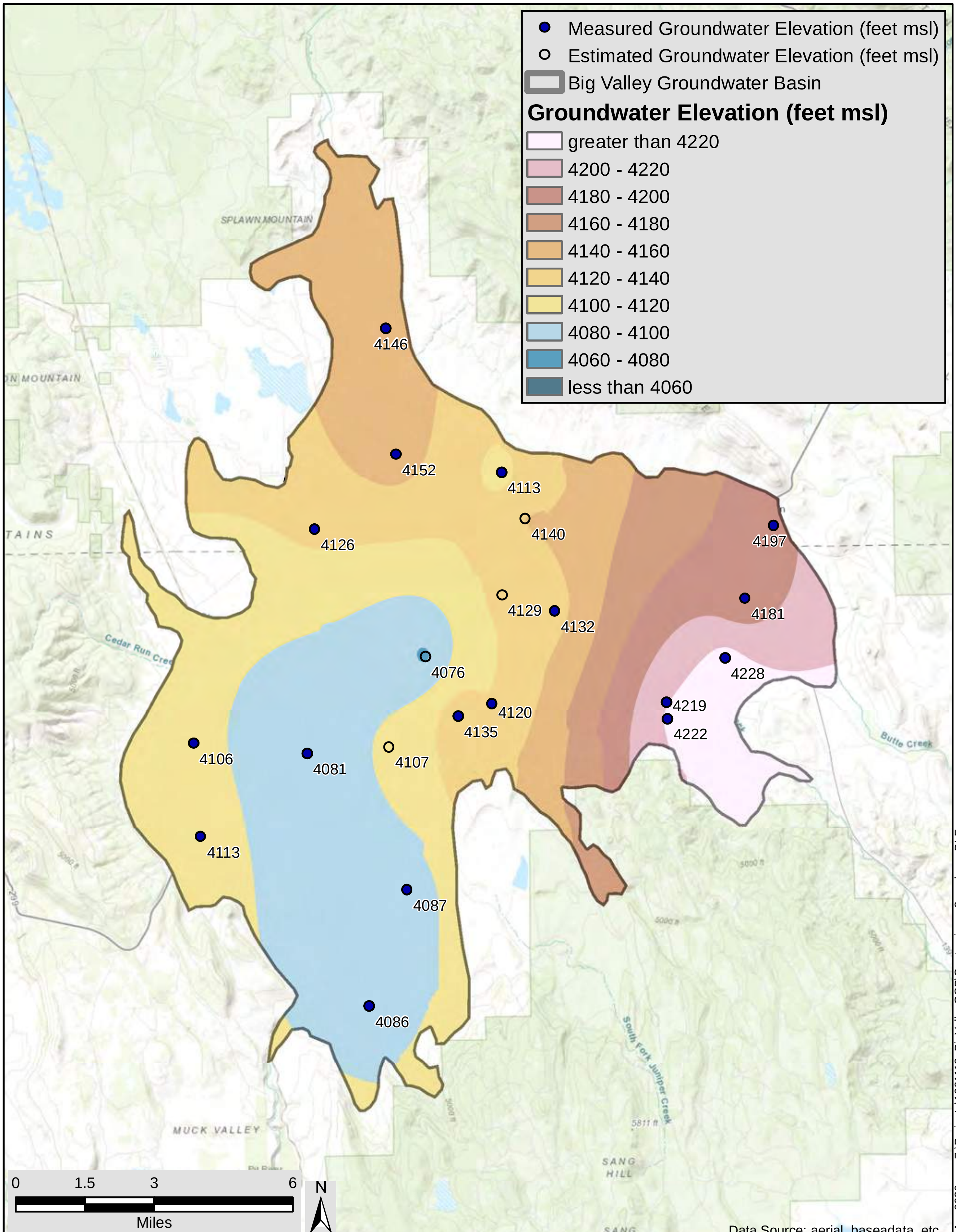

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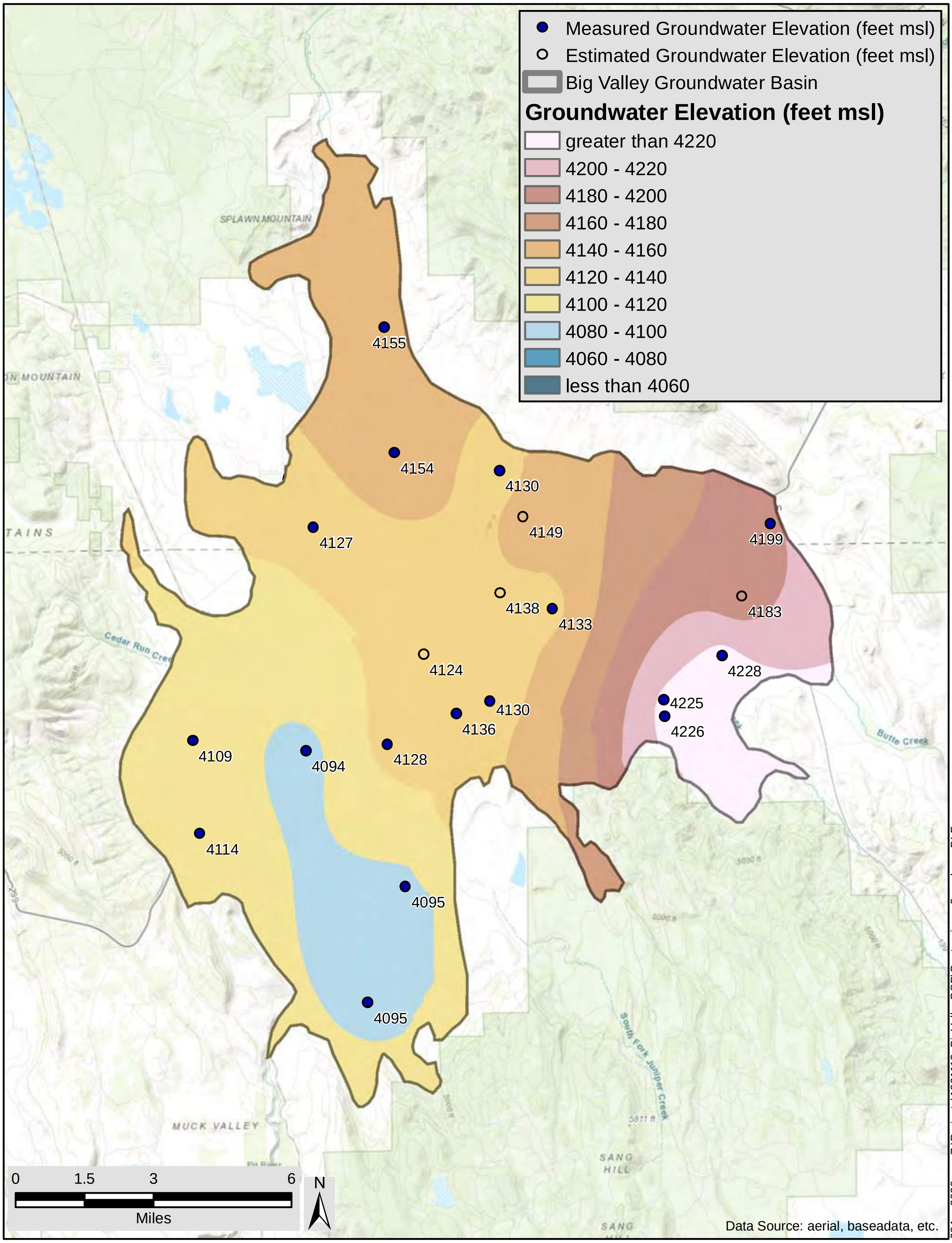


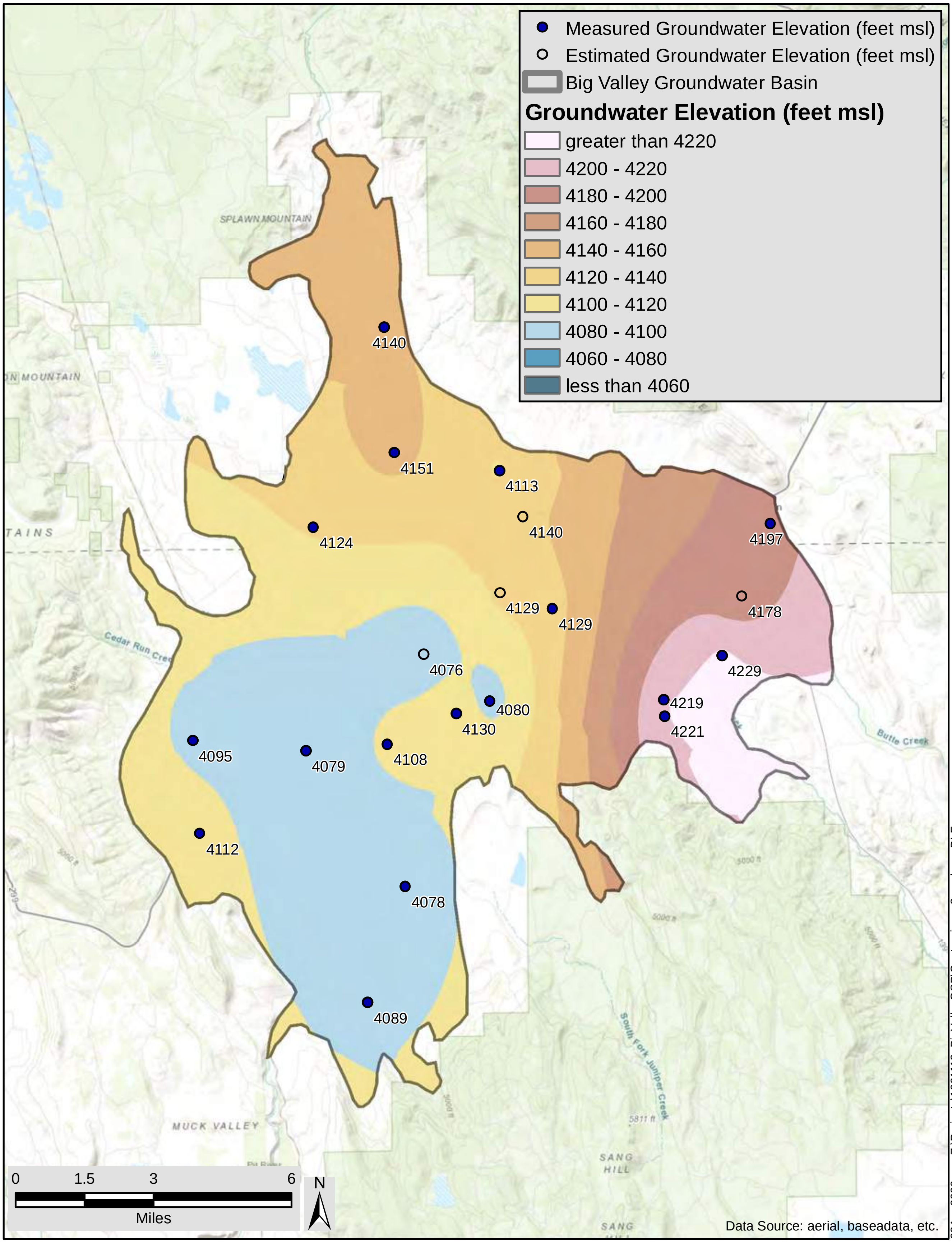
Big Valley Basin Groundwater Sustainability Plan
Modoc and Lassen Counties, California

Big Valley Groundwater Basin GSAs

GEI Consultants

Groundwater Elevations
Spring 2007

AUGUST 2020 DRAFT FIGURE



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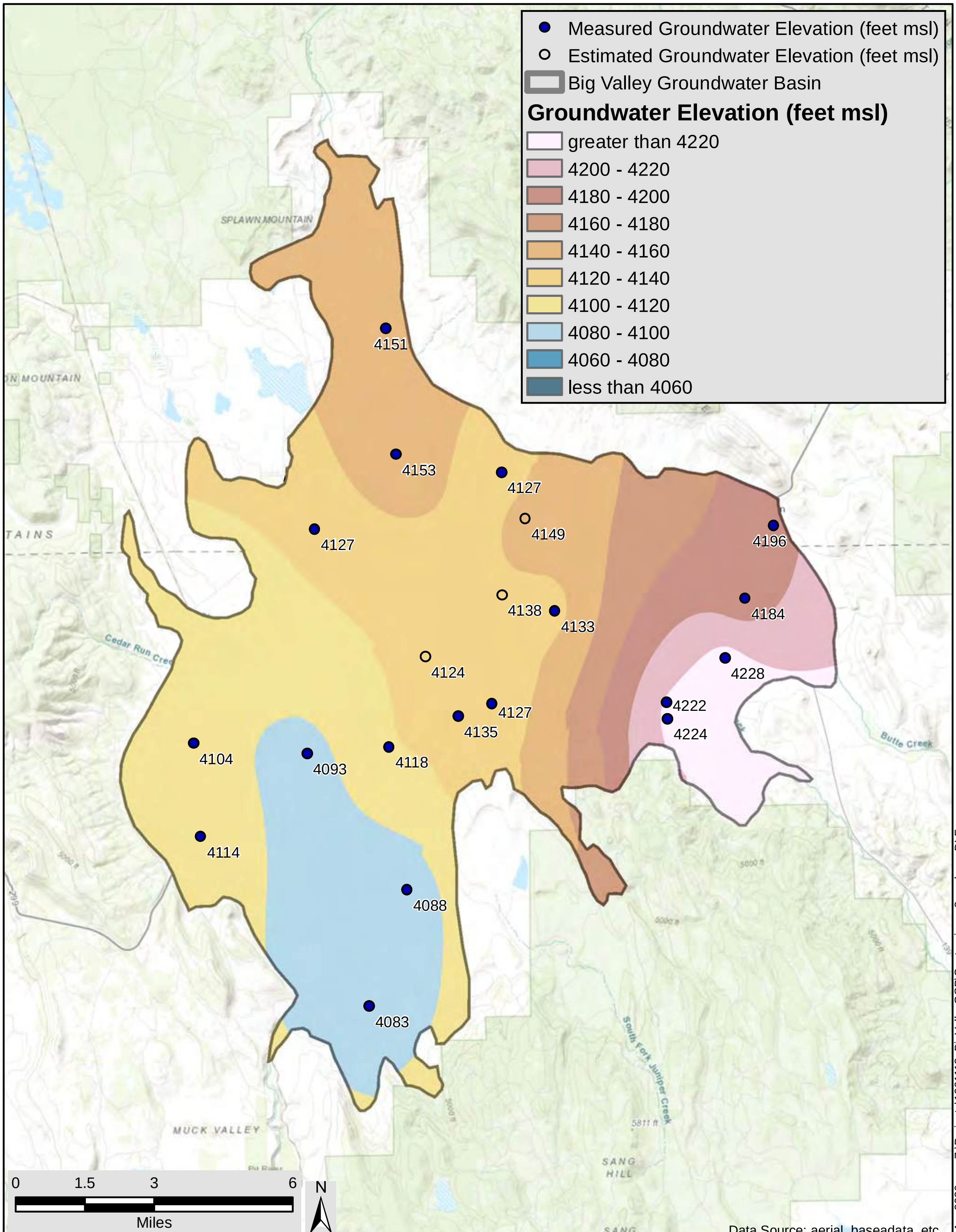

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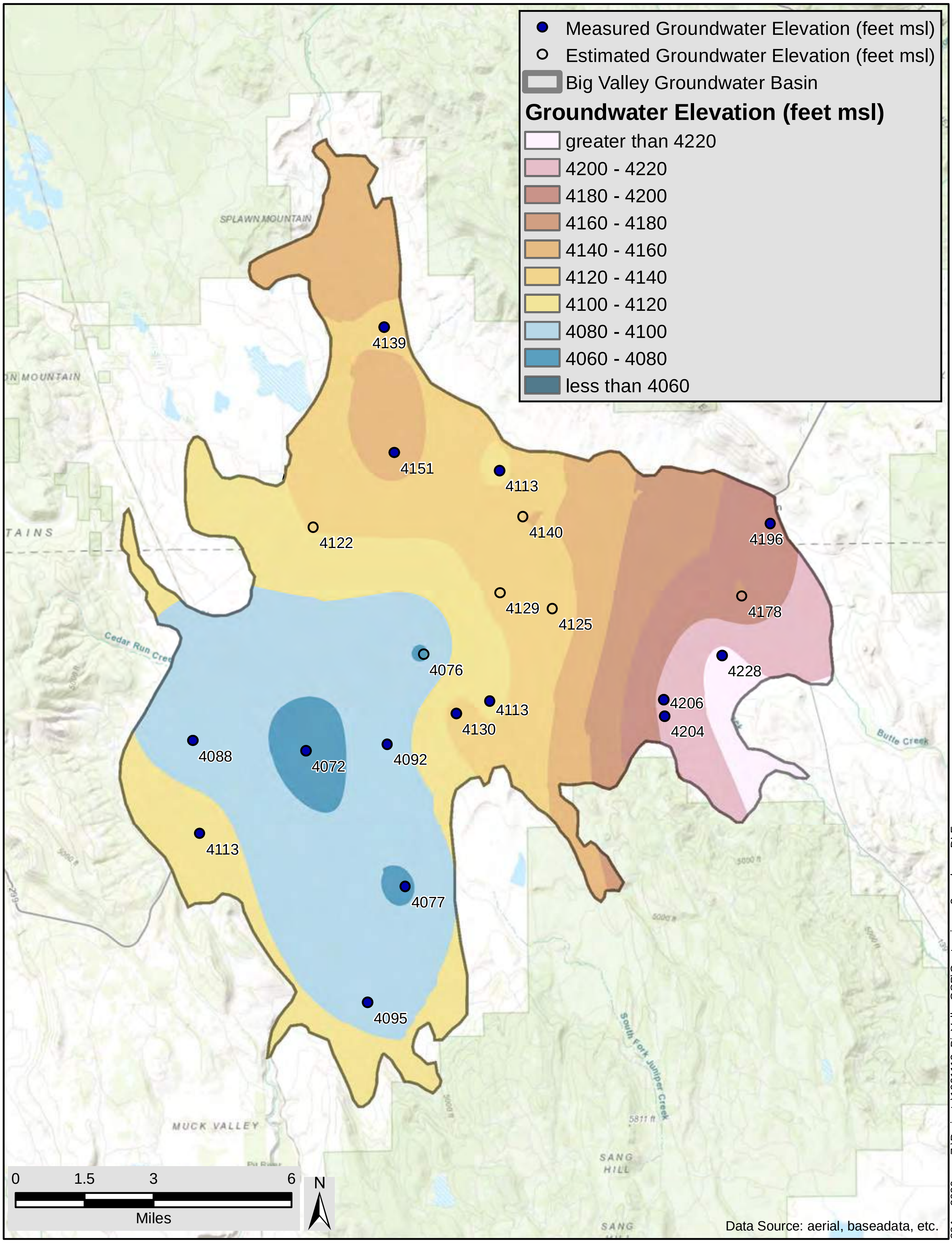

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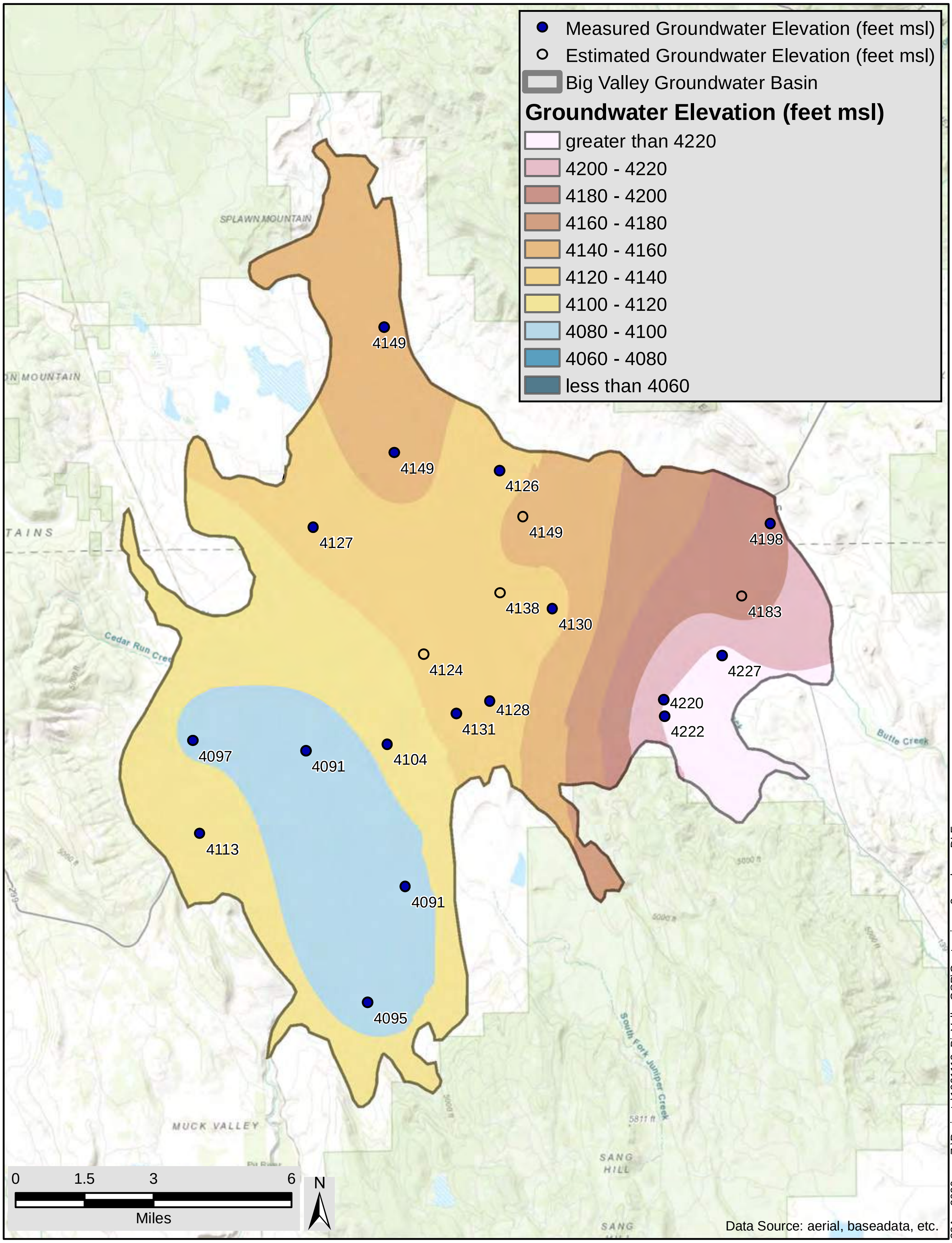

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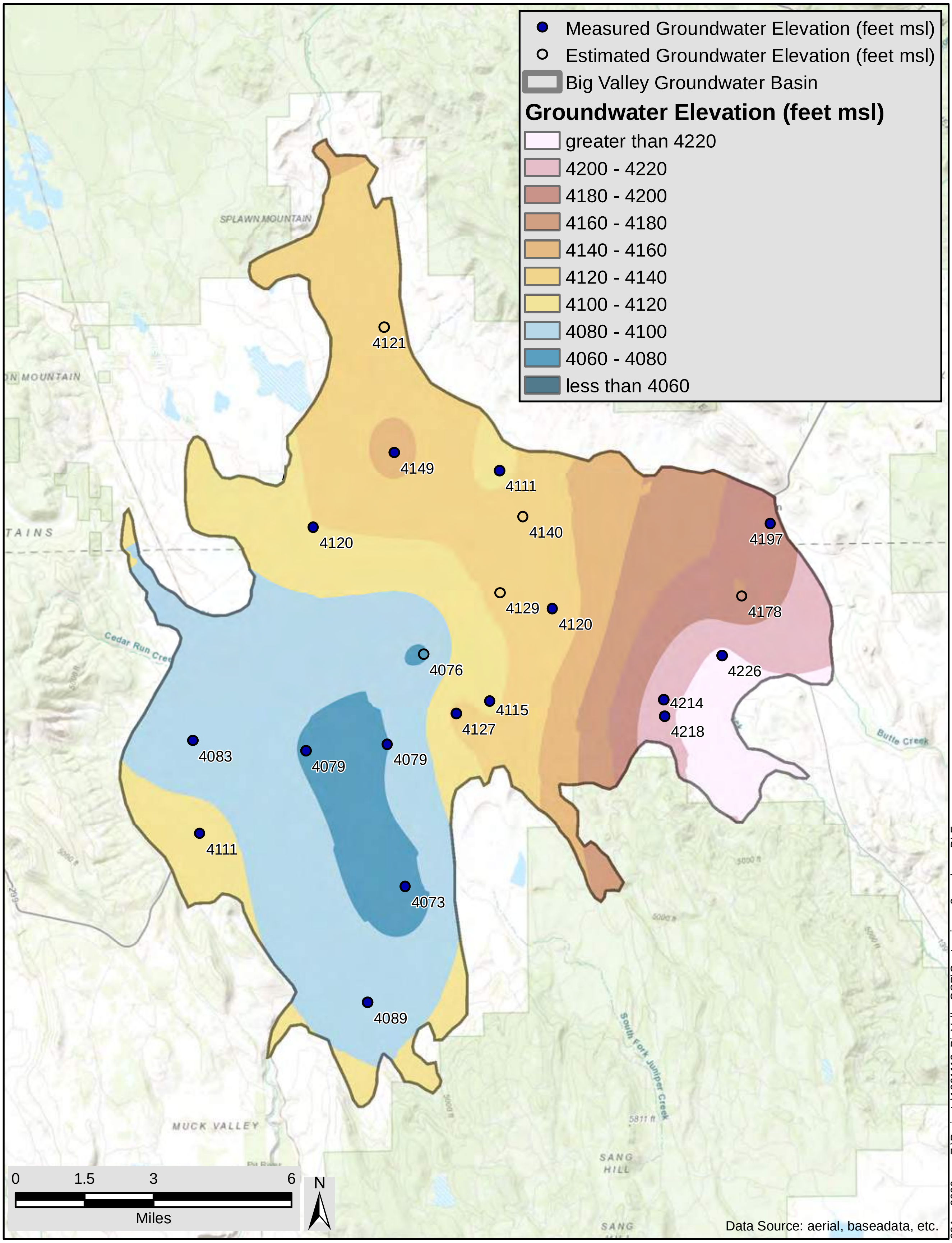
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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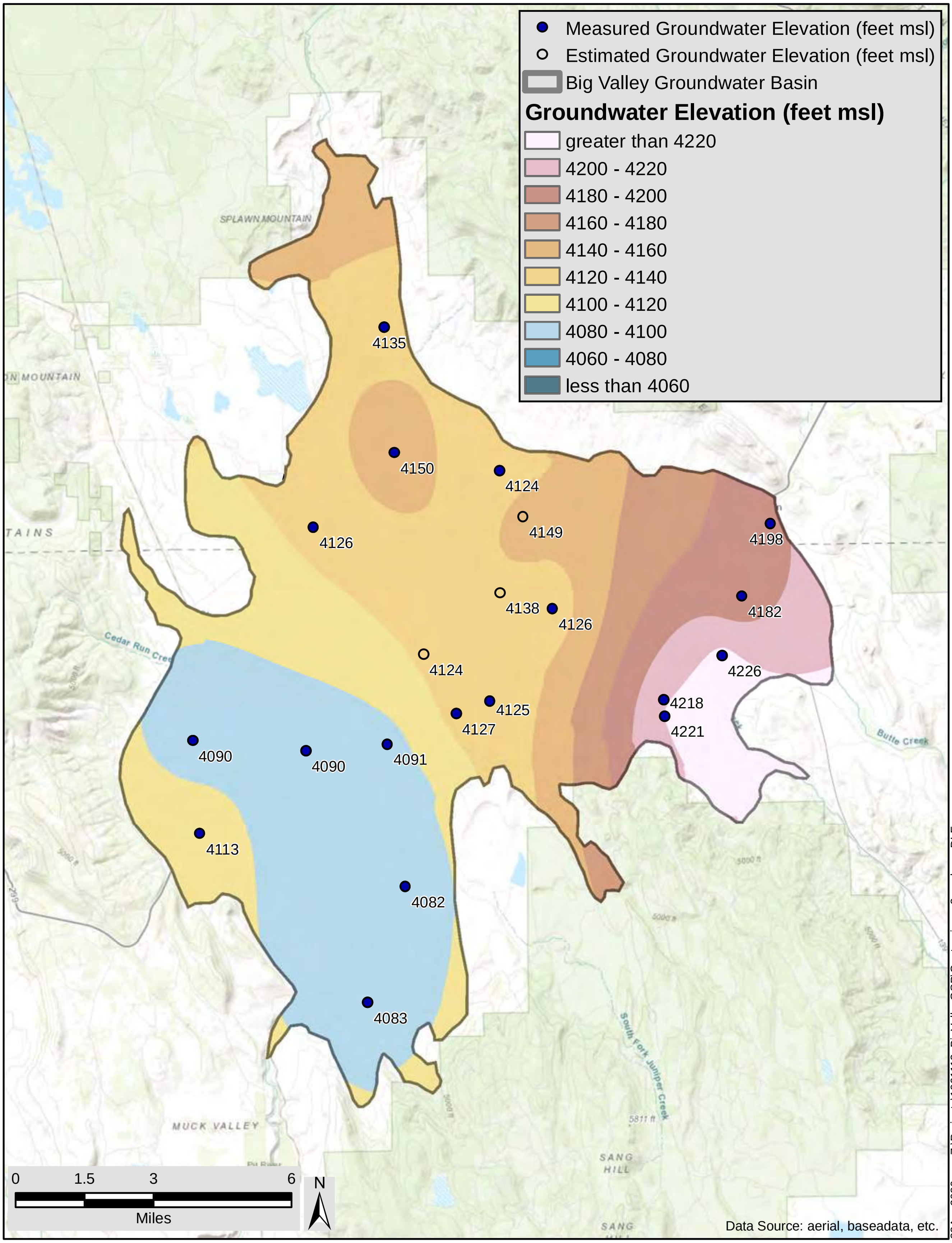

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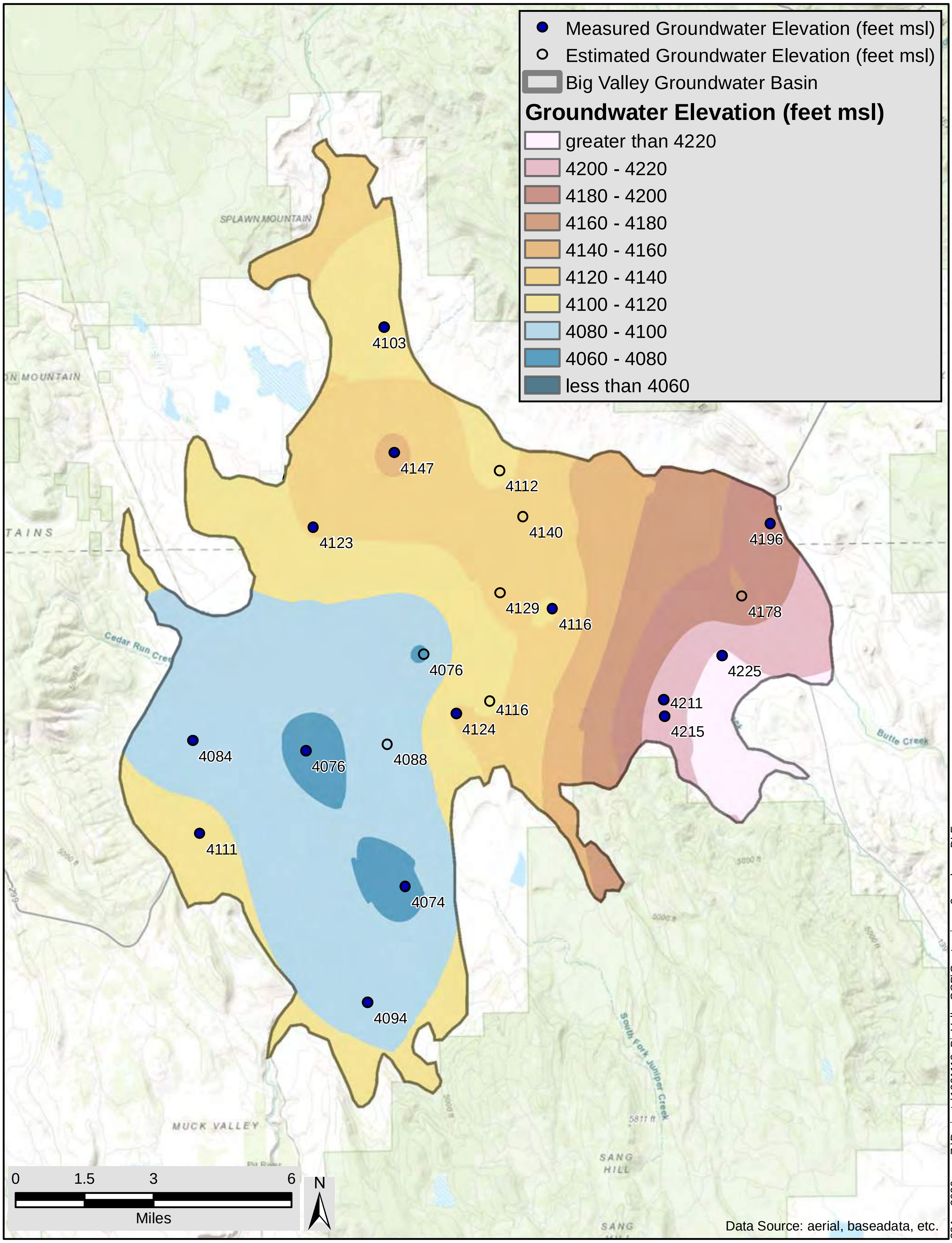

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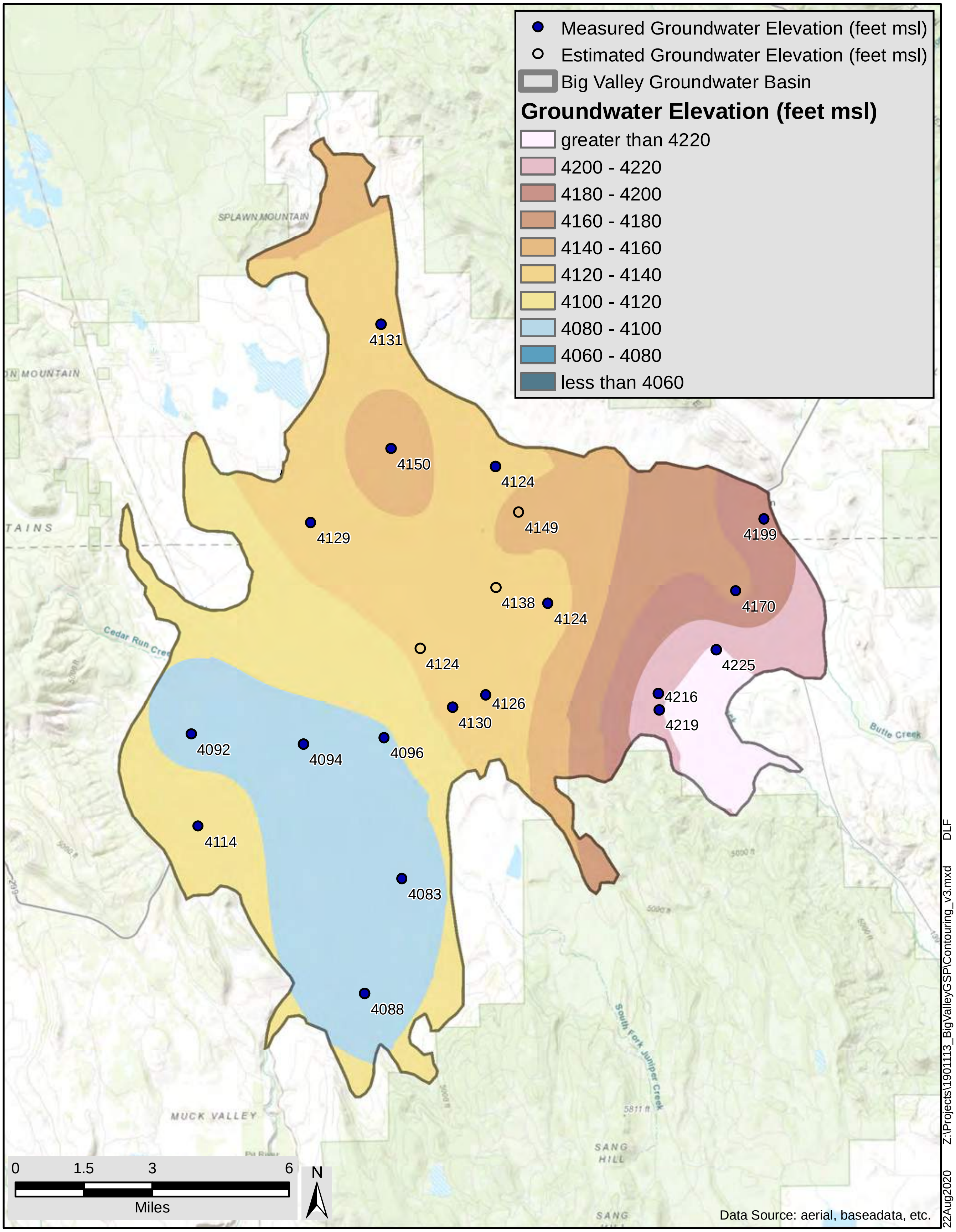

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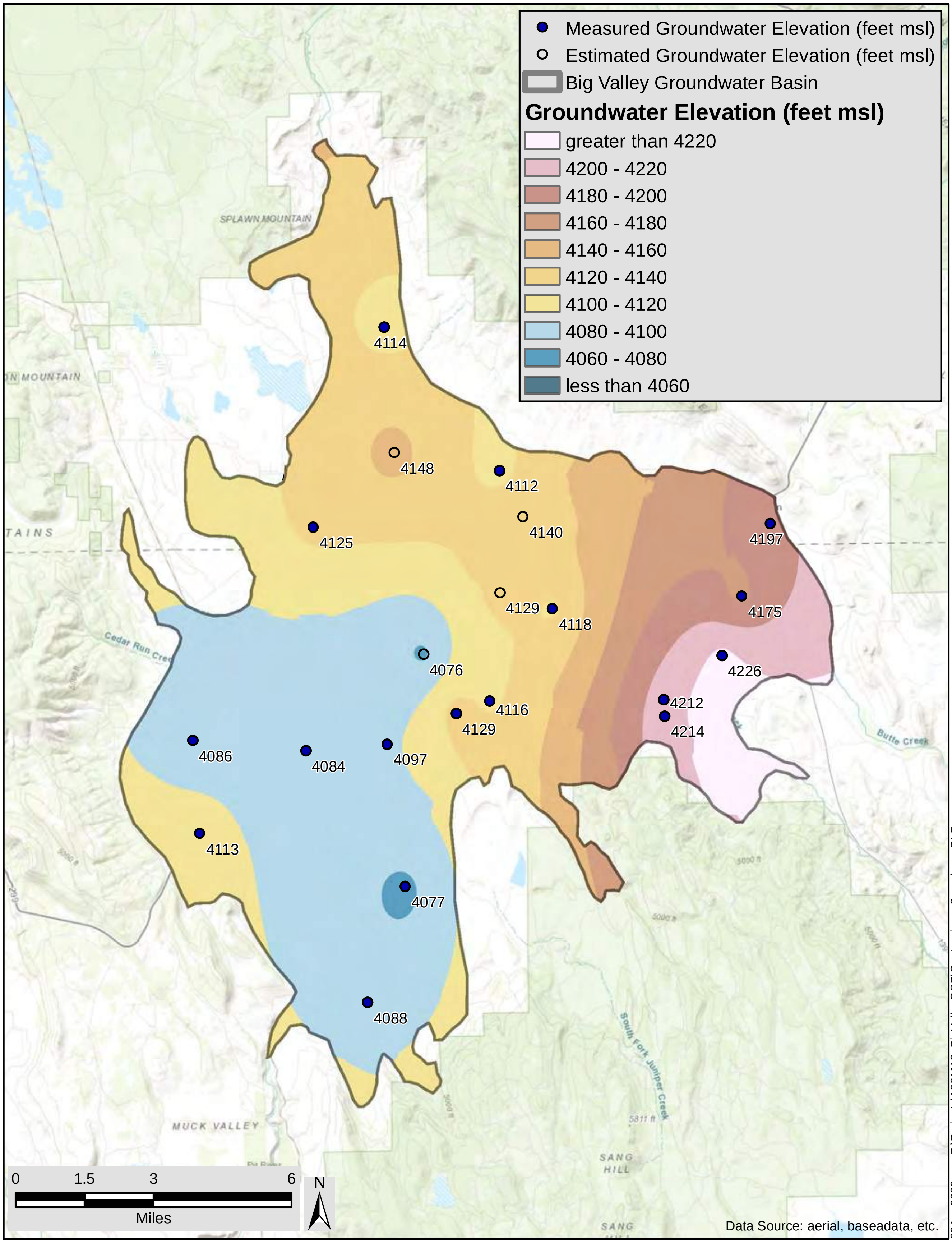

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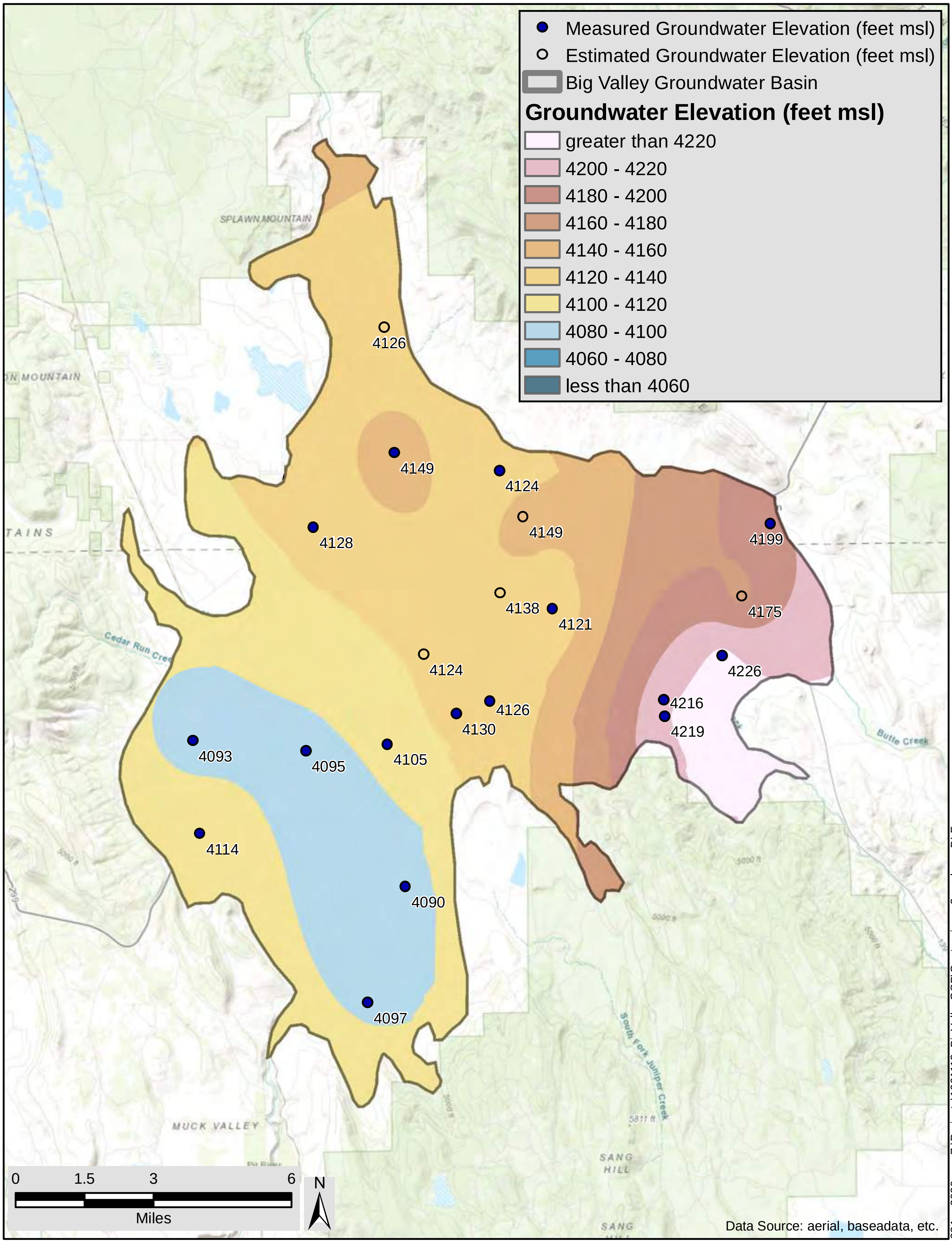

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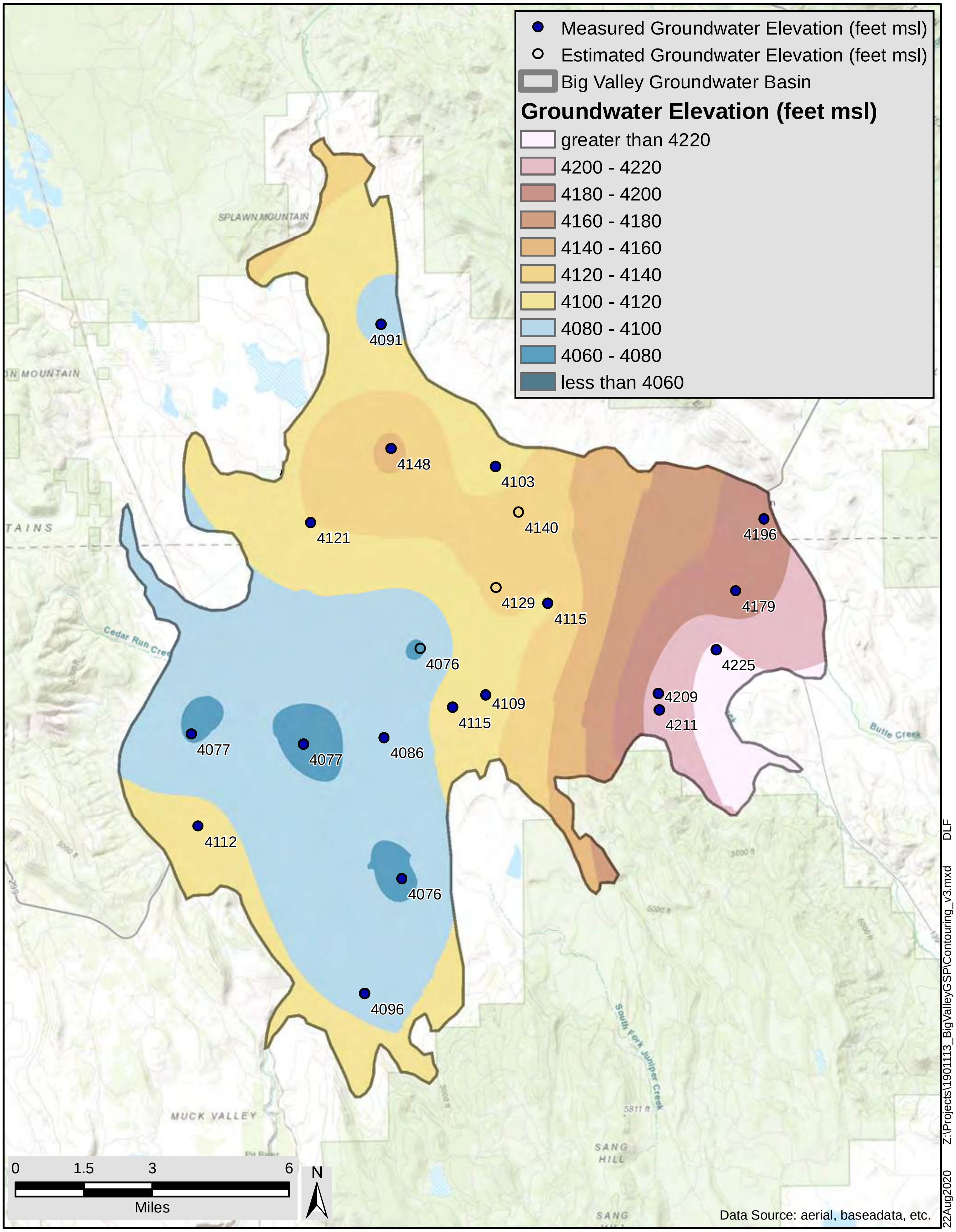

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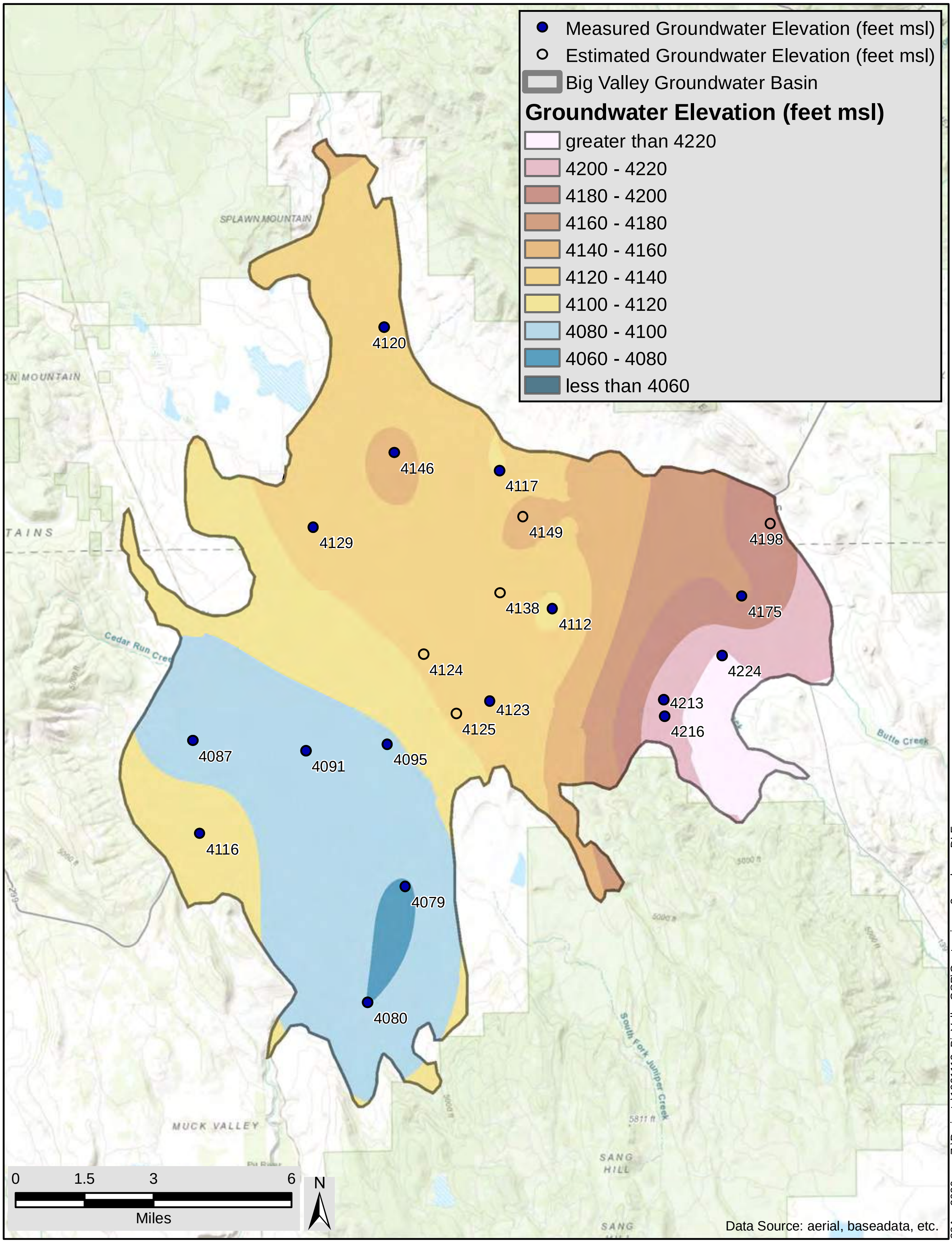

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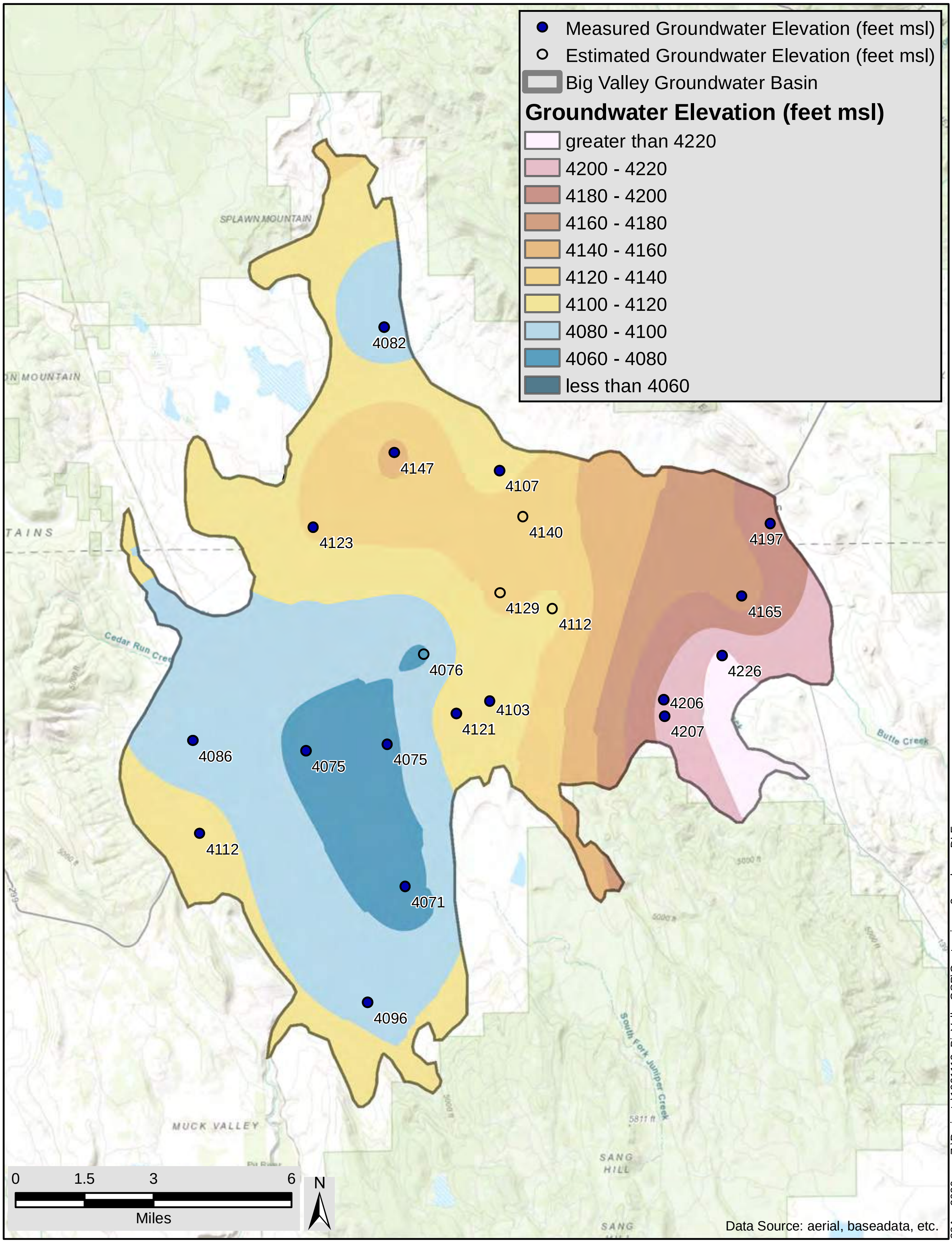

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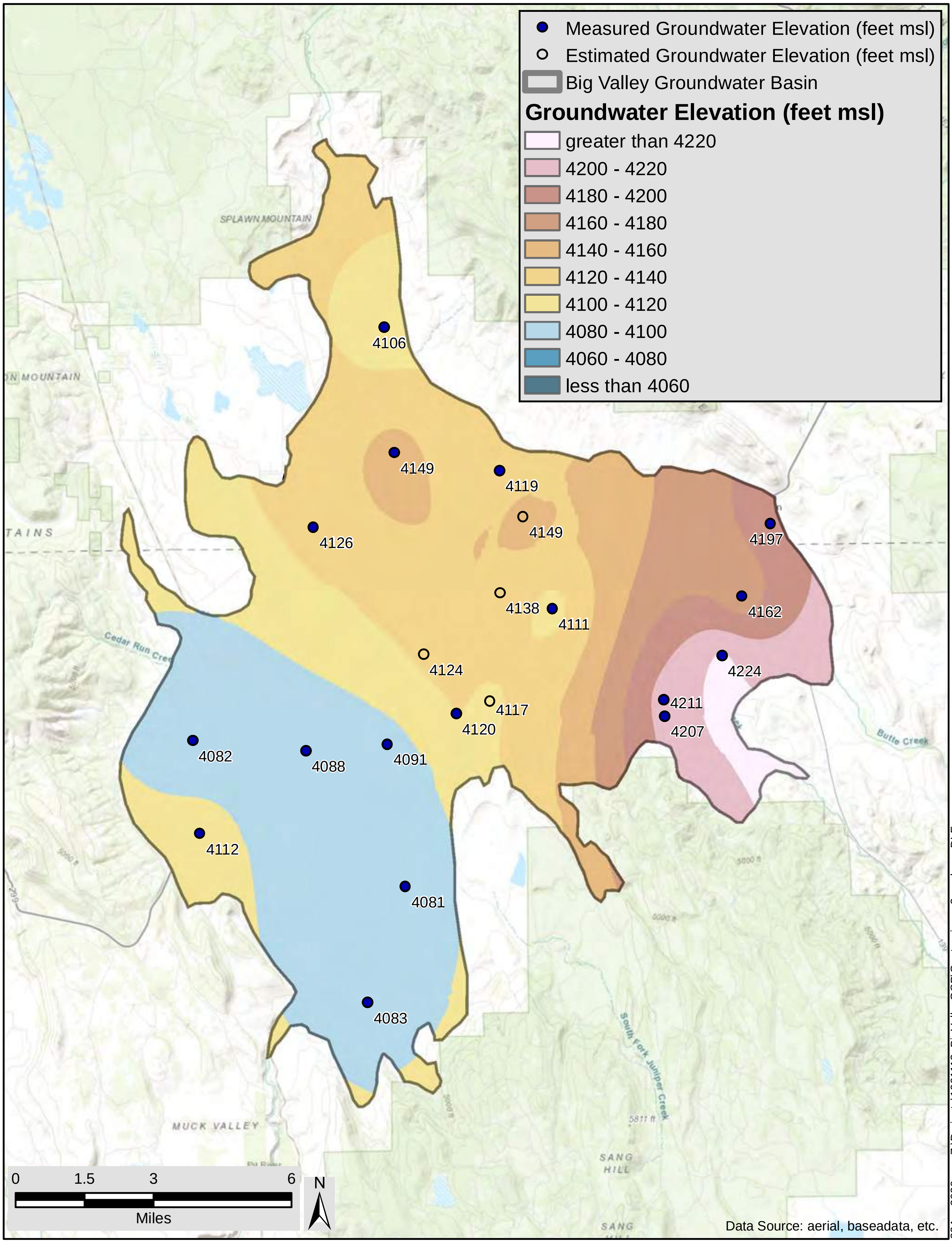

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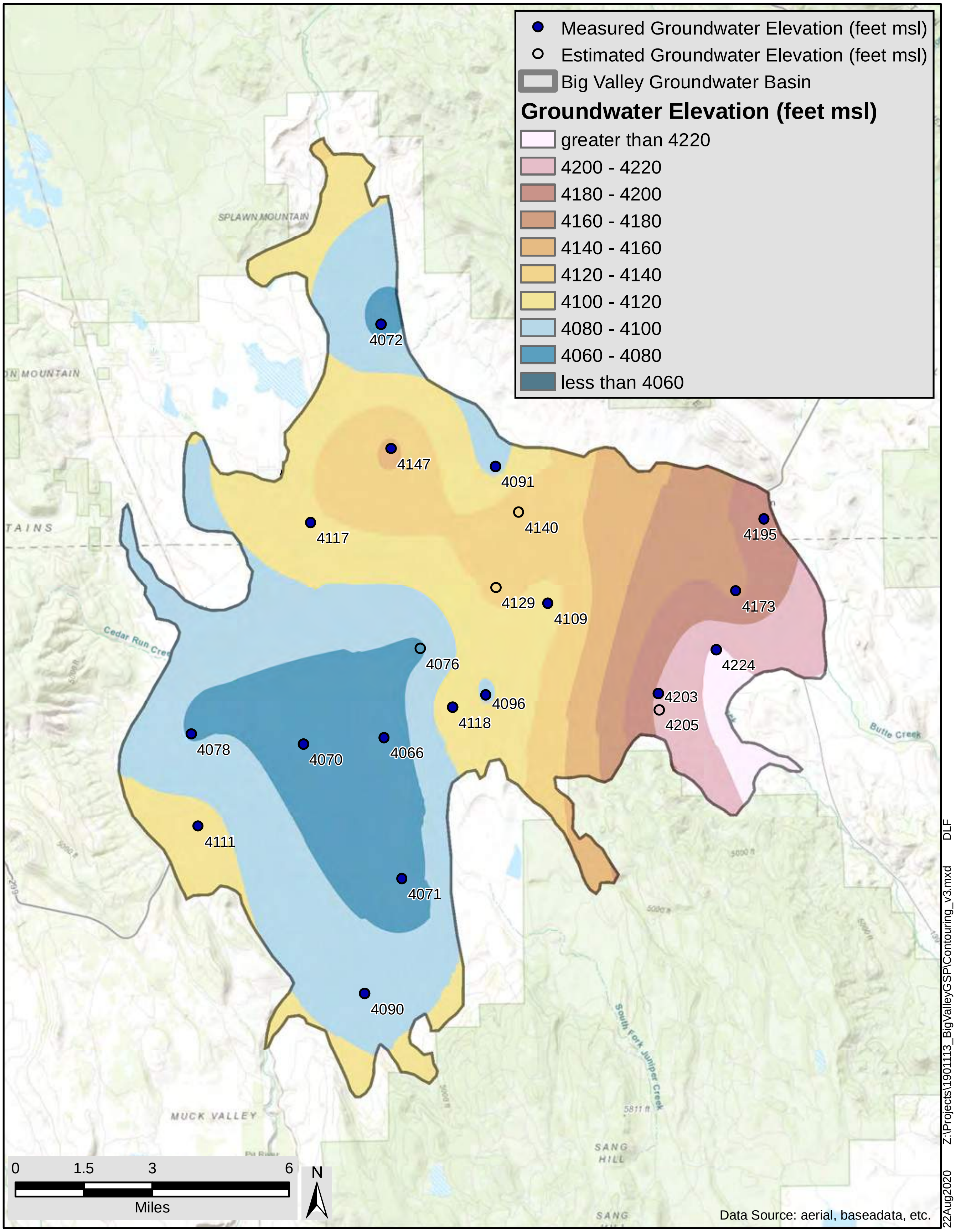
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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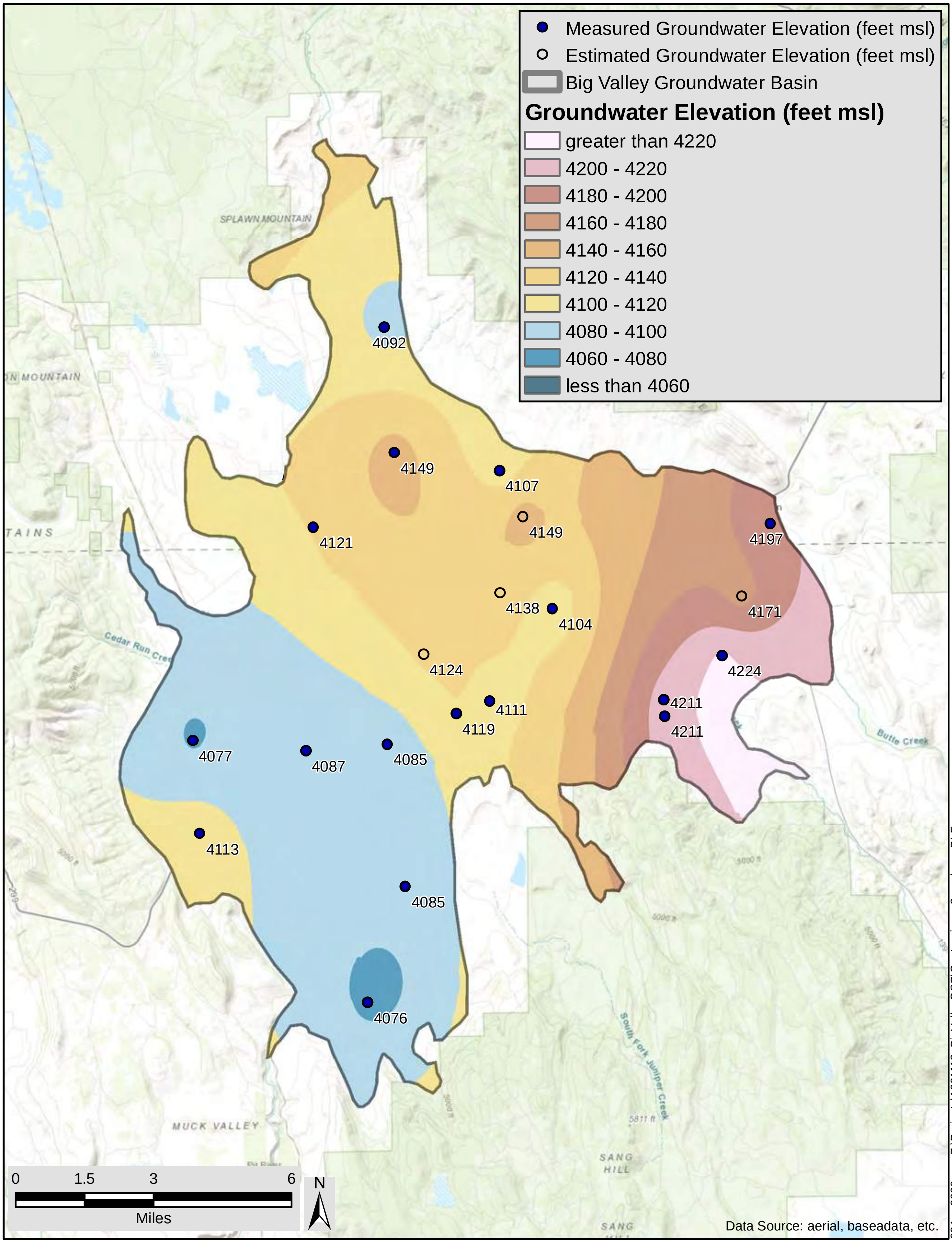

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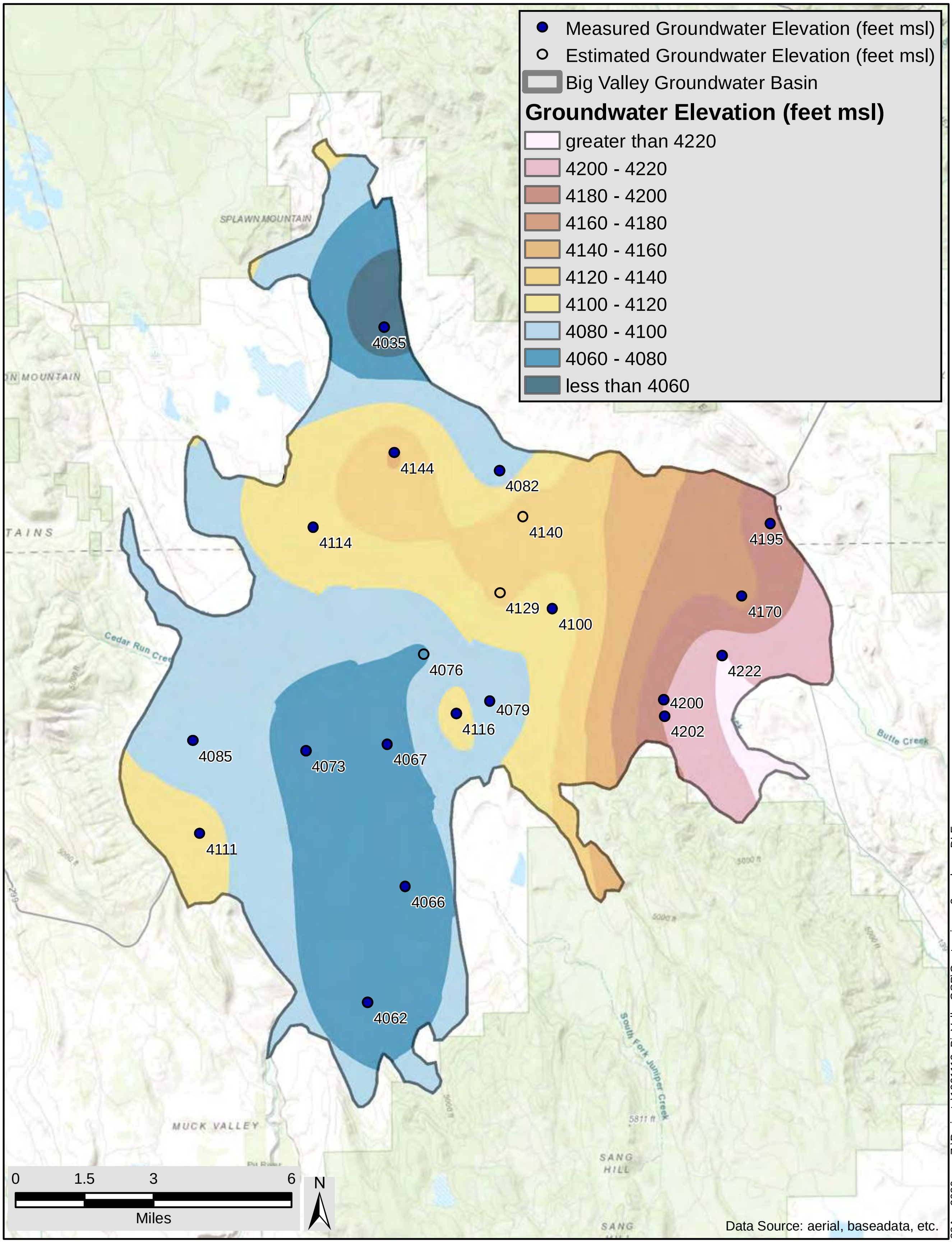

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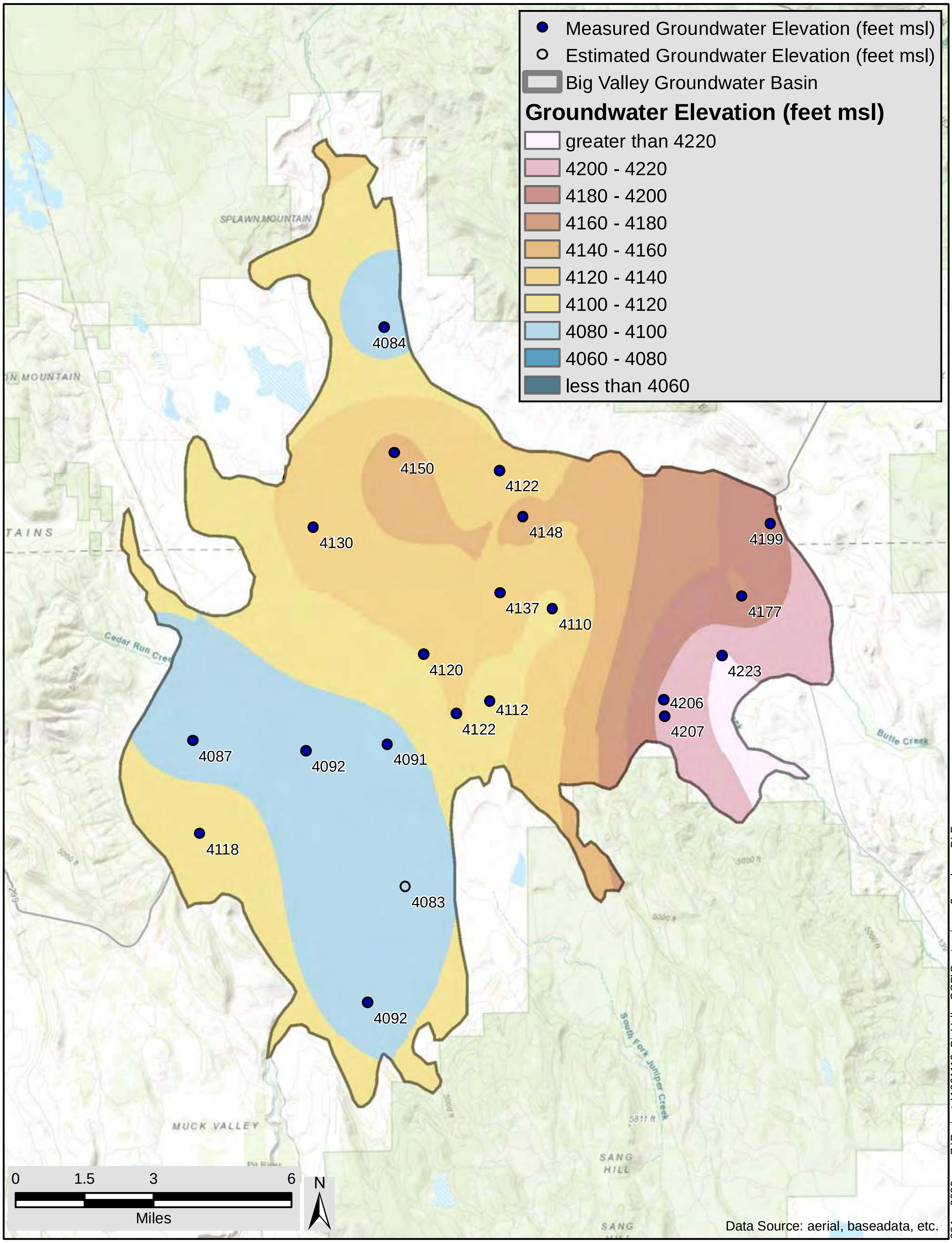

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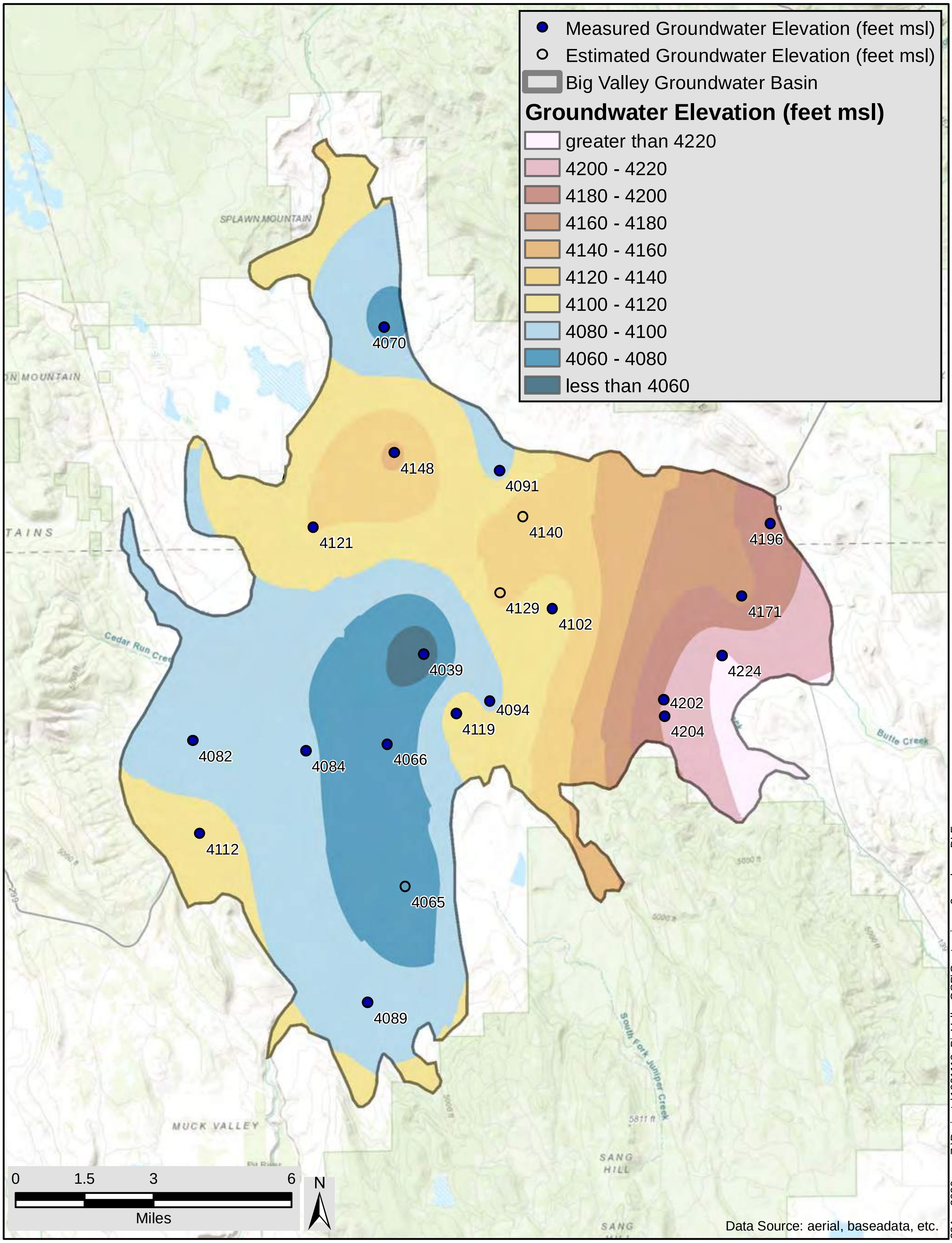

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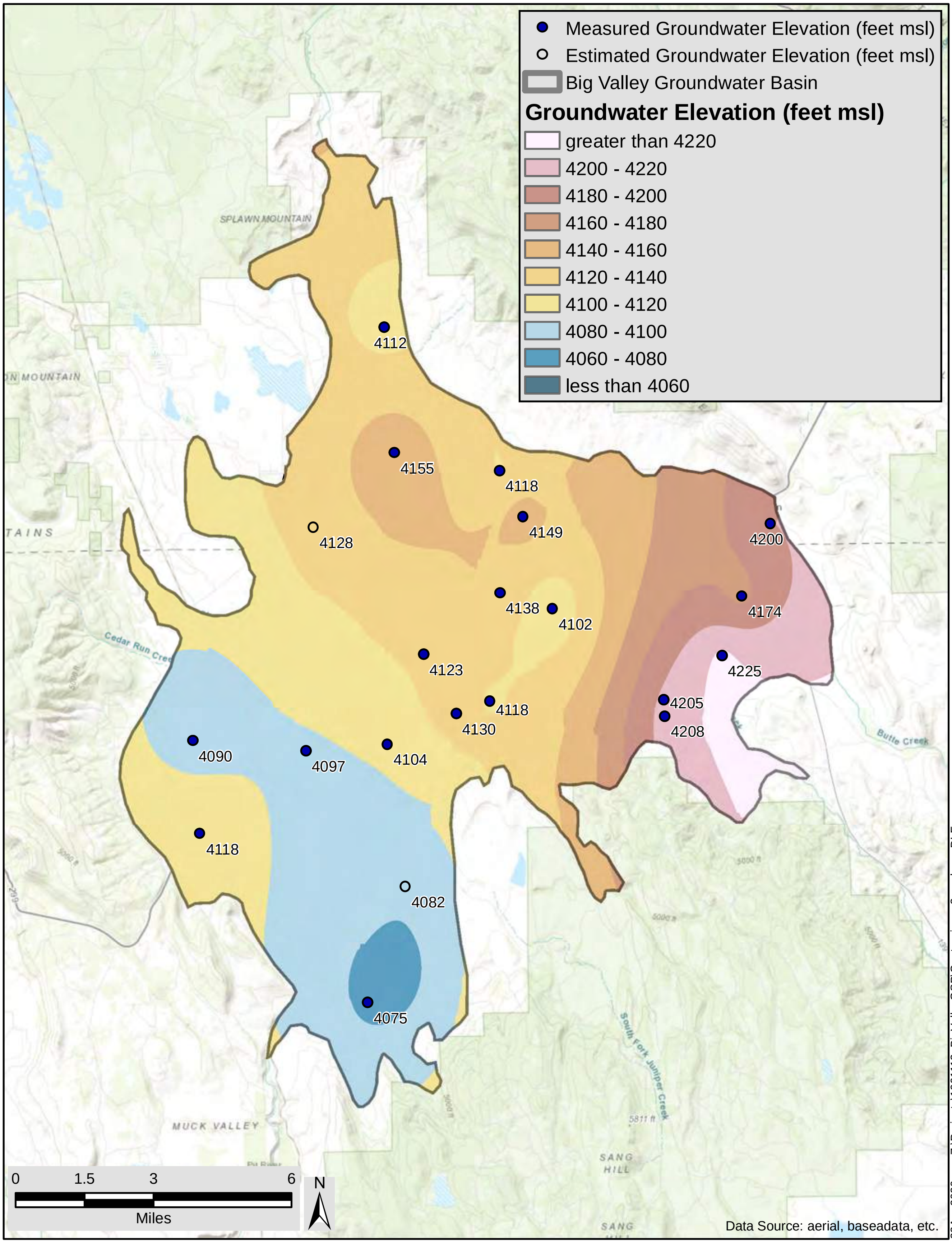

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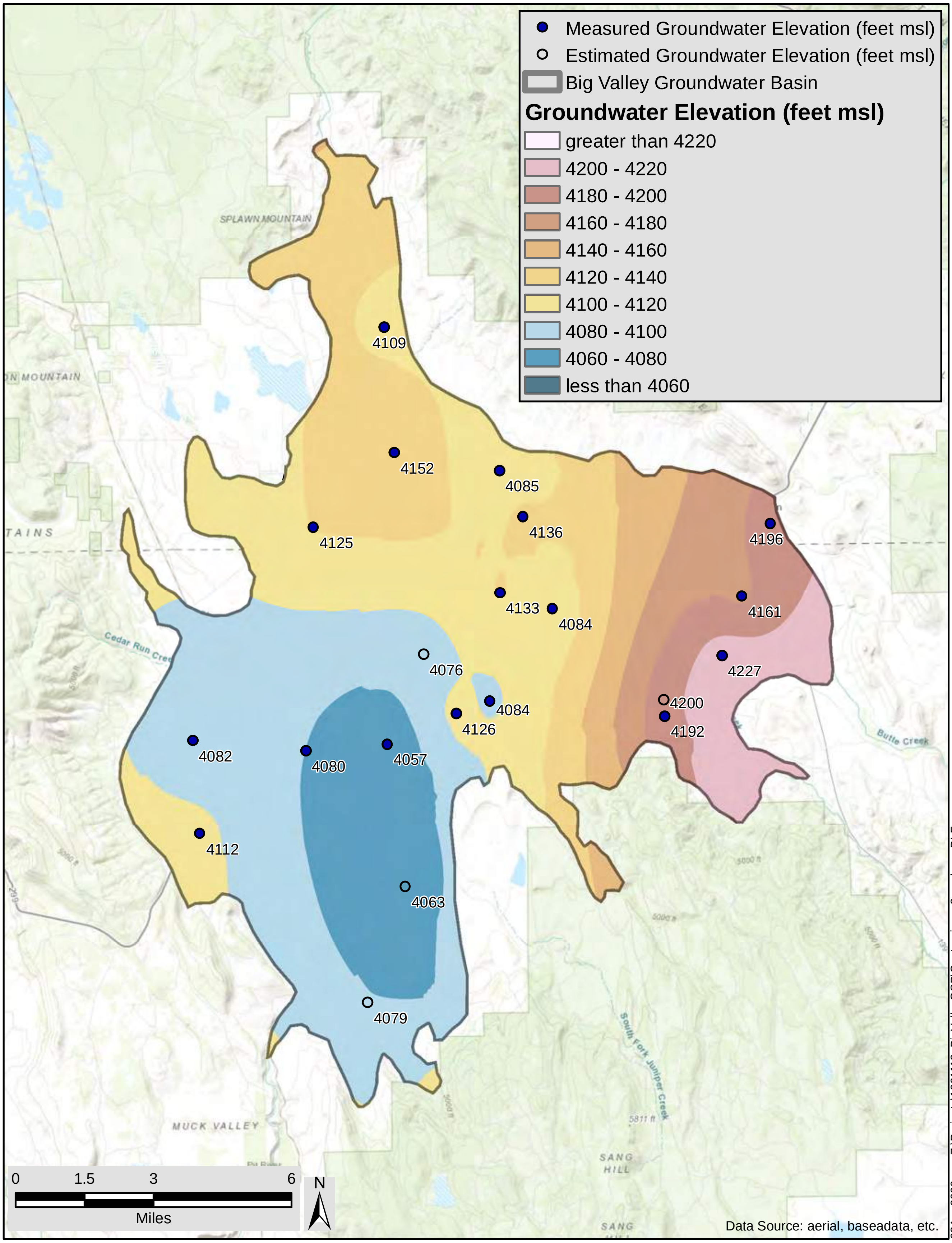

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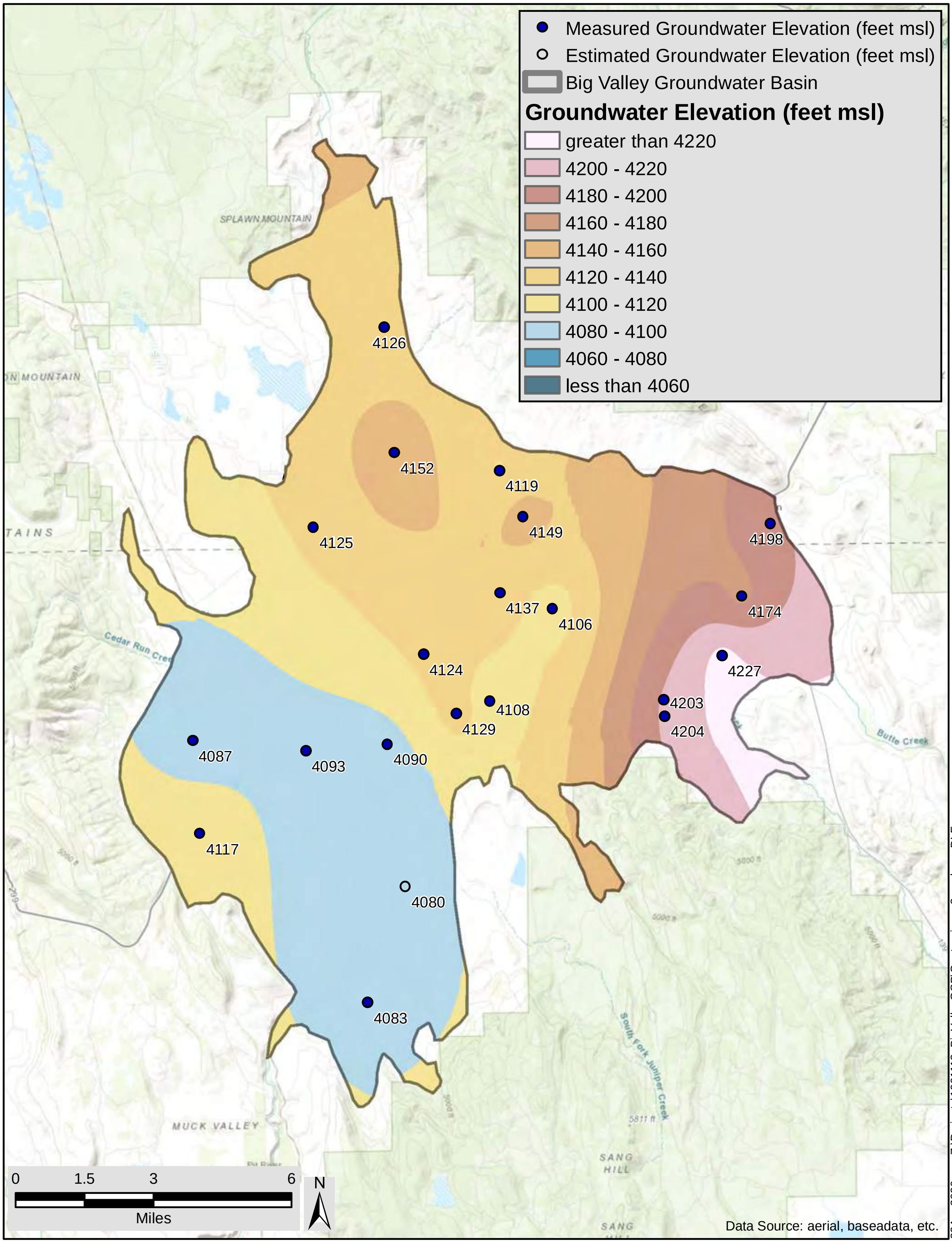

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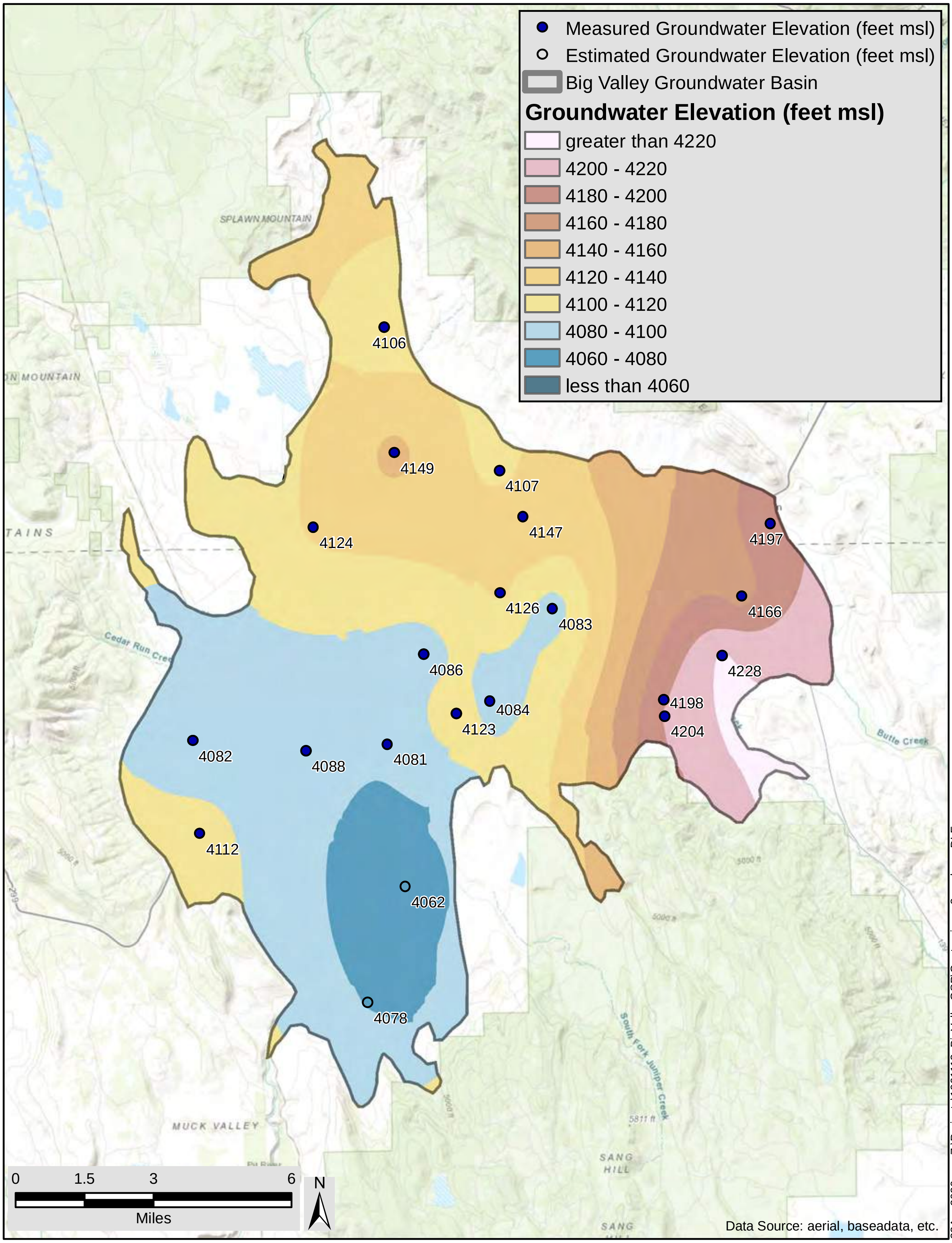

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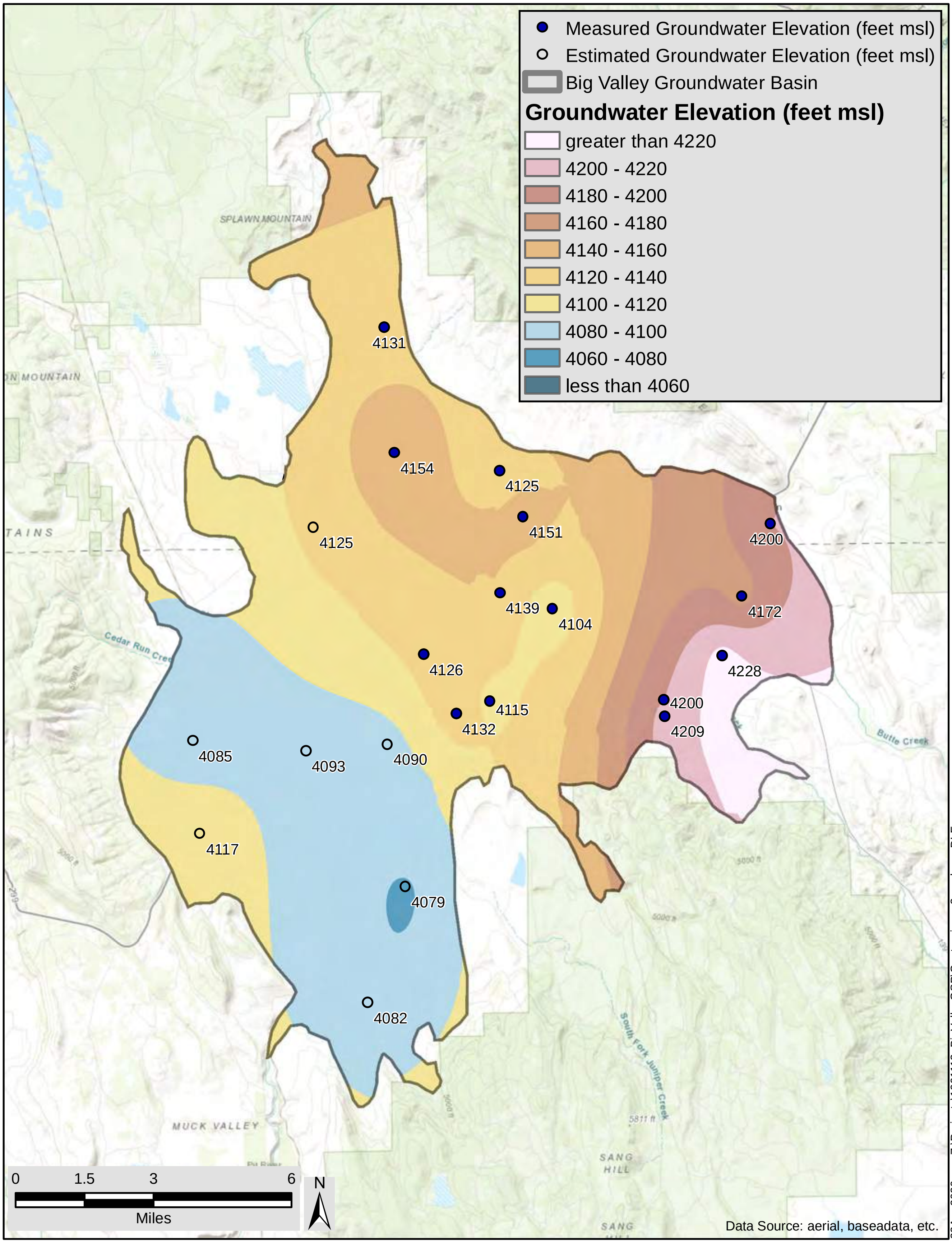

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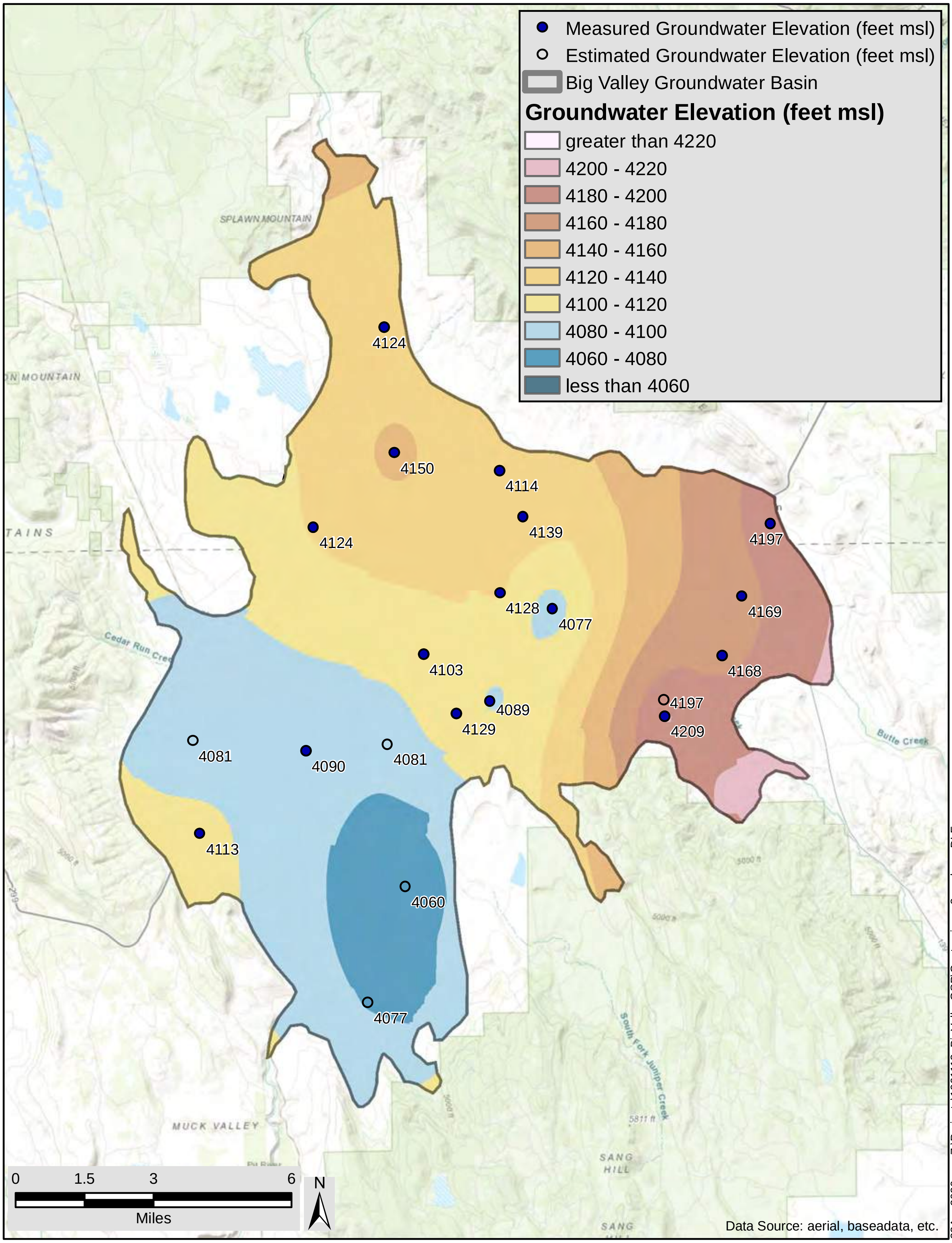
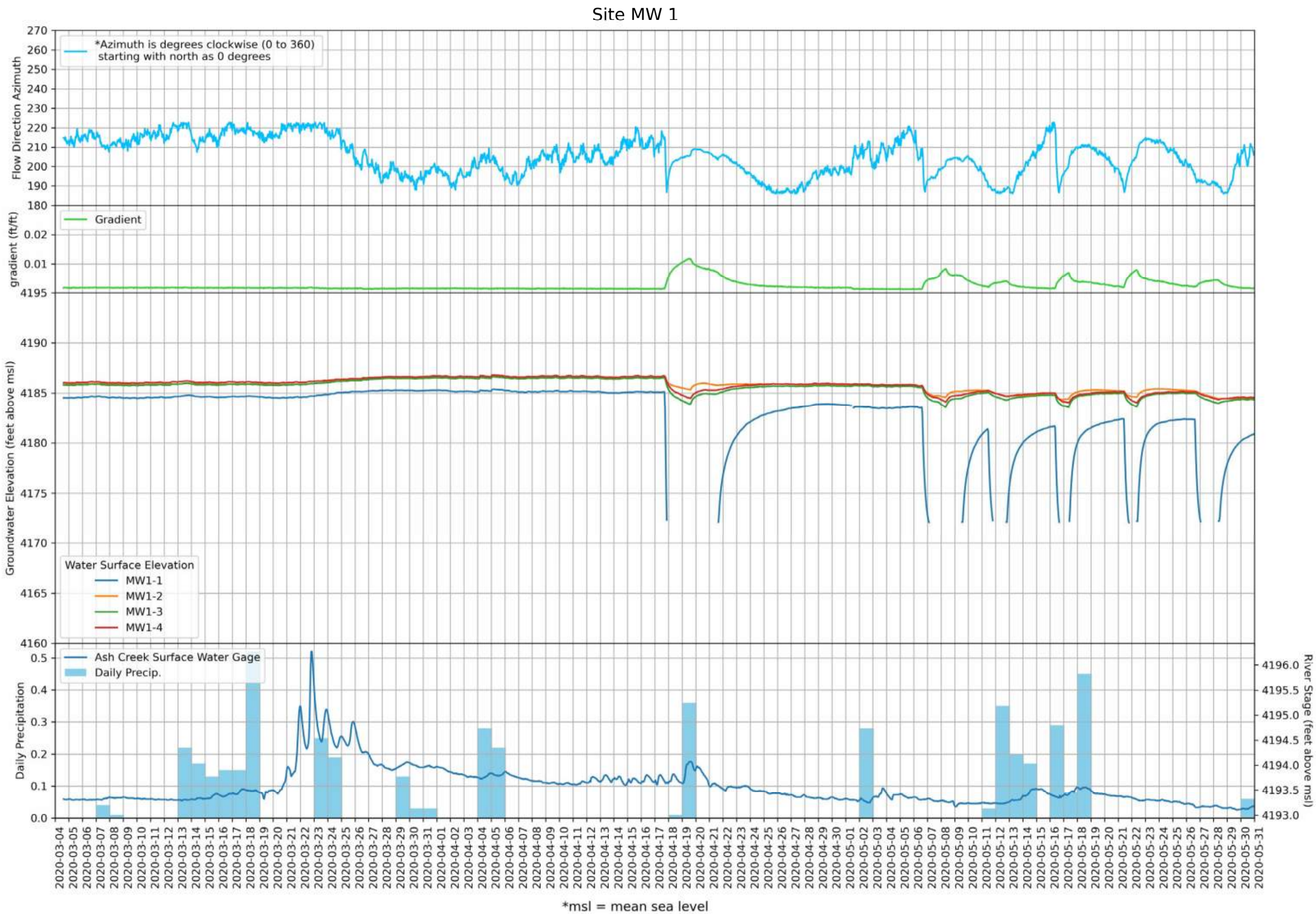
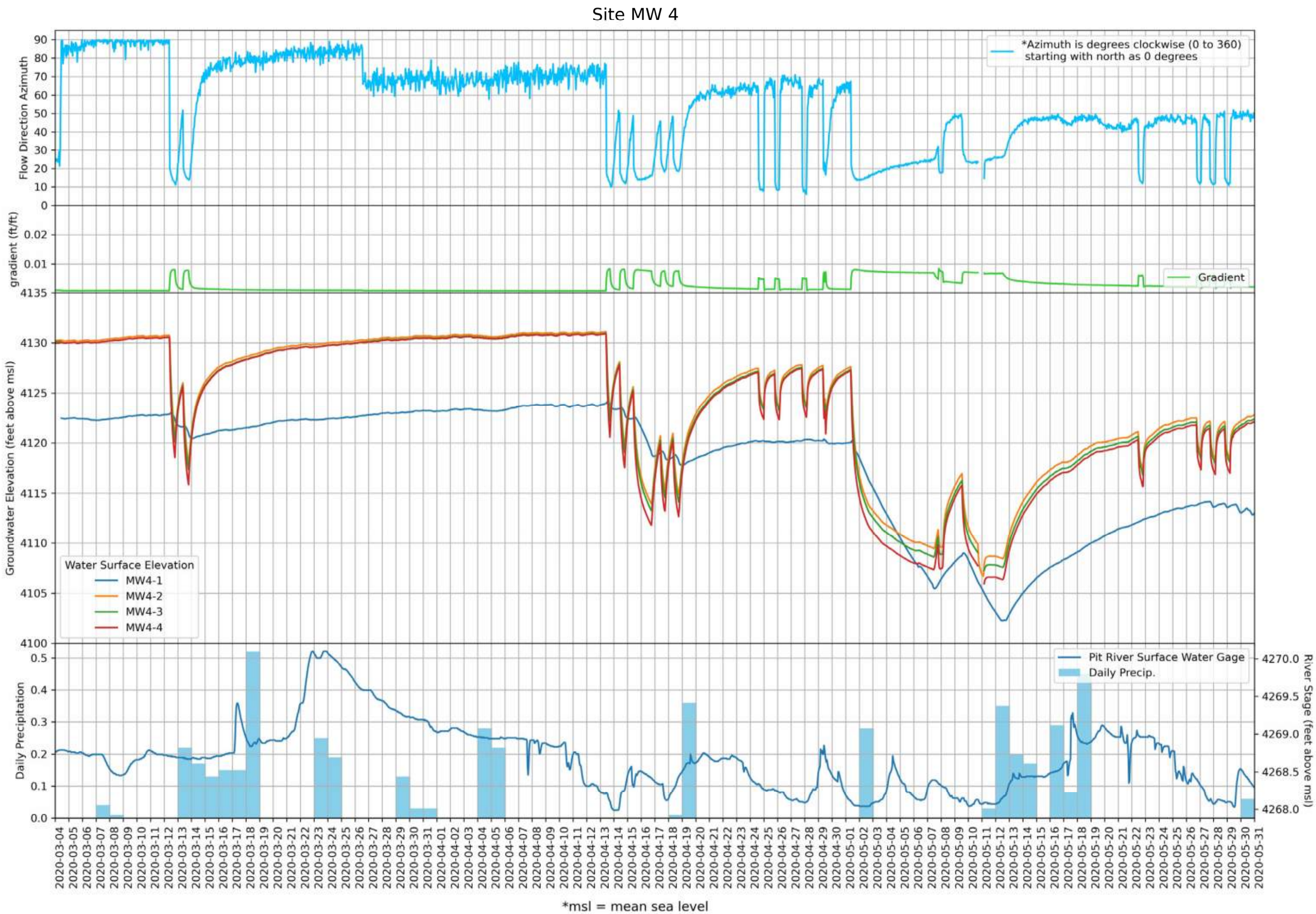


Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Fall 2019		
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE

Appendix 5C Transducer Data from Monitoring Well Clusters 1 and 4



Site MW 1
*Azimuth is degrees clockwise (0 to 360) starting with north as 0 degrees
Flow Direction Azimuth
Gradient
gradient (ft/ft)
Groundwater Elevation (feet above msl)
Water Surface Elevation
MW1-1
MW1-2
MW1-3
MW1-4
Ash Creek Surface Water Gage
Daily Precip.
Daily Precipitation
River Stage (feet above msl)
*msl = mean sea level



Site MW 4
*Azimuth is degrees clockwise (0 to 360) starting with north as 0 degrees
Flow Direction Azimuth
gradient (ft/ft)
Gradient
Groundwater Elevation (feet above msl)
Water Surface Elevation
MW4-1
MW4-2
MW4-3
MW4-4
Daily Precipitation
River Stage (feet above msl)
Pit River Surface Water Gage
Daily Precip.
*msl = mean sea level

Appendix 6A Water Budget Components

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Credit(+)/ Debit(-)	Relationship with Other Systems	Data Source(s)	Assumptions	Relative Level of Precision
(1)	**Inflow**	Into Basin	Precipitation on Land System	+		-Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber -Basin Land area from DWR (2018). -Area of rivers, conveyance, and lakes from USGS (2020).	-Precipitation does not vary spatially throughout the Basin	High
(2)	**Inflow**	Between Systems	Surface Water Delivery	+	Equal to the *Surface Water Delivery* term in the surface water system outflow	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) using CUP model (Orange, et al 2004) -Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-Agriculture and wetland habitats are the only sectors that use surface water. Other uses such as illegal irrigation and fire suppression may use surface water, but there is no way to quantify. -Irrigation efficiency = 85% (NRCS 2020) -35% of agricultural irrigation uses surface water -98% of riparian demands are met by surface water	Low
(3)	**Inflow**	Between Systems	Groundwater Extraction	+	Equal to the *Groundwater Extraction* term in the groundwater system outflow	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) using CUP model (Orange, et al 2004) -Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber Population of Big Valley from DWR (2018) Population of Bieber from United States Census Bureau (2020)	-Irrigation efficiency = 85% (NRCS 2020) -65% of agricultural irrigation uses groundwater -2% of riparian demands are met by groundwater -Per capita water use is 100 gallons/day/person -All domestic users use groundwater	Low
(4)	**Inflow**		*Total Inflow*		*(1)+(2)+(3)*			
(5)	**Outflow**	Out of Basin	Evapotranspiration	-		-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) using CUP model (Orange, et al 2004) -Land use and crop acreages from DWR (2014)	-ETo does not vary throughout the Basin -The land system remains in balance from year to year (no change in land system storage).	Moderate
(6)	**Outflow**	Between Systems	Runoff	-	Equal to the *Runoff* term in Surface Water System*	-Precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-Curve number method was used to estimate the amount of runoff (NRCS 1986)	Low
(7)	**Outflow**	Between Systems	Return Flow	-	Equal to the *Return Flow* term in Surface Water System*	-See surface water delivery and groundwater extraction above	-50% of agricultural inefficiency results in return flow (7.5% of applied water)	Low
(8)	**Outflow**	Between Systems	Recharge of Applied Water	-	Equal to the *Recharge of Applied Water* term in the groundwater system	-See surface water delivery and groundwater extraction above	-50% of agricultural inefficiency results in recharge of grounwater (7.5% of applied water)	Low
(9)	**Outflow**	Between Systems	Recharge of Precipitation	-	Equal to the *Recharge of Precipitation* term in the groundwater system	-Precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-2% of precipitation results in recharge to groundwater	Moderate
(10)	**Outflow**	Between Systems	Managed Aquifer Recharge	-	Equal to the *Managed Aquifer Recharge* term in the groundwater system	No managed recharge is currently documented in the Big Valley Groundwater basin		
(11)	**Outflow**		*Total Outflow*		*(5)+(6)+(7)+(8)+(9)+(10)*			
(12)	**Storage Change**		Change in Land System Storage		*(4)-(11)*			

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Credit(+)/ Debit(-)	Relationship with Other Systems	Data Source(s)	Assumptions	Relative Level of Precision
(13)	**Inflow**	Into Basin	Stream Inflow	+		-Historic and current data from Pit River gage at Canby -Historic data from gage on Pit River north of Lookout (where it enters basin), Ash Creek at Adin, Widow Valley Creek, Willow Creek	-Historic relationship between flow at Canby and flow at historic gages is the same as current. E.g. flow during winter events is about 40% higher than Canby once the Pit River reaches Big Valley -Watershed areas outside of those with historic gage measurements have same runoff per acre as the gaged watersheds	Moderate
(14)	**Inflow**	Into Basin	Precipitation on Lakes	+		-Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber -Area of rivers, conveyance, and lakes from USGS (2020).	-precipitation does not vary spatially throughout the Basin	High
(6)	**Inflow**	Between Systems	Runoff	+	Equal to the *Runoff* term in land system (6)	-Precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-Curve number method was used to estimate the amount of runoff (NRCS 1986)	Low
(7)	**Inflow**	Between Systems	Return Flow	+	Equal to the *Return Flow* term in the land system (7)	-See surface water delivery and groundwater extraction above	-50% of agricultural inefficiency results in return flow (7.5% of applied water)	Low
(15)	**Inflow**	Between Systems	Stream Gain from Groundwater	+	Equal to the *Groundwater Loss to Stream* term in the groundwater system	-None	-Assumed to be 0 until further analysis of transducer data from new monitoring wells	Low
(16)	**Inflow**	Between Systems	Lake Gain from Groundwater	+	Equal to the *Groundwater Loss to Lake* term in the groundwater system	-None	-Assumed to be 0 because most lakes are above the groundwater levels	High
(17)	**Inflow**		*Total Inflow*		*(13)+(14)+(6)+(7)+(15)+(16)*			
(18)	**Outflow**	Out of Basin	Stream Outflow	-		-Estimated based on this water budget -Estimates verified using analysis of historic gage data from Pit River south of Bieber (exit from Basin)	-The surface water system remains in balance from year to year (no change in surface water storage)	Low
(19)	**Outflow**	Out of Basin	Conveyance Evaporation	-		-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of conveyance from USGS (2020)	-Each year, conveyance is full from May to September and empty from October to April	Moderate
(20)	**Outflow**	Between Systems	Conveyance Seepage	-	Equal to the *Conveyance Seepage* term in the groundwater system	-Area of conveyance from USGS (2020)	-Each year, conveyance is full from May to September and empty from October to April -Seepage rate of 0.01 ft/day	Moderate
(2)	**Outflow**	Between Systems	Surface Water Delivery	-	Equal to the *Surface Water Delivery* term in land system (2)	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) using CUP model (Orange, et al 2004) -Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-Agriculture and wetland habitats are the only sectors that use surface water. Other uses such as illegal irrigation and fire suppression may use surface water, but there is no way to quantify. -Irrigation efficiency = 85% (NRCS 2020) -35% of agricultural irrigation uses surface water -98% of riparian demands are met by surface water	Low
(21)	**Outflow**	Between Systems	Stream Loss to Groundwater	-	Equal to the *Gain from Stream* term in the groundwater system	-Historic and current data from Pit River gage at Canby -Historic data from gage on Pit River north of Lookout (where it enters Basin), Ash Creek at Adin, Widow Valley Creek, Willow Creek, Pit River at exit from Basin.	-Calculated from the historic inflow - outflow relationship.	Low
(22)	**Outflow**	Between Systems	Lake Loss to Groundwater	-	Equal to the *Groundwater Gain from Lake* term in the groundwater system	-Area of lakes from USGS (2020)	-Each year, lakes are full (100%) and surface area drops throughout summer to 10% in September, then gradually refill over the winter. -Seepage rate of 0.01 ft/day	Moderate

(23)	**Outflow**	Out of Basin	Lake Evaporation	-		-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of lakes from USGS (2020)	-Each year, lakes are full (100%) and surface area drops throughout summer to 10% in September, then gradually refill over the winter.	High
(24)	**Outflow**	Out of Basin	Stream Evaporation	-		-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of streams from USGS (2020)		High
(25)	**Outflow**		*Total Outflow*		*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*			
(26)	**Storage Change**		Change in Surface Water Storage		*(17)-(25)*			

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Credit(+)/ Debit(-)	Relationship with Other Systems	Data Source(s)	Assumptions	Relative Level of Precision
(8)	Inflow	Between Systems	Recharge of Applied Water	+	Equal to the *Recharge of Applied Water* term in the land system (8)	-See surface water delivery and groundwater extraction above	-50% of agricultural inefficiency results in recharge of grounwater (7.5% of applied water)	Low
(9)	Inflow	Between Systems	Recharge of Precipitation	+	Equal to the *Recharge of Precipitation* term in the land system (9)	-Precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-2% of precipitation results in recharge to groundwater	Moderate
(10)	Inflow	Between Systems	Managed Aquifer Recharge	+	Equal to the *Managed Aquifer Recharge* term in the land system (10)	No managed recharge is currently documented in the Big Valley Groundwater basin		
(21)	Inflow	Between Systems	Groundwater Gain from Stream	+	Equal to the *Stream Loss to Groundwater* term in the surface water system (21)	-Historic and current data from Pit River gage at Canby -Historic data from gage on Pit River north of Lookout (where it enters Basin), Ash Creek at Adin, Widow Valley Creek, Willow Creek, Pit River at exit from Basin.	-Calculated from the historic inflow - outflow relationship.	Low
(22)	Inflow	Between Systems	Groundwater Gain from Lake	+	Equal to the *Lake Loss to Groundwater* term in the surface water system (22)	-Area of lakes from USGS (2020)	-Each year, lakes are full (100%) and surface area drops throughout summer to 10% in September, then gradually refill over the winter. -Seepage rate of 0.01 ft/day	Moderate
(20)	Inflow	Between Systems	Conveyance Seepage	+	Equal to the *Conveyance Seepage* term in the surface water system (20)	-Area of conveyance from USGS (2020)	-Each year, conveyance is full from May to September and empty from October to April -Seepage rate of 0.01 ft/day	Moderate
(27)	Inflow	Into Basin	Subsurface Inflow	+		-Water level data from wells in Round Valley and Adin -Estimate of cross-sectional area of canyon between Round Valley and Big Valley	-Other than subsurface flow from Round Valley (about 1AFY), no subsurface inflow occurs in the BVGB	Moderate
(28)	Inflow		*Total Inflow*		*(8)+(9)+(10)+(21)+(22)+(20)+(27)*			
(3)	Outflow	Between Systems	Groundwater Extraction	-	Equal to the *Groundwater Extraction* term in the land system (3)	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) using CUP model (Orange, et al 2004) -Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber Population of Big Valley from DWR (2018) Population of Bieber from United States Census Bureau (2020)	-Irrigation efficiency = 85% (NRCS 2020) -65% of agricultural irrigation uses groundwater -2% of riparian demands are met by groundwater -Per capita water use is 100 gallons/day/person -All domestic users use groundwater	Low
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	Equal to the *Stream Gain from Groundwater* term in the surface water system (15)	-None	-Assumed to be 0 until further analysis of transducer data from new monitoring wells	Low
(16)	Outflow	Between Systems	Groundwater Loss to Lake	-	Equal to the *Lake Gain from Groundwater* term in the surface water system (16)	-None	-Assumed to be 0 because most lakes are above the groundwater levels	High
(29)	Outflow	Out of Basin	Subsurface Outflow	-			-No subsurface outflow occurs in the BVGB	Moderate
(30)	Outflow		*Total Outflow*		*(3)+(15)+(16)+(29)*			
(31)	Storage Change		Change in Groundwater Storage		(28)-(30)			

TOTAL WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Credit(+)/ Debit(-)	Relationship with Other Systems	Data Source(s)	Assumptions	Relative Level of Precision
(1)	**Inflow**	Into Basin	Precipitation on Land System	+	Equal to the *Precipitation* term in the land system	-Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber -Basin Land area from DWR (2018). -Area of rivers, conveyance, and lakes from USGS (2020).		High
(14)	**Inflow**	Into Basin	Precipitation on Lakes	+	Equal to the *Precipitation on Lakes* term in the surface water system	-Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber -Basin Land area from DWR (2018). -Area of rivers, conveyance, and lakes from USGS (2020).	-Precipitation does not vary spatially throughout the Basin	High
(13)	**Inflow**	Into Basin	Stream Inflow	+	Equal to the *Stream Inflow* term in the surface water system	-Historic and current data from Pit River gage at Canby -Historic data from gage on Pit River north of Lookout (where it enters basin), Ash Creek at Adin, Widow Valley Creek, Willow Creek	-Historic relationship between flow at Canby and flow at historic gages is the same as current. E.g. flow during winter events is about 40% higher than Canby once the Pit River reaches Big Valley -Watershed areas outside of those with historic gage measurements have same runoff per acre as the gaged watersheds	Moderate
(27)	**Inflow**	Into Basin	Subsurface Inflow	+	Equal to the *Subsurface Inflow* term in the groundwater system	-Water level data from wells in Round Valley and Adin -Estimate of cross-sectional area of canyon between Round Valley and Big Valley	-Other than subsurface flow from Round Valley (about 1AFY), no subsurface inflow occurs in the BVGB	Moderate
(32)	**Inflow**		*Total Inflow*		*(1)+(14)+(13)+(27)*			
(5)	**Outflow**	Out of Basin	Evapotranspiration	-	Equal to the *Evapotranspiration* term in the land system	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) using CUP model (Orange, et al 2004) -Land use and crop acreages from DWR (2014)	-ETo does not vary throughout the Basin -The land system remains in balance from year to year (no change in land system storage).	Moderate
(24)	**Outflow**	Out of Basin	Stream Evaporation	-	Equal to the *Stream Evaporation* term in the surface water system	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of streams from USGS (2020)		High
(23)	**Outflow**	Out of Basin	Lake Evaporation	-	Equal to the *Lake Evaporation* term in the surface water system	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of lakes from USGS (2020)	-Each year, lakes are full (100%) and surface area drops throughout summer to 10% in September, then gradually refill over the winter.	High
(19)	**Outflow**	Out of Basin	Conveyance Evaporation	-	Equal to the *Conveyance Evaporation* term in the surface water system	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of conveyance from USGS (2020)	-Each year, conveyance is full from May to September and empty from October to April	Moderate
(18)	**Outflow**	Out of Basin	Stream Outflow	-	Equal to the *Stream Outflow* term in the surface water system	-Estimated based on this water budget -Estimates verified using analysis of historic gage data from Pit River south of Bieber (exit from Basin)	-The surface water system remains in balance from year to year (no change in surface water storage)	Low
(29)	**Outflow**	Out of Basin	Subsurface Outflow	-	Equal to the *Subsurface Outflow* term in the groundwater system		-No subsurface outflow occurs in the BVGB	Moderate
(33)	**Outflow**		*Total Outflow*		*(5)+(24)+(23)+(19)+(18)+(29)*			
(34)	**Storage Change**		Change in Total System Storage		(32)-(33)			

Appendix 6B Water Budget Details

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Average (1984-2018)	1984	1985	1986	1987	1988
(1)	Inflow	Into Basin	Precipitation on Land System	136,801	148,899	132,719	193,698	96,315	88,835
(2)	Inflow	Between Systems	Surface Water Delivery	75,811	68,516	76,750	74,262	78,850	85,952
(3)	Inflow	Between Systems	Groundwater Extraction	44,622	39,192	45,598	41,789	47,782	53,245
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*257,234*	*256,607*	*255,067*	*309,749*	*222,946*	*228,032*
(5)	Outflow	Out of Basin	Evapotranspiration	154,040	146,344	152,399	160,318	155,136	159,362
(6)	Outflow	Between Systems	Runoff	83,449	92,329	82,737	130,033	47,265	46,439
(7)	Outflow	Between Systems	Return Flow	5,012	4,396	5,123	4,685	5,373	5,994
(8)	Outflow	Between Systems	Recharge of Applied Water	13,133	11,840	13,309	12,802	13,701	14,966
(9)	Outflow	Between Systems	Recharge of Precipitation	1,601	1,697	1,499	1,910	1,471	1,272
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*257,234*	*256,607*	*255,067*	*309,749*	*222,946*	*228,032*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Average (1984-2018)	1984	1985	1986	1987	1988
(13)	Inflow	Into Basin	Stream Inflow	371,148	808,462	310,960	878,565	161,807	162,980
(14)	Inflow	Into Basin	Precipitation on Reservoirs	501	546	486	710	353	326
(6)	Inflow	Between Systems	Runoff	83,449	92,329	82,737	130,033	47,265	46,439
(7)	Inflow	Between Systems	Return Flow	5,012	4,396	5,123	4,685	5,373	5,994
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*460,110*	*905,732*	*399,306*	*1,013,993*	*214,798*	*215,738*
(18)	Outflow	Out of Basin	Stream Outflow	358,486	786,443	302,274	865,544	122,626	116,338
(19)	Outflow	Out of Basin	Conveyance Evaporation	46	44	46	45	45	50
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	75,811	68,516	76,750	74,262	78,850	85,952
(21)	Outflow	Between Systems	Stream Loss to Groundwater	24,037	49,085	18,460	72,401	11,524	11,579
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	722	667	760	727	736	777
(24)	Outflow	Out of Basin	Stream Evaporation	385	354	393	389	393	420
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*460,110*	*905,732*	*399,306*	*1,013,993*	*214,798*	*215,738*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Average (1984-2018)	1984	1985	1986	1987	1988
(8)	Inflow	Between Systems	Recharge of Applied Water	13,133	11,840	13,309	12,802	13,701	14,966
(9)	Inflow	Between Systems	Recharge of Precipitation	1,601	1,697	1,499	1,910	1,471	1,272
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	24,037	49,085	18,460	72,401	11,524	11,579
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*39,395*	*63,247*	*33,892*	*87,738*	*27,321*	*28,441*
(3)	Outflow	Between Systems	Groundwater Extraction	44,622	39,192	45,598	41,789	47,782	53,245
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*44,622*	*39,192*	*45,598*	*41,789*	*47,782*	*53,245*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(5,227)	24,055	(11,706)	45,949	(20,461)	(24,804)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Average (1984-2018)	1984	1985	1986	1987	1988
(1)	Inflow	Into Basin	Precipitation on Land System	136,801	148,899	132,719	193,698	96,315	88,835
(14)	Inflow	Into Basin	Precipitation on Reservoirs	501	546	486	710	353	326
(13)	Inflow	Into Basin	Stream Inflow	371,148	808,462	310,960	878,565	161,807	162,980
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*508,451*	*957,907*	*444,166*	*1,072,973*	*258,475*	*252,142*
(5)	Outflow	Out of Basin	Evapotranspiration	154,040	146,344	152,399	160,318	155,136	159,362
(24)	Outflow	Out of Basin	Stream Evaporation	385	354	393	389	393	420
(23)	Outflow	Out of Basin	Reservoir Evaporation	722	667	760	727	736	777
(19)	Outflow	Out of Basin	Conveyance Evaporation	46	44	46	45	45	50
(18)	Outflow	Out of Basin	Stream Outflow	358,486	786,443	302,274	865,544	122,626	116,338
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*513,678*	*933,852*	*455,872*	*1,027,024*	*278,936*	*276,946*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(5,227)	24,055	(11,706)	45,949	(20,461)	(24,804)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1989	1990	1991	1992	1993	1994
(1)	Inflow	Into Basin	Precipitation on Land System	150,654	112,418	108,526	75,556	184,082	104,481
(2)	Inflow	Between Systems	Surface Water Delivery	72,061	72,399	77,619	82,827	70,993	76,177
(3)	Inflow	Between Systems	Groundwater Extraction	41,145	42,407	46,745	52,036	38,861	45,730
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*263,860*	*227,224*	*232,890*	*210,419*	*293,936*	*226,387*
(5)	Outflow	Out of Basin	Evapotranspiration	151,287	148,958	153,216	155,932	156,238	153,369
(6)	Outflow	Between Systems	Runoff	93,806	59,374	59,468	32,898	119,194	53,112
(7)	Outflow	Between Systems	Return Flow	4,615	4,761	5,255	5,860	4,351	5,140
(8)	Outflow	Between Systems	Recharge of Applied Water	12,446	12,539	13,479	14,449	12,207	13,226
(9)	Outflow	Between Systems	Recharge of Precipitation	1,705	1,591	1,472	1,280	1,947	1,541
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*263,860*	*227,224*	*232,890*	*210,419*	*293,936*	*226,387*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1989	1990	1991	1992	1993	1994
(13)	Inflow	Into Basin	Stream Inflow	390,854	133,594	263,663	76,254	602,999	167,393
(14)	Inflow	Into Basin	Precipitation on Reservoirs	552	412	398	277	675	383
(6)	Inflow	Between Systems	Runoff	93,806	59,374	59,468	32,898	119,194	53,112
(7)	Inflow	Between Systems	Return Flow	4,615	4,761	5,255	5,860	4,351	5,140
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*489,827*	*198,142*	*328,784*	*115,288*	*727,219*	*226,028*
(18)	Outflow	Out of Basin	Stream Outflow	393,854	113,802	233,159	23,084	622,453	136,286
(19)	Outflow	Out of Basin	Conveyance Evaporation	45	44	47	48	46	46
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	72,061	72,399	77,619	82,827	70,993	76,177
(21)	Outflow	Between Systems	Stream Loss to Groundwater	22,175	10,212	16,260	7,546	32,039	11,784
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	697	693	693	754	693	726
(24)	Outflow	Out of Basin	Stream Evaporation	371	368	382	406	370	386
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*489,827*	*198,142*	*328,784*	*115,288*	*727,219*	*226,028*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1989	1990	1991	1992	1993	1994
(8)	Inflow	Between Systems	Recharge of Applied Water	12,446	12,539	13,479	14,449	12,207	13,226
(9)	Inflow	Between Systems	Recharge of Precipitation	1,705	1,591	1,472	1,280	1,947	1,541
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	22,175	10,212	16,260	7,546	32,039	11,784
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*36,950*	*24,967*	*31,836*	*23,899*	*46,817*	*27,175*
(3)	Outflow	Between Systems	Groundwater Extraction	41,145	42,407	46,745	52,036	38,861	45,730
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*41,145*	*42,407*	*46,745*	*52,036*	*38,861*	*45,730*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(4,194)	(17,440)	(14,909)	(28,137)	7,956	(18,555)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1989	1990	1991	1992	1993	1994
(1)	Inflow	Into Basin	Precipitation on Land System	150,654	112,418	108,526	75,556	184,082	104,481
(14)	Inflow	Into Basin	Precipitation on Reservoirs	552	412	398	277	675	383
(13)	Inflow	Into Basin	Stream Inflow	390,854	133,594	263,663	76,254	602,999	167,393
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*542,060*	*246,425*	*372,587*	*152,087*	*787,756*	*272,257*
(5)	Outflow	Out of Basin	Evapotranspiration	151,287	148,958	153,216	155,932	156,238	153,369
(24)	Outflow	Out of Basin	Stream Evaporation	371	368	382	406	370	386
(23)	Outflow	Out of Basin	Reservoir Evaporation	697	693	693	754	693	726
(19)	Outflow	Out of Basin	Conveyance Evaporation	45	44	47	48	46	46
(18)	Outflow	Out of Basin	Stream Outflow	393,854	113,802	233,159	23,084	622,453	136,286
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*546,255*	*263,865*	*387,496*	*180,224*	*779,799*	*290,812*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(4,194)	(17,440)	(14,909)	(28,137)	7,956	(18,555)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1995	1996	1997	1998	1999	2000
(1)	Inflow	Into Basin	Precipitation on Land System	192,248	183,776	171,871	229,110	146,533	128,140
(2)	Inflow	Between Systems	Surface Water Delivery	65,439	70,985	74,958	64,027	74,092	76,327
(3)	Inflow	Between Systems	Groundwater Extraction	35,592	41,037	42,916	32,854	43,259	44,735
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*293,278*	*295,799*	*289,744*	*325,992*	*263,883*	*249,201*
(5)	Outflow	Out of Basin	Evapotranspiration	143,128	150,803	159,397	151,378	152,590	157,889
(6)	Outflow	Between Systems	Runoff	133,143	126,391	110,752	157,864	91,975	71,370
(7)	Outflow	Between Systems	Return Flow	3,983	4,605	4,815	3,667	4,857	5,024
(8)	Outflow	Between Systems	Recharge of Applied Water	11,251	12,278	12,946	10,945	12,826	13,215
(9)	Outflow	Between Systems	Recharge of Precipitation	1,773	1,722	1,834	2,137	1,637	1,703
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*293,278*	*295,799*	*289,744*	*325,992*	*263,883*	*249,201*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1995	1996	1997	1998	1999	2000
(13)	Inflow	Into Basin	Stream Inflow	912,444	780,720	614,680	832,300	691,739	240,124
(14)	Inflow	Into Basin	Precipitation on Reservoirs	704	673	630	840	537	470
(6)	Inflow	Between Systems	Runoff	133,143	126,391	110,752	157,864	91,975	71,370
(7)	Inflow	Between Systems	Return Flow	3,983	4,605	4,815	3,667	4,857	5,024
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*1,050,275*	*912,389*	*730,877*	*994,671*	*789,107*	*316,987*
(18)	Outflow	Out of Basin	Stream Outflow	897,057	798,101	621,549	872,733	677,081	223,698
(19)	Outflow	Out of Basin	Conveyance Evaporation	41	44	46	42	45	47
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	65,439	70,985	74,958	64,027	74,092	76,327
(21)	Outflow	Between Systems	Stream Loss to Groundwater	86,149	41,575	32,583	56,285	36,166	15,166
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	625	692	729	619	720	736
(24)	Outflow	Out of Basin	Stream Evaporation	340	369	388	340	379	390
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*1,050,275*	*912,389*	*730,877*	*994,671*	*789,107*	*316,987*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1995	1996	1997	1998	1999	2000
(8)	Inflow	Between Systems	Recharge of Applied Water	11,251	12,278	12,946	10,945	12,826	13,215
(9)	Inflow	Between Systems	Recharge of Precipitation	1,773	1,722	1,834	2,137	1,637	1,703
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	86,149	41,575	32,583	56,285	36,166	15,166
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*99,798*	*56,199*	*47,987*	*69,992*	*51,253*	*30,709*
(3)	Outflow	Between Systems	Groundwater Extraction	35,592	41,037	42,916	32,854	43,259	44,735
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*35,592*	*41,037*	*42,916*	*32,854*	*43,259*	*44,735*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	64,206	15,162	5,071	37,138	7,994	(14,026)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1995	1996	1997	1998	1999	2000
(1)	Inflow	Into Basin	Precipitation on Land System	192,248	183,776	171,871	229,110	146,533	128,140
(14)	Inflow	Into Basin	Precipitation on Reservoirs	704	673	630	840	537	470
(13)	Inflow	Into Basin	Stream Inflow	912,444	780,720	614,680	832,300	691,739	240,124
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*1,105,397*	*965,170*	*787,182*	*1,062,250*	*838,809*	*368,734*
(5)	Outflow	Out of Basin	Evapotranspiration	143,128	150,803	159,397	151,378	152,590	157,889
(24)	Outflow	Out of Basin	Stream Evaporation	340	369	388	340	379	390
(23)	Outflow	Out of Basin	Reservoir Evaporation	625	692	729	619	720	736
(19)	Outflow	Out of Basin	Conveyance Evaporation	41	44	46	42	45	47
(18)	Outflow	Out of Basin	Stream Outflow	897,057	798,101	621,549	872,733	677,081	223,698
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*1,041,192*	*950,008*	*782,111*	*1,025,112*	*830,815*	*382,760*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	64,206	15,162	5,071	37,138	7,994	(14,026)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2001	2002	2003	2004	2005	2006	2007
(1)	Inflow	Into Basin	Precipitation on Land System	79,296	109,976	136,611	136,687	147,525	190,721	99,291
(2)	Inflow	Between Systems	Surface Water Delivery	80,992	80,604	75,245	78,776	70,606	72,295	78,989
(3)	Inflow	Between Systems	Groundwater Extraction	49,626	48,753	44,131	47,093	40,332	40,960	48,745
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*209,913*	*239,333*	*255,987*	*262,556*	*258,462*	*303,976*	*227,025*
(5)	Outflow	Out of Basin	Evapotranspiration	152,585	153,349	151,547	153,751	149,036	151,973	156,935
(6)	Outflow	Between Systems	Runoff	36,368	65,156	84,903	88,396	91,011	133,210	49,352
(7)	Outflow	Between Systems	Return Flow	5,583	5,482	4,956	5,293	4,524	4,593	5,485
(8)	Outflow	Between Systems	Recharge of Applied Water	14,089	14,001	13,030	13,667	12,197	12,475	13,755
(9)	Outflow	Between Systems	Recharge of Precipitation	1,288	1,345	1,551	1,449	1,695	1,725	1,498
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*209,913*	*239,333*	*255,987*	*262,556*	*258,462*	*303,976*	*227,025*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2001	2002	2003	2004	2005	2006	2007
(13)	Inflow	Into Basin	Stream Inflow	100,742	153,035	219,963	295,581	381,347	735,770	127,762
(14)	Inflow	Into Basin	Precipitation on Reservoirs	291	403	501	501	541	699	364
(6)	Inflow	Between Systems	Runoff	36,368	65,156	84,903	88,396	91,011	133,210	49,352
(7)	Inflow	Between Systems	Return Flow	5,583	5,482	4,956	5,293	4,524	4,593	5,485
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*142,983*	*224,076*	*310,322*	*389,772*	*477,422*	*874,271*	*182,963*
(18)	Outflow	Out of Basin	Stream Outflow	51,472	130,528	219,088	291,439	383,378	762,028	92,199
(19)	Outflow	Out of Basin	Conveyance Evaporation	48	48	45	46	43	45	47
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	80,992	80,604	75,245	78,776	70,606	72,295	78,989
(21)	Outflow	Between Systems	Stream Loss to Groundwater	8,684	11,116	14,228	17,745	21,733	38,213	9,941
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	763	756	711	747	675	694	762
(24)	Outflow	Out of Basin	Stream Evaporation	400	400	380	395	364	372	402
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*142,983*	*224,076*	*310,322*	*389,772*	*477,422*	*874,271*	*182,963*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2001	2002	2003	2004	2005	2006	2007
(8)	Inflow	Between Systems	Recharge of Applied Water	14,089	14,001	13,030	13,667	12,197	12,475	13,755
(9)	Inflow	Between Systems	Recharge of Precipitation	1,288	1,345	1,551	1,449	1,695	1,725	1,498
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	8,684	11,116	14,228	17,745	21,733	38,213	9,941
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*24,686*	*27,086*	*29,435*	*33,485*	*36,249*	*53,038*	*25,818*
(3)	Outflow	Between Systems	Groundwater Extraction	49,626	48,753	44,131	47,093	40,332	40,960	48,745
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*49,626*	*48,753*	*44,131*	*47,093*	*40,332*	*40,960*	*48,745*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(24,940)	(21,666)	(14,696)	(13,608)	(4,082)	12,079	(22,927)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2001	2002	2003	2004	2005	2006	2007
(1)	Inflow	Into Basin	Precipitation on Land System	79,296	109,976	136,611	136,687	147,525	190,721	99,291
(14)	Inflow	Into Basin	Precipitation on Reservoirs	291	403	501	501	541	699	364
(13)	Inflow	Into Basin	Stream Inflow	100,742	153,035	219,963	295,581	381,347	735,770	127,762
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*180,328*	*263,415*	*357,075*	*432,770*	*529,413*	*927,191*	*227,418*
(5)	Outflow	Out of Basin	Evapotranspiration	152,585	153,349	151,547	153,751	149,036	151,973	156,935
(24)	Outflow	Out of Basin	Stream Evaporation	400	400	380	395	364	372	402
(23)	Outflow	Out of Basin	Reservoir Evaporation	763	756	711	747	675	694	762
(19)	Outflow	Out of Basin	Conveyance Evaporation	48	48	45	46	43	45	47
(18)	Outflow	Out of Basin	Stream Outflow	51,472	130,528	219,088	291,439	383,378	762,028	92,199
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*205,269*	*285,081*	*371,772*	*446,379*	*533,495*	*915,112*	*250,345*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(24,940)	(21,666)	(14,696)	(13,608)	(4,082)	12,079	(22,927)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2008	2009	2010	2011	2012	2013	2014
(1)	Inflow	Into Basin	Precipitation on Land System	97,459	114,173	120,660	167,215	93,491	126,995	88,759
(2)	Inflow	Between Systems	Surface Water Delivery	78,709	78,245	71,749	68,856	81,443	78,026	85,157
(3)	Inflow	Between Systems	Groundwater Extraction	47,716	46,430	41,387	38,575	49,850	46,719	54,126
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*223,885*	*238,849*	*233,797*	*274,646*	*224,784*	*251,740*	*228,042*
(5)	Outflow	Out of Basin	Evapotranspiration	151,305	156,057	151,911	146,988	154,515	161,099	159,338
(6)	Outflow	Between Systems	Runoff	52,178	62,460	63,110	109,739	49,166	70,144	46,463
(7)	Outflow	Between Systems	Return Flow	5,366	5,217	4,644	4,323	5,608	5,251	6,098
(8)	Outflow	Between Systems	Recharge of Applied Water	13,678	13,564	12,406	11,872	14,165	13,540	14,874
(9)	Outflow	Between Systems	Recharge of Precipitation	1,358	1,551	1,727	1,724	1,330	1,706	1,269
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*223,885*	*238,849*	*233,797*	*274,646*	*224,784*	*251,740*	*228,042*
(12)	Storage Change	(4)-(11)	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2008	2009	2010	2011	2012	2013	2014
(13)	Inflow	Into Basin	Stream Inflow	240,456	143,169	103,605	629,359	125,535	142,221	52,739
(14)	Inflow	Into Basin	Precipitation on Reservoirs	357	418	442	613	343	465	325
(6)	Inflow	Between Systems	Runoff	52,178	62,460	63,110	109,739	49,166	70,144	46,463
(7)	Inflow	Between Systems	Return Flow	5,366	5,217	4,644	4,323	5,608	5,251	6,098
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*298,356*	*211,263*	*171,801*	*744,034*	*180,651*	*218,081*	*105,625*
(18)	Outflow	Out of Basin	Stream Outflow	202,668	120,562	89,515	640,247	87,552	127,602	12,117
(19)	Outflow	Out of Basin	Conveyance Evaporation	46	46	44	42	47	47	49
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	78,709	78,245	71,749	68,856	81,443	78,026	85,157
(21)	Outflow	Between Systems	Stream Loss to Groundwater	15,181	10,657	8,818	33,265	9,837	10,613	6,452
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	737	736	684	648	748	766	802
(24)	Outflow	Out of Basin	Stream Evaporation	391	393	368	352	401	403	423
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*298,356*	*211,263*	*171,801*	*744,034*	*180,651*	*218,081*	*105,625*
(26)	Storage Change	(17)-(25)	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2008	2009	2010	2011	2012	2013	2014
(8)	Inflow	Between Systems	Recharge of Applied Water	13,678	13,564	12,406	11,872	14,165	13,540	14,874
(9)	Inflow	Between Systems	Recharge of Precipitation	1,358	1,551	1,727	1,724	1,330	1,706	1,269
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	15,181	10,657	8,818	33,265	9,837	10,613	6,452
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*30,842*	*26,398*	*23,575*	*47,486*	*25,957*	*26,484*	*23,220*
(3)	Outflow	Between Systems	Groundwater Extraction	47,716	46,430	41,387	38,575	49,850	46,719	54,126
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*47,716*	*46,430*	*41,387*	*38,575*	*49,850*	*46,719*	*54,126*
(31)	Storage Change	(28)-(30)	Change in Groundwater Storage	(16,874)	(20,033)	(17,812)	8,910	(23,893)	(20,235)	(30,907)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2008	2009	2010	2011	2012	2013	2014
(1)	Inflow	Into Basin	Precipitation on Land System	97,459	114,173	120,660	167,215	93,491	126,995	88,759
(14)	Inflow	Into Basin	Precipitation on Reservoirs	357	418	442	613	343	465	325
(13)	Inflow	Into Basin	Stream Inflow	240,456	143,169	103,605	629,359	125,535	142,221	52,739
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*338,273*	*257,761*	*224,709*	*797,188*	*219,369*	*269,682*	*141,824*
(5)	Outflow	Out of Basin	Evapotranspiration	151,305	156,057	151,911	146,988	154,515	161,099	159,338
(24)	Outflow	Out of Basin	Stream Evaporation	391	393	368	352	401	403	423
(23)	Outflow	Out of Basin	Reservoir Evaporation	737	736	684	648	748	766	802
(19)	Outflow	Out of Basin	Conveyance Evaporation	46	46	44	42	47	47	49
(18)	Outflow	Out of Basin	Stream Outflow	202,668	120,562	89,515	640,247	87,552	127,602	12,117
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*355,147*	*277,794*	*242,521*	*788,277*	*243,262*	*289,917*	*172,731*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(16,874)	(20,033)	(17,812)	8,910	(23,893)	(20,235)	(30,907)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2015	2016	2017	2018
(1)	Inflow	Into Basin	Precipitation on Land System	129,361	160,423	201,559	139,969
(2)	Inflow	Between Systems	Surface Water Delivery	80,035	78,452	75,027	77,947
(3)	Inflow	Between Systems	Groundwater Extraction	47,485	45,590	42,392	46,930
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*256,881*	*284,465*	*318,977*	*264,846*
(5)	Outflow	Out of Basin	Evapotranspiration	161,258	158,534	159,998	153,469
(6)	Outflow	Between Systems	Runoff	74,778	105,600	139,423	91,100
(7)	Outflow	Between Systems	Return Flow	5,336	5,118	4,753	5,276
(8)	Outflow	Between Systems	Recharge of Applied Water	13,872	13,568	12,939	13,535
(9)	Outflow	Between Systems	Recharge of Precipitation	1,637	1,645	1,864	1,466
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*256,881*	*284,465*	*318,977*	*264,846*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2015	2016	2017	2018
(13)	Inflow	Into Basin	Stream Inflow	82,881	374,311	809,028	243,145
(14)	Inflow	Into Basin	Precipitation on Reservoirs	474	588	739	513
(6)	Inflow	Between Systems	Runoff	74,778	105,600	139,423	91,100
(7)	Inflow	Between Systems	Return Flow	5,336	5,118	4,753	5,276
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*163,468*	*485,618*	*953,943*	*340,034*
(18)	Outflow	Out of Basin	Stream Outflow	73,721	383,946	827,869	244,988
(19)	Outflow	Out of Basin	Conveyance Evaporation	47	47	48	47
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	80,035	78,452	75,027	77,947
(21)	Outflow	Between Systems	Stream Loss to Groundwater	7,854	21,405	49,248	15,306
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	778	746	737	730
(24)	Outflow	Out of Basin	Stream Evaporation	409	398	391	392
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*163,468*	*485,618*	*953,943*	*340,034*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2015	2016	2017	2018
(8)	Inflow	Between Systems	Recharge of Applied Water	13,872	13,568	12,939	13,535
(9)	Inflow	Between Systems	Recharge of Precipitation	1,637	1,645	1,864	1,466
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	7,854	21,405	49,248	15,306
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*23,988*	*37,242*	*64,675*	*30,932*
(3)	Outflow	Between Systems	Groundwater Extraction	47,485	45,590	42,392	46,930
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*47,485*	*45,590*	*42,392*	*46,930*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(23,497)	(8,348)	22,283	(15,998)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2015	2016	2017	2018
(1)	Inflow	Into Basin	Precipitation on Land System	129,361	160,423	201,559	139,969
(14)	Inflow	Into Basin	Precipitation on Reservoirs	474	588	739	513
(13)	Inflow	Into Basin	Stream Inflow	82,881	374,311	809,028	243,145
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*212,717*	*535,323*	*1,011,326*	*383,627*
(5)	Outflow	Out of Basin	Evapotranspiration	161,258	158,534	159,998	153,469
(24)	Outflow	Out of Basin	Stream Evaporation	409	398	391	392
(23)	Outflow	Out of Basin	Reservoir Evaporation	778	746	737	730
(19)	Outflow	Out of Basin	Conveyance Evaporation	47	47	48	47
(18)	Outflow	Out of Basin	Stream Outflow	73,721	383,946	827,869	244,988
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*236,214*	*543,670*	*989,042*	*399,625*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(23,497)	(8,348)	22,283	(15,998)

LAND SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	Average (2019-2068)
Inflow	Into Basin	Precipitation on Land System	143,208
Inflow	Between Systems	Surface Water Delivery	77,048
Inflow	Between Systems	Groundwater Extraction	45,162
Inflow	*(1)+(2)+(3)*	*Total Inflow*	*265,418*
Outflow	Out of Basin	Evapotranspiration	156,873
Outflow	Between Systems	Runoff	88,493
Outflow	Between Systems	Return Flow	5,072
Outflow	Between Systems	Recharge of Applied Water	13,339
Outflow	Between Systems	Recharge of Precipitation	1,641
Outflow	Between Systems	Managed Aquifer Recharge	-
Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*265,418*
Storage Change	(4)-(11)	Change in Land System Storage	-

SURFACE WATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	Average (2019-2068)
Inflow	Into Basin	Stream Inflow	430,242
Inflow	Into Basin	Precipitation on Reservoirs	525
Inflow	Between Systems	Runoff	88,493
Inflow	Between Systems	Return Flow	5,072
Inflow	Between Systems	Stream Gain from Groundwater	-
Inflow	Between Systems	Reservoir Gain from Groundwater	-
Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*524,331*
Outflow	Out of Basin	Stream Outflow	418,003
Outflow	Out of Basin	Conveyance Evaporation	47
Outflow	Between Systems	Conveyance Seepage	27
Outflow	Between Systems	Surface Water Delivery	77,048
Outflow	Between Systems	Stream Loss to Groundwater	27,476
Outflow	Between Systems	Reservoir Loss to Groundwater	596
Outflow	Out of Basin	Reservoir Evaporation	741
Outflow	Out of Basin	Stream Evaporation	393
Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*524,331*
Storage Change	(17)-(25)	Change in Surface Water Storage	-

GROUNDWATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	Average (2019-2068)
Inflow	Between Systems	Recharge of Applied Water	13,339
Inflow	Between Systems	Recharge of Precipitation	1,641
Inflow	Between Systems	Managed Aquifer Recharge	-
Inflow	Between Systems	Groundwater Gain from Stream	27,476
Inflow	Between Systems	Groundwater Gain from Reservoir	596
Inflow	Between Systems	Conveyance Seepage	27
Inflow	Into Basin	Subsurface Inflow	1
Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*43,081*
Outflow	Between Systems	Groundwater Extraction	45,162
Outflow	Between Systems	Groundwater Loss to Stream	-
Outflow	Between Systems	Groundwater Loss to Reservoir s	-
Outflow	Out of Basin	Subsurface Outflow	-
Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*45,162*
Storage Change	(28)-(30)	Change in Groundwater Storage	(2,080)

TOTAL BASIN WATER BUDGET

Flow Type	Origin/ Destination	Component	Average (2019-2068)
Inflow	Into Basin	Precipitation on Land System	143,208
Inflow	Into Basin	Precipitation on Reservoirs	525
Inflow	Into Basin	Stream Inflow	430,242
Inflow	Into Basin	Subsurface Inflow	1
Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*573,975*
Outflow	Out of Basin	Evapotranspiration	156,873
Outflow	Out of Basin	Stream Evaporation	393
Outflow	Out of Basin	Reservoir Evaporation	741
Outflow	Out of Basin	Conveyance Evaporation	47
Outflow	Out of Basin	Stream Outflow	418,003
Outflow	Out of Basin	Subsurface Outflow	-
Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*576,056*
Storage Change	(32)-(33)	Change in Total System Storage	(2,080)

LAND SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2019	2020	2021	2022	2023	2024
Inflow	Into Basin	Precipitation on Land System	124,782	214,533	111,731	190,645	87,538	177,442
Inflow	Between Systems	Surface Water Delivery	82,510	73,612	82,236	77,699	85,805	79,223
Inflow	Between Systems	Groundwater Extraction	49,372	40,325	49,679	45,952	53,502	46,213
Inflow	*(1)+(2)+(3)*	*Total Inflow*	*256,664*	*328,470*	*243,646*	*314,297*	*226,845*	*302,878*
Outflow	Out of Basin	Evapotranspiration	161,959	157,895	160,313	160,477	160,427	158,375
Outflow	Between Systems	Runoff	73,298	151,514	61,974	133,477	44,140	124,005
Outflow	Between Systems	Return Flow	5,550	4,516	5,586	5,162	6,024	5,189
Outflow	Between Systems	Recharge of Applied Water	14,312	12,655	14,281	13,465	14,952	13,706
Outflow	Between Systems	Recharge of Precipitation	1,545	1,891	1,493	1,715	1,302	1,603
Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*256,664*	*328,470*	*243,646*	*314,297*	*226,845*	*302,878*
Storage Change	(4)-(11)	Change in Land System Storage	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2019	2020	2021	2022	2023	2024
Inflow	Into Basin	Stream Inflow	218,123	697,723	307,955	767,905	183,806	502,177
Inflow	Into Basin	Precipitation on Reservoirs	457	786	409	699	321	650
Inflow	Between Systems	Runoff	73,298	151,514	61,974	133,477	44,140	124,005
Inflow	Between Systems	Return Flow	5,550	4,516	5,586	5,162	6,024	5,189
Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-
Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*297,429*	*854,539*	*375,924*	*907,243*	*234,290*	*632,021*
Outflow	Out of Basin	Stream Outflow	198,898	742,701	273,501	787,992	134,030	523,627
Outflow	Out of Basin	Conveyance Evaporation	49	48	48	47	50	49
Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27
Outflow	Between Systems	Surface Water Delivery	82,510	73,612	82,236	77,699	85,805	79,223
Outflow	Between Systems	Stream Loss to Groundwater	14,143	36,444	18,320	39,708	12,547	27,351
Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596
Outflow	Out of Basin	Reservoir Evaporation	790	727	782	770	809	747
Outflow	Out of Basin	Stream Evaporation	416	383	414	403	426	400
Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*297,429*	*854,539*	*375,924*	*907,243*	*234,290*	*632,021*
Storage Change	(17)-(25)	Change in Surface Water Storage	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2019	2020	2021	2022	2023	2024
Inflow	Between Systems	Recharge of Applied Water	14,312	12,655	14,281	13,465	14,952	13,706
Inflow	Between Systems	Recharge of Precipitation	1,545	1,891	1,493	1,715	1,302	1,603
Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
Inflow	Between Systems	Groundwater Gain from Stream	14,143	36,444	18,320	39,708	12,547	27,351
Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596
Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1
Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*30,624*	*51,614*	*34,718*	*55,512*	*29,425*	*43,285*
Outflow	Between Systems	Groundwater Extraction	49,372	40,325	49,679	45,952	53,502	46,213
Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*49,372*	*40,325*	*49,679*	*45,952*	*53,502*	*46,213*
Storage Change	(28)-(30)	Change in Groundwater Storage	(18,748)	11,289	(14,961)	9,560	(24,077)	(2,928)

TOTAL BASIN WATER BUDGET

Flow Type	Origin/ Destination	Component	2019	2020	2021	2022	2023	2024
Inflow	Into Basin	Precipitation on Land System	124,782	214,533	111,731	190,645	87,538	177,442
Inflow	Into Basin	Precipitation on Reservoirs	457	786	409	699	321	650
Inflow	Into Basin	Stream Inflow	218,123	697,723	307,955	767,905	183,806	502,177
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1
Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*343,363*	*913,043*	*420,096*	*959,249*	*271,665*	*680,269*
Outflow	Out of Basin	Evapotranspiration	161,959	157,895	160,313	160,477	160,427	158,375
Outflow	Out of Basin	Stream Evaporation	416	383	414	403	426	400
Outflow	Out of Basin	Reservoir Evaporation	790	727	782	770	809	747
Outflow	Out of Basin	Conveyance Evaporation	49	48	48	47	50	49
Outflow	Out of Basin	Stream Outflow	198,898	742,701	273,501	787,992	134,030	523,627
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*362,111*	*901,754*	*435,058*	*949,689*	*295,742*	*683,197*
Storage Change	(32)-(33)	Change in Total System Storage	(18,748)	11,289	(14,961)	9,560	(24,077)	(2,928)

LAND SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2025	2026	2027	2028	2029	2030	2031
Inflow	Into Basin	Precipitation on Land System	133,558	164,010	182,632	204,764	123,866	115,700	185,913
Inflow	Between Systems	Surface Water Delivery	79,192	82,117	81,376	74,115	82,207	83,257	79,490
Inflow	Between Systems	Groundwater Extraction	46,615	48,324	47,544	41,095	48,483	49,808	45,707
Inflow	*(1)+(2)+(3)*	*Total Inflow*	*259,366*	*294,451*	*311,552*	*319,974*	*254,556*	*248,765*	*311,111*
Outflow	Out of Basin	Evapotranspiration	160,592	163,111	162,673	161,164	164,323	164,927	162,327
Outflow	Between Systems	Runoff	78,161	110,076	127,816	139,490	68,901	62,194	128,193
Outflow	Between Systems	Return Flow	5,236	5,429	5,339	4,604	5,447	5,599	5,130
Outflow	Between Systems	Recharge of Applied Water	13,715	14,217	14,078	12,757	14,236	14,440	13,730
Outflow	Between Systems	Recharge of Precipitation	1,662	1,618	1,644	1,958	1,649	1,605	1,732
Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*259,366*	*294,451*	*311,552*	*319,974*	*254,556*	*248,765*	*311,111*
Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2025	2026	2027	2028	2029	2030	2031
Inflow	Into Basin	Stream Inflow	255,335	637,275	624,047	1,007,609	667,874	318,068	592,563
Inflow	Into Basin	Precipitation on Reservoirs	489	601	669	750	454	424	681
Inflow	Between Systems	Runoff	78,161	110,076	127,816	139,490	68,901	62,194	128,193
Inflow	Between Systems	Return Flow	5,236	5,429	5,339	4,604	5,447	5,599	5,130
Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*339,222*	*753,380*	*757,872*	*1,152,454*	*742,676*	*386,285*	*726,567*
Outflow	Out of Basin	Stream Outflow	242,296	635,748	641,606	941,819	623,530	282,329	613,664
Outflow	Out of Basin	Conveyance Evaporation	46	49	49	46	49	49	49
Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
Outflow	Between Systems	Surface Water Delivery	79,192	82,117	81,376	74,115	82,207	83,257	79,490
Outflow	Between Systems	Stream Loss to Groundwater	15,873	33,633	33,018	134,726	35,056	18,790	31,554
Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
Outflow	Out of Basin	Reservoir Evaporation	783	792	785	733	793	811	778
Outflow	Out of Basin	Stream Evaporation	408	417	413	390	417	423	407
Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*339,222*	*753,380*	*757,872*	*1,152,454*	*742,676*	*386,285*	*726,567*
Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2025	2026	2027	2028	2029	2030	2031
Inflow	Between Systems	Recharge of Applied Water	13,715	14,217	14,078	12,757	14,236	14,440	13,730
Inflow	Between Systems	Recharge of Precipitation	1,662	1,618	1,644	1,958	1,649	1,605	1,732
Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
Inflow	Between Systems	Groundwater Gain from Stream	15,873	33,633	33,018	134,726	35,056	18,790	31,554
Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*31,874*	*50,093*	*49,366*	*150,066*	*51,566*	*35,460*	*47,640*
Outflow	Between Systems	Groundwater Extraction	46,615	48,324	47,544	41,095	48,483	49,808	45,707
Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*46,615*	*48,324*	*47,544*	*41,095*	*48,483*	*49,808*	*45,707*
Storage Change	**(28)-(30)**	Change in Groundwater Storage	(14,741)	1,769	1,822	108,971	3,083	(14,348)	1,933

TOTAL BASIN WATER BUDGET

Flow Type	Origin/ Destination	Component	2025	2026	2027	2028	2029	2030	2031
Inflow	Into Basin	Precipitation on Land System	133,558	164,010	182,632	204,764	123,866	115,700	185,913
Inflow	Into Basin	Precipitation on Reservoirs	489	601	669	750	454	424	681
Inflow	Into Basin	Stream Inflow	255,335	637,275	624,047	1,007,609	667,874	318,068	592,563
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*389,384*	*801,886*	*807,348*	*1,213,124*	*792,195*	*434,193*	*779,158*
Outflow	Out of Basin	Evapotranspiration	160,592	163,111	162,673	161,164	164,323	164,927	162,327
Outflow	Out of Basin	Stream Evaporation	408	417	413	390	417	423	407
Outflow	Out of Basin	Reservoir Evaporation	783	792	785	733	793	811	778
Outflow	Out of Basin	Conveyance Evaporation	46	49	49	46	49	49	49
Outflow	Out of Basin	Stream Outflow	242,296	635,748	641,606	941,819	623,530	282,329	613,664
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*404,125*	*800,117*	*805,527*	*1,104,153*	*789,112*	*448,540*	*777,226*
Storage Change	**(32)-(33)**	Change in Total System Storage	(14,741)	1,769	1,822	108,971	3,083	(14,348)	1,933

LAND SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2032	2033	2034	2035	2036	2037	2038	2039
Inflow	Into Basin	Precipitation on Land System	139,206	110,510	85,325	164,468	106,923	179,197	114,326	204,535
Inflow	Between Systems	Surface Water Delivery	79,545	79,582	82,522	77,244	81,768	78,012	81,900	76,749
Inflow	Between Systems	Groundwater Extraction	46,907	48,100	51,806	43,861	49,645	43,934	48,901	42,492
Inflow	*(1)+(2)+(3)*	*Total Inflow*	*265,658*	*238,192*	*219,653*	*285,573*	*238,337*	*301,143*	*245,127*	*323,776*
Outflow	Out of Basin	Evapotranspiration	162,112	159,554	157,350	163,976	159,997	166,332	163,172	165,607
Outflow	Between Systems	Runoff	82,807	57,826	40,736	101,461	57,051	114,498	60,644	138,214
Outflow	Between Systems	Return Flow	5,269	5,409	5,834	4,920	5,584	4,926	5,496	4,761
Outflow	Between Systems	Recharge of Applied Water	13,778	13,823	14,395	13,326	14,208	13,445	14,203	13,205
Outflow	Between Systems	Recharge of Precipitation	1,692	1,581	1,338	1,890	1,496	1,941	1,610	1,990
Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-	-
Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*265,658*	*238,192*	*219,653*	*285,573*	*238,337*	*301,143*	*245,127*	*323,776*
Storage Change	(4)-(11)	Change in Land System Storage	-	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2032	2033	2034	2035	2036	2037	2038	2039
Inflow	Into Basin	Stream Inflow	557,523	196,081	110,187	299,161	236,541	547,651	165,958	760,457
Inflow	Into Basin	Precipitation on Reservoirs	510	405	313	603	392	657	419	749
Inflow	Between Systems	Runoff	82,807	57,826	40,736	101,461	57,051	114,498	60,644	138,214
Inflow	Between Systems	Return Flow	5,269	5,409	5,834	4,920	5,584	4,926	5,496	4,761
Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-	-
Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-	-
Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*646,109*	*259,720*	*157,070*	*406,144*	*299,568*	*667,733*	*232,517*	*904,181*
Outflow	Out of Basin	Stream Outflow	534,796	165,138	63,542	309,163	200,936	558,396	137,030	786,222
Outflow	Out of Basin	Conveyance Evaporation	48	46	47	48	48	48	49	49
Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27	27
Outflow	Between Systems	Surface Water Delivery	79,545	79,582	82,522	77,244	81,768	78,012	81,900	76,749
Outflow	Between Systems	Stream Loss to Groundwater	29,925	13,118	9,124	17,911	14,999	29,466	11,717	39,361
Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596	596
Outflow	Out of Basin	Reservoir Evaporation	766	802	794	754	781	779	783	773
Outflow	Out of Basin	Stream Evaporation	404	411	416	400	412	408	414	403
Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*646,109*	*259,720*	*157,070*	*406,144*	*299,568*	*667,733*	*232,517*	*904,181*
Storage Change	(17)-(25)	Change in Surface Water Storage	-	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2032	2033	2034	2035	2036	2037	2038	2039
Inflow	Between Systems	Recharge of Applied Water	13,778	13,823	14,395	13,326	14,208	13,445	14,203	13,205
Inflow	Between Systems	Recharge of Precipitation	1,692	1,581	1,338	1,890	1,496	1,941	1,610	1,990
Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-	-
Inflow	Between Systems	Groundwater Gain from Stream	29,925	13,118	9,124	17,911	14,999	29,466	11,717	39,361
Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596	596
Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27	27
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1	1
Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*46,020*	*29,146*	*25,481*	*33,752*	*31,328*	*45,477*	*28,156*	*55,180*
Outflow	Between Systems	Groundwater Extraction	46,907	48,100	51,806	43,861	49,645	43,934	48,901	42,492
Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-	-
Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-	-
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-	-
Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*46,907*	*48,100*	*51,806*	*43,861*	*49,645*	*43,934*	*48,901*	*42,492*
Storage Change	(28)-(30)	Change in Groundwater Storage	(888)	(18,954)	(26,325)	(10,109)	(18,317)	1,543	(20,745)	12,688

TOTAL BASIN WATER BUDGET

Flow Type	Origin/ Destination	Component	2032	2033	2034	2035	2036	2037	2038	2039
Inflow	Into Basin	Precipitation on Land System	139,206	110,510	85,325	164,468	106,923	179,197	114,326	204,535
Inflow	Into Basin	Precipitation on Reservoirs	510	405	313	603	392	657	419	749
Inflow	Into Basin	Stream Inflow	557,523	196,081	110,187	299,161	236,541	547,651	165,958	760,457
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1	1
Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*697,240*	*306,996*	*195,825*	*464,232*	*343,856*	*727,506*	*280,703*	*965,743*
Outflow	Out of Basin	Evapotranspiration	162,112	159,554	157,350	163,976	159,997	166,332	163,172	165,607
Outflow	Out of Basin	Stream Evaporation	404	411	416	400	412	408	414	403
Outflow	Out of Basin	Reservoir Evaporation	766	802	794	754	781	779	783	773
Outflow	Out of Basin	Conveyance Evaporation	48	46	47	48	48	48	49	49
Outflow	Out of Basin	Stream Outflow	534,796	165,138	63,542	309,163	200,936	558,396	137,030	786,222
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-	-
Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*698,127*	*325,950*	*222,150*	*474,341*	*362,174*	*725,963*	*301,449*	*953,054*
Storage Change	(32)-(33)	Change in Total System Storage	(888)	(18,954)	(26,325)	(10,109)	(18,317)	1,543	(20,745)	12,688

LAND SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2040	2041	2042	2043	2044	2045	2046	2047
Inflow	Into Basin	Precipitation on Land System	191,332	148,899	132,719	193,698	96,315	88,835	150,654	112,418
Inflow	Between Systems	Surface Water Delivery	74,947	68,516	76,750	74,262	78,850	85,952	72,061	72,399
Inflow	Between Systems	Groundwater Extraction	41,152	39,192	45,598	41,789	47,782	53,245	41,145	42,407
Inflow	*(1)+(2)+(3)*	*Total Inflow*	*307,432*	*256,607*	*255,067*	*309,749*	*222,946*	*228,032*	*263,860*	*227,224*
Outflow	Out of Basin	Evapotranspiration	163,789	146,344	152,399	160,318	155,136	159,362	151,287	148,958
Outflow	Between Systems	Runoff	124,132	92,329	82,737	130,033	47,265	46,439	93,806	59,374
Outflow	Between Systems	Return Flow	4,609	4,396	5,123	4,685	5,373	5,994	4,615	4,761
Outflow	Between Systems	Recharge of Applied Water	12,886	11,840	13,309	12,802	13,701	14,966	12,446	12,539
Outflow	Between Systems	Recharge of Precipitation	2,016	1,697	1,499	1,910	1,471	1,272	1,705	1,591
Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-	-
Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*307,432*	*256,607*	*255,067*	*309,749*	*222,946*	*228,032*	*263,860*	*227,224*
Storage Change	(4)-(11)	Change in Land System Storage	-	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2040	2041	2042	2043	2044	2045	2046	2047
Inflow	Into Basin	Stream Inflow	697,741	808,462	310,960	878,565	161,807	162,980	390,854	133,594
Inflow	Into Basin	Precipitation on Reservoirs	701	546	486	710	353	326	552	412
Inflow	Between Systems	Runoff	124,132	92,329	82,737	130,033	47,265	46,439	93,806	59,374
Inflow	Between Systems	Return Flow	4,609	4,396	5,123	4,685	5,373	5,994	4,615	4,761
Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-	-
Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-	-
Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*827,183*	*905,732*	*399,306*	*#######*	*214,798*	*215,738*	*489,827*	*198,142*
Outflow	Out of Basin	Stream Outflow	713,968	786,443	302,274	865,544	122,626	116,338	393,854	113,802
Outflow	Out of Basin	Conveyance Evaporation	47	44	46	45	45	50	45	44
Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27	27
Outflow	Between Systems	Surface Water Delivery	74,947	68,516	76,750	74,262	78,850	85,952	72,061	72,399
Outflow	Between Systems	Stream Loss to Groundwater	36,445	49,085	18,460	72,401	11,524	11,579	22,175	10,212
Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596	596
Outflow	Out of Basin	Reservoir Evaporation	757	667	760	727	736	777	697	693
Outflow	Out of Basin	Stream Evaporation	395	354	393	389	393	420	371	368
Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*827,183*	*905,732*	*399,306*	*#######*	*214,798*	*215,738*	*489,827*	*198,142*
Storage Change	(17)-(25)	Change in Surface Water Storage	-	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2040	2041	2042	2043	2044	2045	2046	2047
Inflow	Between Systems	Recharge of Applied Water	12,886	11,840	13,309	12,802	13,701	14,966	12,446	12,539
Inflow	Between Systems	Recharge of Precipitation	2,016	1,697	1,499	1,910	1,471	1,272	1,705	1,591
Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-	-
Inflow	Between Systems	Groundwater Gain from Stream	36,445	49,085	18,460	72,401	11,524	11,579	22,175	10,212
Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596	596
Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27	27
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1	1
Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*51,971*	*63,247*	*33,892*	*87,738*	*27,321*	*28,441*	*36,950*	*24,967*
Outflow	Between Systems	Groundwater Extraction	41,152	39,192	45,598	41,789	47,782	53,245	41,145	42,407
Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-	-
Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-	-
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-	-
Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*41,152*	*39,192*	*45,598*	*41,789*	*47,782*	*53,245*	*41,145*	*42,407*
Storage Change	(28)-(30)	Change in Groundwater Storage	10,819	24,055	(11,706)	45,949	(20,461)	(24,804)	(4,194)	(17,440)

TOTAL BASIN WATER BUDGET

Flow Type	Origin/ Destination	Component	2040	2041	2042	2043	2044	2045	2046	2047
Inflow	Into Basin	Precipitation on Land System	191,332	148,899	132,719	193,698	96,315	88,835	150,654	112,418
Inflow	Into Basin	Precipitation on Reservoirs	701	546	486	710	353	326	552	412
Inflow	Into Basin	Stream Inflow	697,741	808,462	310,960	878,565	161,807	162,980	390,854	133,594
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1	1
Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*889,774*	*957,907*	*444,166*	*#######*	*258,475*	*252,142*	*542,060*	*246,425*
Outflow	Out of Basin	Evapotranspiration	163,789	146,344	152,399	160,318	155,136	159,362	151,287	148,958
Outflow	Out of Basin	Stream Evaporation	395	354	393	389	393	420	371	368
Outflow	Out of Basin	Reservoir Evaporation	757	667	760	727	736	777	697	693
Outflow	Out of Basin	Conveyance Evaporation	47	44	46	45	45	50	45	44
Outflow	Out of Basin	Stream Outflow	713,968	786,443	302,274	865,544	122,626	116,338	393,854	113,802
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-	-
Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*878,956*	*933,852*	*455,872*	*#######*	*278,936*	*276,946*	*546,255*	*263,865*
Storage Change	(32)-(33)	Change in Total System Storage	10,819	24,055	(11,706)	45,949	(20,461)	(24,804)	(4,194)	(17,440)

LAND SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2048	2049	2050	2051	2052	2053	2054	2055
Inflow	Into Basin	Precipitation on Land System	108,526	75,556	184,082	104,481	192,248	183,776	171,871	229,110
Inflow	Between Systems	Surface Water Delivery	77,619	82,827	70,993	76,177	65,439	70,985	74,958	64,027
Inflow	Between Systems	Groundwater Extraction	46,745	52,036	38,861	45,730	35,592	41,037	42,916	32,854
Inflow	*(1)+(2)+(3)*	*Total Inflow*	*232,890*	*210,419*	*293,936*	*226,387*	*293,278*	*295,799*	*289,744*	*325,992*
Outflow	Out of Basin	Evapotranspiration	153,216	155,932	156,238	153,369	143,128	150,803	159,397	151,378
Outflow	Between Systems	Runoff	59,468	32,898	119,194	53,112	133,143	126,391	110,752	157,864
Outflow	Between Systems	Return Flow	5,255	5,860	4,351	5,140	3,983	4,605	4,815	3,667
Outflow	Between Systems	Recharge of Applied Water	13,479	14,449	12,207	13,226	11,251	12,278	12,946	10,945
Outflow	Between Systems	Recharge of Precipitation	1,472	1,280	1,947	1,541	1,773	1,722	1,834	2,137
Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-	-
Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*232,890*	*210,419*	*293,936*	*226,387*	*293,278*	*295,799*	*289,744*	*325,992*
Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2048	2049	2050	2051	2052	2053	2054	2055
Inflow	Into Basin	Stream Inflow	263,663	76,254	602,999	167,393	912,444	780,720	614,680	832,300
Inflow	Into Basin	Precipitation on Reservoirs	398	277	675	383	704	673	630	840
Inflow	Between Systems	Runoff	59,468	32,898	119,194	53,112	133,143	126,391	110,752	157,864
Inflow	Between Systems	Return Flow	5,255	5,860	4,351	5,140	3,983	4,605	4,815	3,667
Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-	-
Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-	-
Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*328,784*	*115,288*	*727,219*	*226,028*	*1,050,275*	*912,389*	*730,877*	*994,671*
Outflow	Out of Basin	Stream Outflow	233,159	23,084	622,453	136,286	897,057	798,101	621,549	872,733
Outflow	Out of Basin	Conveyance Evaporation	47	48	46	46	41	44	46	42
Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27	27
Outflow	Between Systems	Surface Water Delivery	77,619	82,827	70,993	76,177	65,439	70,985	74,958	64,027
Outflow	Between Systems	Stream Loss to Groundwater	16,260	7,546	32,039	11,784	86,149	41,575	32,583	56,285
Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596	596
Outflow	Out of Basin	Reservoir Evaporation	693	754	693	726	625	692	729	619
Outflow	Out of Basin	Stream Evaporation	382	406	370	386	340	369	388	340
Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*328,784*	*115,288*	*727,219*	*226,028*	*1,050,275*	*912,389*	*730,877*	*994,671*
Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2048	2049	2050	2051	2052	2053	2054	2055
Inflow	Between Systems	Recharge of Applied Water	13,479	14,449	12,207	13,226	11,251	12,278	12,946	10,945
Inflow	Between Systems	Recharge of Precipitation	1,472	1,280	1,947	1,541	1,773	1,722	1,834	2,137
Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-	-
Inflow	Between Systems	Groundwater Gain from Stream	16,260	7,546	32,039	11,784	86,149	41,575	32,583	56,285
Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596	596
Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27	27
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1	1
Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*31,836*	*23,899*	*46,817*	*27,175*	*99,798*	*56,199*	*47,987*	*69,992*
Outflow	Between Systems	Groundwater Extraction	46,745	52,036	38,861	45,730	35,592	41,037	42,916	32,854
Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-	-
Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-	-
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-	-
Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*46,745*	*52,036*	*38,861*	*45,730*	*35,592*	*41,037*	*42,916*	*32,854*
Storage Change	**(28)-(30)**	Change in Groundwater Storage	(14,909)	(28,137)	7,956	(18,555)	64,206	15,162	5,071	37,138

TOTAL BASIN WATER BUDGET

Flow Type	Origin/ Destination	Component	2048	2049	2050	2051	2052	2053	2054	2055
Inflow	Into Basin	Precipitation on Land System	108,526	75,556	184,082	104,481	192,248	183,776	171,871	229,110
Inflow	Into Basin	Precipitation on Reservoirs	398	277	675	383	704	673	630	840
Inflow	Into Basin	Stream Inflow	263,663	76,254	602,999	167,393	912,444	780,720	614,680	832,300
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1	1
Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*372,587*	*152,087*	*787,756*	*272,257*	*1,105,397*	*965,170*	*787,182*	*#######*
Outflow	Out of Basin	Evapotranspiration	153,216	155,932	156,238	153,369	143,128	150,803	159,397	151,378
Outflow	Out of Basin	Stream Evaporation	382	406	370	386	340	369	388	340
Outflow	Out of Basin	Reservoir Evaporation	693	754	693	726	625	692	729	619
Outflow	Out of Basin	Conveyance Evaporation	47	48	46	46	41	44	46	42
Outflow	Out of Basin	Stream Outflow	233,159	23,084	622,453	136,286	897,057	798,101	621,549	872,733
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-	-
Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*387,496*	*180,224*	*779,799*	*290,812*	*1,041,192*	*950,008*	*782,111*	*#######*
Storage Change	**(32)-(33)**	Change in Total System Storage	(14,909)	(28,137)	7,956	(18,555)	64,206	15,162	5,071	37,138

LAND SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2056	2057	2058	2059	2060	2061	2062	2063
Inflow	Into Basin	Precipitation on Land System	146,533	128,140	79,296	109,976	136,611	136,687	147,525	190,721
Inflow	Between Systems	Surface Water Delivery	74,092	76,327	80,992	80,604	75,245	78,776	70,606	72,295
Inflow	Between Systems	Groundwater Extraction	43,259	44,735	49,626	48,753	44,131	47,093	40,332	40,960
Inflow	*(1)+(2)+(3)*	*Total Inflow*	*263,883*	*249,201*	*209,913*	*239,333*	*255,987*	*262,556*	*258,462*	*303,976*
Outflow	Out of Basin	Evapotranspiration	152,590	157,889	152,585	153,349	151,547	153,751	149,036	151,973
Outflow	Between Systems	Runoff	91,975	71,370	36,368	65,156	84,903	88,396	91,011	133,210
Outflow	Between Systems	Return Flow	4,857	5,024	5,583	5,482	4,956	5,293	4,524	4,593
Outflow	Between Systems	Recharge of Applied Water	12,826	13,215	14,089	14,001	13,030	13,667	12,197	12,475
Outflow	Between Systems	Recharge of Precipitation	1,637	1,703	1,288	1,345	1,551	1,449	1,695	1,725
Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-	-
Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*263,883*	*249,201*	*209,913*	*239,333*	*255,987*	*262,556*	*258,462*	*303,976*
Storage Change	(4)-(11)	Change in Land System Storage	-	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2056	2057	2058	2059	2060	2061	2062	2063
Inflow	Into Basin	Stream Inflow	691,739	240,124	100,742	153,035	219,963	295,581	381,347	735,770
Inflow	Into Basin	Precipitation on Reservoirs	537	470	291	403	501	501	541	699
Inflow	Between Systems	Runoff	91,975	71,370	36,368	65,156	84,903	88,396	91,011	133,210
Inflow	Between Systems	Return Flow	4,857	5,024	5,583	5,482	4,956	5,293	4,524	4,593
Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-	-
Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-	-
Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*789,107*	*316,987*	*142,983*	*224,076*	*310,322*	*389,772*	*477,422*	*874,271*
Outflow	Out of Basin	Stream Outflow	677,081	223,698	51,472	130,528	219,088	291,439	383,378	762,028
Outflow	Out of Basin	Conveyance Evaporation	45	47	48	48	45	46	43	45
Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27	27
Outflow	Between Systems	Surface Water Delivery	74,092	76,327	80,992	80,604	75,245	78,776	70,606	72,295
Outflow	Between Systems	Stream Loss to Groundwater	36,166	15,166	8,684	11,116	14,228	17,745	21,733	38,213
Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596	596
Outflow	Out of Basin	Reservoir Evaporation	720	736	763	756	711	747	675	694
Outflow	Out of Basin	Stream Evaporation	379	390	400	400	380	395	364	372
Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*789,107*	*316,987*	*142,983*	*224,076*	*310,322*	*389,772*	*477,422*	*874,271*
Storage Change	(17)-(25)	Change in Surface Water Storage	-	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2056	2057	2058	2059	2060	2061	2062	2063
Inflow	Between Systems	Recharge of Applied Water	12,826	13,215	14,089	14,001	13,030	13,667	12,197	12,475
Inflow	Between Systems	Recharge of Precipitation	1,637	1,703	1,288	1,345	1,551	1,449	1,695	1,725
Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-	-
Inflow	Between Systems	Groundwater Gain from Stream	36,166	15,166	8,684	11,116	14,228	17,745	21,733	38,213
Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596	596
Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27	27
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1	1
Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*51,253*	*30,709*	*24,686*	*27,086*	*29,435*	*33,485*	*36,249*	*53,038*
Outflow	Between Systems	Groundwater Extraction	43,259	44,735	49,626	48,753	44,131	47,093	40,332	40,960
Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-	-
Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-	-
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-	-
Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*43,259*	*44,735*	*49,626*	*48,753*	*44,131*	*47,093*	*40,332*	*40,960*
Storage Change	(28)-(30)	Change in Groundwater Storage	7,994	(14,026)	(24,940)	(21,666)	(14,696)	(13,608)	(4,082)	12,079

TOTAL BASIN WATER BUDGET

Flow Type	Origin/ Destination	Component	2056	2057	2058	2059	2060	2061	2062	2063
Inflow	Into Basin	Precipitation on Land System	146,533	128,140	79,296	109,976	136,611	136,687	147,525	190,721
Inflow	Into Basin	Precipitation on Reservoirs	537	470	291	403	501	501	541	699
Inflow	Into Basin	Stream Inflow	691,739	240,124	100,742	153,035	219,963	295,581	381,347	735,770
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1	1
Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*838,809*	*368,734*	*180,328*	*263,415*	*357,075*	*432,770*	*529,413*	*927,191*
Outflow	Out of Basin	Evapotranspiration	152,590	157,889	152,585	153,349	151,547	153,751	149,036	151,973
Outflow	Out of Basin	Stream Evaporation	379	390	400	400	380	395	364	372
Outflow	Out of Basin	Reservoir Evaporation	720	736	763	756	711	747	675	694
Outflow	Out of Basin	Conveyance Evaporation	45	47	48	48	45	46	43	45
Outflow	Out of Basin	Stream Outflow	677,081	223,698	51,472	130,528	219,088	291,439	383,378	762,028
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-	-
Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*830,815*	*382,760*	*205,269*	*285,081*	*371,772*	*446,379*	*533,495*	*915,112*
Storage Change	(32)-(33)	Change in Total System Storage	7,994	(14,026)	(24,940)	(21,666)	(14,696)	(13,608)	(4,082)	12,079

LAND SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2064	2065	2066	2067	2068
Inflow	Into Basin	Precipitation on Land System	99,291	97,459	114,173	120,660	167,215
Inflow	Between Systems	Surface Water Delivery	78,989	78,709	78,245	71,749	68,856
Inflow	Between Systems	Groundwater Extraction	48,745	47,716	46,430	41,387	38,575
Inflow	*(1)+(2)+(3)*	*Total Inflow*	*227,025*	*223,885*	*238,849*	*233,797*	*274,646*
Outflow	Out of Basin	Evapotranspiration	156,935	151,305	156,057	151,911	146,988
Outflow	Between Systems	Runoff	49,352	52,178	62,460	63,110	109,739
Outflow	Between Systems	Return Flow	5,485	5,366	5,217	4,644	4,323
Outflow	Between Systems	Recharge of Applied Water	13,755	13,678	13,564	12,406	11,872
Outflow	Between Systems	Recharge of Precipitation	1,498	1,358	1,551	1,727	1,724
Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-
Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*227,025*	*223,885*	*238,849*	*233,797*	*274,646*
Storage Change	(4)-(11)	Change in Land System Storage	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2064	2065	2066	2067	2068
Inflow	Into Basin	Stream Inflow	127,762	240,456	143,169	103,605	629,359
Inflow	Into Basin	Precipitation on Reservoirs	364	357	418	442	613
Inflow	Between Systems	Runoff	49,352	52,178	62,460	63,110	109,739
Inflow	Between Systems	Return Flow	5,485	5,366	5,217	4,644	4,323
Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-
Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-
Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*182,963*	*298,356*	*211,263*	*171,801*	*744,034*
Outflow	Out of Basin	Stream Outflow	92,199	202,668	120,562	89,515	640,247
Outflow	Out of Basin	Conveyance Evaporation	47	46	46	44	42
Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27
Outflow	Between Systems	Surface Water Delivery	78,989	78,709	78,245	71,749	68,856
Outflow	Between Systems	Stream Loss to Groundwater	9,941	15,181	10,657	8,818	33,265
Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596
Outflow	Out of Basin	Reservoir Evaporation	762	737	736	684	648
Outflow	Out of Basin	Stream Evaporation	402	391	393	368	352
Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*182,963*	*298,356*	*211,263*	*171,801*	*744,034*
Storage Change	(17)-(25)	Change in Surface Water Storage	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

Flow Type	Origin/ Destination	Component	2064	2065	2066	2067	2068
Inflow	Between Systems	Recharge of Applied Water	13,755	13,678	13,564	12,406	11,872
Inflow	Between Systems	Recharge of Precipitation	1,498	1,358	1,551	1,727	1,724
Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-
Inflow	Between Systems	Groundwater Gain from Stream	9,941	15,181	10,657	8,818	33,265
Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596
Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1
Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*25,818*	*30,842*	*26,398*	*23,575*	*47,486*
Outflow	Between Systems	Groundwater Extraction	48,745	47,716	46,430	41,387	38,575
Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-
Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-
Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*48,745*	*47,716*	*46,430*	*41,387*	*38,575*
Storage Change	(28)-(30)	Change in Groundwater Storage	(22,927)	(16,874)	(20,033)	(17,812)	8,910

TOTAL BASIN WATER BUDGET

Flow Type	Origin/ Destination	Component	2064	2065	2066	2067	2068
Inflow	Into Basin	Precipitation on Land System	99,291	97,459	114,173	120,660	167,215
Inflow	Into Basin	Precipitation on Reservoirs	364	357	418	442	613
Inflow	Into Basin	Stream Inflow	127,762	240,456	143,169	103,605	629,359
Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1
Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*227,418*	*338,273*	*257,761*	*224,709*	*797,188*
Outflow	Out of Basin	Evapotranspiration	156,935	151,305	156,057	151,911	146,988
Outflow	Out of Basin	Stream Evaporation	402	391	393	368	352
Outflow	Out of Basin	Reservoir Evaporation	762	737	736	684	648
Outflow	Out of Basin	Conveyance Evaporation	47	46	46	44	42
Outflow	Out of Basin	Stream Outflow	92,199	202,668	120,562	89,515	640,247
Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-
Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*250,345*	*355,147*	*277,794*	*242,521*	*788,277*
Storage Change	(32)-(33)	Change in Total System Storage	(22,927)	(16,874)	(20,033)	(17,812)	8,910

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Average (2019-2068)
(1)	Inflow	Into Basin	Precipitation on Land System	152,224
(2)	Inflow	Between Systems	Surface Water Delivery	81,239
(3)	Inflow	Between Systems	Groundwater Extraction	47,500
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*280,964*
(5)	Outflow	Out of Basin	Evapotranspiration	165,795
(6)	Outflow	Between Systems	Runoff	94,032
(7)	Outflow	Between Systems	Return Flow	5,335
(8)	Outflow	Between Systems	Recharge of Applied Water	14,056
(9)	Outflow	Between Systems	Recharge of Precipitation	1,746
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*280,964*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Average (2019-2068)
(13)	Inflow	Into Basin	Stream Inflow	450,360
(14)	Inflow	Into Basin	Precipitation on Reservoirs	558
(6)	Inflow	Between Systems	Runoff	94,032
(7)	Inflow	Between Systems	Return Flow	5,335
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*550,284*
(18)	Outflow	Out of Basin	Stream Outflow	436,663
(19)	Outflow	Out of Basin	Conveyance Evaporation	50
(20)	Outflow	Between Systems	Conveyance Seepage	27
(2)	Outflow	Between Systems	Surface Water Delivery	81,239
(21)	Outflow	Between Systems	Stream Loss to Groundwater	30,515
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	780
(24)	Outflow	Out of Basin	Stream Evaporation	414
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*550,284*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Average (2019-2068)
(8)	Inflow	Between Systems	Recharge of Applied Water	14,056
(9)	Inflow	Between Systems	Recharge of Precipitation	1,746
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	30,515
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596
(20)	Inflow	Between Systems	Conveyance Seepage	27
(27)	Inflow	Into Basin	Subsurface Inflow	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*46,942*
(3)	Outflow	Between Systems	Groundwater Extraction	47,500
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*47,500*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(558)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Average (2019-2068)
(1)	Inflow	Into Basin	Precipitation on Land System	152,224
(14)	Inflow	Into Basin	Precipitation on Reservoirs	558
(13)	Inflow	Into Basin	Stream Inflow	450,360
(27)	Inflow	Into Basin	Subsurface Inflow	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*603,143*
(5)	Outflow	Out of Basin	Evapotranspiration	165,795
(24)	Outflow	Out of Basin	Stream Evaporation	414
(23)	Outflow	Out of Basin	Reservoir Evaporation	780
(19)	Outflow	Out of Basin	Conveyance Evaporation	50
(18)	Outflow	Out of Basin	Stream Outflow	436,663
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*603,701*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(558)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2019	2020	2021	2022	2023	2024	2025
(1)	Inflow	Into Basin	Precipitation on Land System	129,500	222,333	117,416	190,878	86,735	178,276	131,750
(2)	Inflow	Between Systems	Surface Water Delivery	85,796	76,976	85,067	81,416	89,423	82,756	83,061
(3)	Inflow	Between Systems	Groundwater Extraction	51,348	42,198	51,204	48,394	55,962	48,513	49,306
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*266,644*	*341,507*	*253,687*	*320,687*	*232,119*	*309,545*	*264,117*
(5)	Outflow	Out of Basin	Evapotranspiration	168,320	164,569	166,471	165,779	165,207	163,577	165,440
(6)	Outflow	Between Systems	Runoff	76,070	157,023	65,127	133,640	43,735	124,588	77,103
(7)	Outflow	Between Systems	Return Flow	5,773	4,726	5,758	5,438	6,302	5,449	5,541
(8)	Outflow	Between Systems	Recharge of Applied Water	14,879	13,230	14,763	14,113	15,585	14,321	14,394
(9)	Outflow	Between Systems	Recharge of Precipitation	1,603	1,959	1,569	1,717	1,290	1,611	1,639
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*266,644*	*341,507*	*253,687*	*320,687*	*232,119*	*309,545*	*264,117*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2019	2020	2021	2022	2023	2024	2025
(13)	Inflow	Into Basin	Stream Inflow	231,125	772,605	313,116	811,978	194,478	508,919	263,663
(14)	Inflow	Into Basin	Precipitation on Reservoirs	475	815	430	699	318	653	483
(6)	Inflow	Between Systems	Runoff	76,070	157,023	65,127	133,640	43,735	124,588	77,103
(7)	Inflow	Between Systems	Return Flow	5,773	4,726	5,758	5,438	6,302	5,449	5,541
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*313,442*	*935,169*	*384,431*	*951,756*	*244,833*	*639,609*	*346,789*
(18)	Outflow	Out of Basin	Stream Outflow	210,973	816,434	278,896	818,346	140,411	527,323	245,560
(19)	Outflow	Out of Basin	Conveyance Evaporation	51	50	50	49	52	51	48
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	85,796	76,976	85,067	81,416	89,423	82,756	83,061
(21)	Outflow	Between Systems	Stream Loss to Groundwater	14,747	39,926	18,560	50,102	13,043	27,665	16,260
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	818	759	807	799	839	775	812
(24)	Outflow	Out of Basin	Stream Evaporation	432	400	428	419	442	415	424
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*313,442*	*935,169*	*384,431*	*951,756*	*244,833*	*639,609*	*346,789*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2019	2020	2021	2022	2023	2024	2025
(8)	Inflow	Between Systems	Recharge of Applied Water	14,879	13,230	14,763	14,113	15,585	14,321	14,394
(9)	Inflow	Between Systems	Recharge of Precipitation	1,603	1,959	1,569	1,717	1,290	1,611	1,639
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	14,747	39,926	18,560	50,102	13,043	27,665	16,260
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*31,854*	*55,740*	*35,516*	*66,557*	*30,543*	*44,221*	*32,918*
(3)	Outflow	Between Systems	Groundwater Extraction	51,348	42,198	51,204	48,394	55,962	48,513	49,306
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*51,348*	*42,198*	*51,204*	*48,394*	*55,962*	*48,513*	*49,306*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(19,494)	13,542	(15,688)	18,163	(25,419)	(4,292)	(16,388)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2019	2020	2021	2022	2023	2024	2025
(1)	Inflow	Into Basin	Precipitation on Land System	129,500	222,333	117,416	190,878	86,735	178,276	131,750
(14)	Inflow	Into Basin	Precipitation on Reservoirs	475	815	430	699	318	653	483
(13)	Inflow	Into Basin	Stream Inflow	231,125	772,605	313,116	811,978	194,478	508,919	263,663
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*361,100*	*995,753*	*430,963*	*1,003,556*	*281,532*	*687,849*	*395,896*
(5)	Outflow	Out of Basin	Evapotranspiration	168,320	164,569	166,471	165,779	165,207	163,577	165,440
(24)	Outflow	Out of Basin	Stream Evaporation	432	400	428	419	442	415	424
(23)	Outflow	Out of Basin	Reservoir Evaporation	818	759	807	799	839	775	812
(19)	Outflow	Out of Basin	Conveyance Evaporation	51	50	50	49	52	51	48
(18)	Outflow	Out of Basin	Stream Outflow	210,973	816,434	278,896	818,346	140,411	527,323	245,560
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*380,595*	*982,212*	*446,651*	*985,392*	*306,950*	*692,141*	*412,284*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(19,494)	13,542	(15,688)	18,163	(25,419)	(4,292)	(16,388)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2026	2027	2028	2029	2030	2031	2032
(1)	Inflow	Into Basin	Precipitation on Land System	169,078	181,223	223,561	122,811	117,302	187,191	133,627
(2)	Inflow	Between Systems	Surface Water Delivery	85,585	85,130	76,120	85,600	86,677	82,850	83,904
(3)	Inflow	Between Systems	Groundwater Extraction	50,419	50,097	41,580	50,791	52,010	47,910	50,101
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*305,082*	*316,450*	*341,260*	*259,201*	*255,989*	*317,951*	*267,632*
(5)	Outflow	Out of Basin	Evapotranspiration	169,456	167,624	169,093	168,714	170,424	167,439	166,339
(6)	Outflow	Between Systems	Runoff	113,477	126,831	152,295	68,314	63,055	129,075	79,488
(7)	Outflow	Between Systems	Return Flow	5,665	5,628	4,656	5,708	5,848	5,379	5,632
(8)	Outflow	Between Systems	Recharge of Applied Water	14,816	14,735	13,079	14,830	15,035	14,315	14,549
(9)	Outflow	Between Systems	Recharge of Precipitation	1,668	1,632	2,138	1,635	1,627	1,743	1,624
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*305,082*	*316,450*	*341,260*	*259,201*	*255,989*	*317,951*	*267,632*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2026	2027	2028	2029	2030	2031	2032
(13)	Inflow	Into Basin	Stream Inflow	657,649	631,029	1,061,564	701,971	332,242	627,237	588,265
(14)	Inflow	Into Basin	Precipitation on Reservoirs	620	664	819	450	430	686	490
(6)	Inflow	Between Systems	Runoff	113,477	126,831	152,295	68,314	63,055	129,075	79,488
(7)	Inflow	Between Systems	Return Flow	5,665	5,628	4,656	5,708	5,848	5,379	5,632
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*777,411*	*764,153*	*1,219,334*	*776,443*	*401,574*	*762,376*	*673,874*
(18)	Outflow	Out of Basin	Stream Outflow	655,315	643,761	971,790	652,274	293,494	644,456	556,723
(19)	Outflow	Out of Basin	Conveyance Evaporation	52	51	48	51	52	51	51
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	85,585	85,130	76,120	85,600	86,677	82,850	83,904
(21)	Outflow	Between Systems	Stream Loss to Groundwater	34,581	33,343	169,590	36,642	19,449	33,167	31,354
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	822	814	759	820	840	806	796
(24)	Outflow	Out of Basin	Stream Evaporation	433	429	404	432	439	423	421
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*777,411*	*764,153*	*1,219,334*	*776,443*	*401,574*	*762,376*	*673,874*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2026	2027	2028	2029	2030	2031	2032
(8)	Inflow	Between Systems	Recharge of Applied Water	14,816	14,735	13,079	14,830	15,035	14,315	14,549
(9)	Inflow	Between Systems	Recharge of Precipitation	1,668	1,632	2,138	1,635	1,627	1,743	1,624
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	34,581	33,343	169,590	36,642	19,449	33,167	31,354
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*51,689*	*50,335*	*185,432*	*53,731*	*36,736*	*49,850*	*48,152*
(3)	Outflow	Between Systems	Groundwater Extraction	50,419	50,097	41,580	50,791	52,010	47,910	50,101
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*50,419*	*50,097*	*41,580*	*50,791*	*52,010*	*47,910*	*50,101*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	1,270	238	143,851	2,941	(15,273)	1,939	(1,949)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2026	2027	2028	2029	2030	2031	2032
(1)	Inflow	Into Basin	Precipitation on Land System	169,078	181,223	223,561	122,811	117,302	187,191	133,627
(14)	Inflow	Into Basin	Precipitation on Reservoirs	620	664	819	450	430	686	490
(13)	Inflow	Into Basin	Stream Inflow	657,649	631,029	1,061,564	701,971	332,242	627,237	588,265
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*827,348*	*812,918*	*1,285,945*	*825,232*	*449,974*	*815,115*	*722,382*
(5)	Outflow	Out of Basin	Evapotranspiration	169,456	167,624	169,093	168,714	170,424	167,439	166,339
(24)	Outflow	Out of Basin	Stream Evaporation	433	429	404	432	439	423	421
(23)	Outflow	Out of Basin	Reservoir Evaporation	822	814	759	820	840	806	796
(19)	Outflow	Out of Basin	Conveyance Evaporation	52	51	48	51	52	51	51
(18)	Outflow	Out of Basin	Stream Outflow	655,315	643,761	971,790	652,274	293,494	644,456	556,723
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*826,078*	*812,679*	*1,142,093*	*822,292*	*465,248*	*813,176*	*724,331*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	1,270	238	143,851	2,941	(15,273)	1,939	(1,949)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2033	2034	2035	2036	2037	2038	2039
(1)	Inflow	Into Basin	Precipitation on Land System	112,985	87,563	166,097	108,662	182,240	116,838	212,359
(2)	Inflow	Between Systems	Surface Water Delivery	82,916	85,651	80,321	84,772	81,197	84,997	79,509
(3)	Inflow	Between Systems	Groundwater Extraction	50,186	53,811	45,810	51,508	45,858	50,845	43,902
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*246,087*	*227,025*	*292,228*	*244,942*	*309,296*	*252,680*	*335,770*
(5)	Outflow	Out of Basin	Evapotranspiration	165,305	162,848	168,854	164,920	171,741	168,601	171,612
(6)	Outflow	Between Systems	Runoff	59,121	41,805	102,466	57,979	116,443	61,977	143,501
(7)	Outflow	Between Systems	Return Flow	5,644	6,060	5,140	5,794	5,143	5,716	4,919
(8)	Outflow	Between Systems	Recharge of Applied Water	14,401	14,939	13,860	14,728	13,995	14,740	13,672
(9)	Outflow	Between Systems	Recharge of Precipitation	1,616	1,373	1,909	1,520	1,974	1,646	2,066
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*246,087*	*227,025*	*292,228*	*244,942*	*309,296*	*252,680*	*335,770*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2033	2034	2035	2036	2037	2038	2039
(13)	Inflow	Into Basin	Stream Inflow	207,813	116,791	312,968	249,739	560,602	170,483	840,537
(14)	Inflow	Into Basin	Precipitation on Reservoirs	414	321	609	398	668	428	778
(6)	Inflow	Between Systems	Runoff	59,121	41,805	102,466	57,979	116,443	61,977	143,501
(7)	Inflow	Between Systems	Return Flow	5,644	6,060	5,140	5,794	5,143	5,716	4,919
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*272,991*	*164,977*	*421,182*	*313,910*	*682,856*	*238,603*	*989,735*
(18)	Outflow	Out of Basin	Stream Outflow	174,482	67,971	320,441	211,623	569,687	139,767	849,395
(19)	Outflow	Out of Basin	Conveyance Evaporation	49	49	50	50	51	51	51
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	82,916	85,651	80,321	84,772	81,197	84,997	79,509
(21)	Outflow	Between Systems	Stream Loss to Groundwater	13,663	9,431	18,553	15,613	30,068	11,927	58,942
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	831	821	779	804	807	809	798
(24)	Outflow	Out of Basin	Stream Evaporation	427	431	413	425	422	429	417
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*272,991*	*164,977*	*421,182*	*313,910*	*682,856*	*238,603*	*989,735*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2033	2034	2035	2036	2037	2038	2039
(8)	Inflow	Between Systems	Recharge of Applied Water	14,401	14,939	13,860	14,728	13,995	14,740	13,672
(9)	Inflow	Between Systems	Recharge of Precipitation	1,616	1,373	1,909	1,520	1,974	1,646	2,066
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	13,663	9,431	18,553	15,613	30,068	11,927	58,942
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*30,305*	*26,367*	*34,946*	*32,486*	*46,661*	*28,938*	*75,305*
(3)	Outflow	Between Systems	Groundwater Extraction	50,186	53,811	45,810	51,508	45,858	50,845	43,902
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*50,186*	*53,811*	*45,810*	*51,508*	*45,858*	*50,845*	*43,902*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(19,881)	(27,444)	(10,864)	(19,022)	803	(21,907)	31,402

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2033	2034	2035	2036	2037	2038	2039
(1)	Inflow	Into Basin	Precipitation on Land System	112,985	87,563	166,097	108,662	182,240	116,838	212,359
(14)	Inflow	Into Basin	Precipitation on Reservoirs	414	321	609	398	668	428	778
(13)	Inflow	Into Basin	Stream Inflow	207,813	116,791	312,968	249,739	560,602	170,483	840,537
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*321,212*	*204,676*	*479,674*	*358,800*	*743,511*	*287,749*	*#######*
(5)	Outflow	Out of Basin	Evapotranspiration	165,305	162,848	168,854	164,920	171,741	168,601	171,612
(24)	Outflow	Out of Basin	Stream Evaporation	427	431	413	425	422	429	417
(23)	Outflow	Out of Basin	Reservoir Evaporation	831	821	779	804	807	809	798
(19)	Outflow	Out of Basin	Conveyance Evaporation	49	49	50	50	51	51	51
(18)	Outflow	Out of Basin	Stream Outflow	174,482	67,971	320,441	211,623	569,687	139,767	849,395
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*341,093*	*232,120*	*490,538*	*377,822*	*742,708*	*309,656*	*#######*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(19,881)	(27,444)	(10,864)	(19,022)	803	(21,907)	31,402

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2040	2041	2042	2043	2044	2045	2046
(1)	Inflow	Into Basin	Precipitation on Land System	194,896	150,631	141,993	197,252	96,916	93,605	146,583
(2)	Inflow	Between Systems	Surface Water Delivery	78,633	71,640	78,677	77,256	81,529	88,716	75,392
(3)	Inflow	Between Systems	Groundwater Extraction	43,464	41,156	46,349	43,597	49,524	54,803	43,509
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*316,993*	*263,426*	*267,019*	*318,105*	*227,969*	*237,125*	*265,484*
(5)	Outflow	Out of Basin	Evapotranspiration	170,100	151,307	158,063	165,533	159,191	165,244	154,639
(6)	Outflow	Between Systems	Runoff	126,445	93,403	88,518	132,419	47,560	48,932	91,271
(7)	Outflow	Between Systems	Return Flow	4,870	4,617	5,206	4,889	5,570	6,169	4,883
(8)	Outflow	Between Systems	Recharge of Applied Water	13,524	12,382	13,627	13,319	14,168	15,439	13,032
(9)	Outflow	Between Systems	Recharge of Precipitation	2,054	1,717	1,604	1,945	1,481	1,340	1,659
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*316,993*	*263,426*	*267,019*	*318,105*	*227,969*	*237,125*	*265,484*
(12)	Storage Change	(4)-(11)	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2040	2041	2042	2043	2044	2045	2046
(13)	Inflow	Into Basin	Stream Inflow	727,089	878,808	337,563	890,868	170,896	171,875	421,974
(14)	Inflow	Into Basin	Precipitation on Reservoirs	714	552	520	723	355	343	537
(6)	Inflow	Between Systems	Runoff	126,445	93,403	88,518	132,419	47,560	48,932	91,271
(7)	Inflow	Between Systems	Return Flow	4,870	4,617	5,206	4,889	5,570	6,169	4,883
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*859,118*	*977,381*	*431,808*	*#######*	*224,381*	*227,319*	*518,665*
(18)	Outflow	Out of Basin	Stream Outflow	740,802	831,518	331,578	872,619	129,071	124,699	417,877
(19)	Outflow	Out of Basin	Conveyance Evaporation	49	46	48	47	47	52	47
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	78,633	71,640	78,677	77,256	81,529	88,716	75,392
(21)	Outflow	Between Systems	Stream Loss to Groundwater	37,810	72,494	19,697	77,195	11,947	11,992	23,622
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	789	691	781	754	758	802	720
(24)	Outflow	Out of Basin	Stream Evaporation	412	368	404	403	405	433	384
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*859,118*	*977,381*	*431,808*	*#######*	*224,381*	*227,319*	*518,665*
(26)	Storage Change	(17)-(25)	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2040	2041	2042	2043	2044	2045	2046
(8)	Inflow	Between Systems	Recharge of Applied Water	13,524	12,382	13,627	13,319	14,168	15,439	13,032
(9)	Inflow	Between Systems	Recharge of Precipitation	2,054	1,717	1,604	1,945	1,481	1,340	1,659
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	37,810	72,494	19,697	77,195	11,947	11,992	23,622
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*54,012*	*87,217*	*35,553*	*93,084*	*28,220*	*29,396*	*38,938*
(3)	Outflow	Between Systems	Groundwater Extraction	43,464	41,156	46,349	43,597	49,524	54,803	43,509
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*43,464*	*41,156*	*46,349*	*43,597*	*49,524*	*54,803*	*43,509*
(31)	Storage Change	(28)-(30)	Change in Groundwater Storage	10,548	46,061	(10,796)	49,487	(21,304)	(25,407)	(4,571)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2040	2041	2042	2043	2044	2045	2046
(1)	Inflow	Into Basin	Precipitation on Land System	194,896	150,631	141,993	197,252	96,916	93,605	146,583
(14)	Inflow	Into Basin	Precipitation on Reservoirs	714	552	520	723	355	343	537
(13)	Inflow	Into Basin	Stream Inflow	727,089	878,808	337,563	890,868	170,896	171,875	421,974
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*922,700*	*#######*	*480,077*	*#######*	*268,168*	*265,823*	*569,095*
(5)	Outflow	Out of Basin	Evapotranspiration	170,100	151,307	158,063	165,533	159,191	165,244	154,639
(24)	Outflow	Out of Basin	Stream Evaporation	412	368	404	403	405	433	384
(23)	Outflow	Out of Basin	Reservoir Evaporation	789	691	781	754	758	802	720
(19)	Outflow	Out of Basin	Conveyance Evaporation	49	46	48	47	47	52	47
(18)	Outflow	Out of Basin	Stream Outflow	740,802	831,518	331,578	872,619	129,071	124,699	417,877
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*912,152*	*983,931*	*490,873*	*#######*	*289,472*	*291,231*	*573,666*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	10,548	46,061	(10,796)	49,487	(21,304)	(25,407)	(4,571)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2047	2048	2049	2050	2051	2052	2053
(1)	Inflow	Into Basin	Precipitation on Land System	112,828	109,588	75,064	225,757	109,477	199,671	205,058
(2)	Inflow	Between Systems	Surface Water Delivery	75,481	81,148	86,327	75,721	83,120	71,972	76,728
(3)	Inflow	Between Systems	Groundwater Extraction	44,408	49,085	54,406	39,876	50,096	39,618	44,076
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*232,717*	*239,821*	*215,797*	*341,355*	*242,692*	*311,261*	*325,861*
(5)	Outflow	Out of Basin	Evapotranspiration	153,467	158,670	160,652	175,368	165,364	154,317	164,713
(6)	Outflow	Between Systems	Runoff	59,591	60,050	32,684	146,180	55,652	138,285	141,027
(7)	Outflow	Between Systems	Return Flow	4,988	5,520	6,128	4,458	5,633	4,437	4,946
(8)	Outflow	Between Systems	Recharge of Applied Water	13,076	14,095	15,061	12,961	14,429	12,381	13,254
(9)	Outflow	Between Systems	Recharge of Precipitation	1,597	1,486	1,271	2,387	1,615	1,842	1,921
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*232,717*	*239,821*	*215,797*	*341,355*	*242,692*	*311,261*	*325,861*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2047	2048	2049	2050	2051	2052	2053
(13)	Inflow	Into Basin	Stream Inflow	136,845	266,826	77,677	639,443	168,796	939,201	838,666
(14)	Inflow	Into Basin	Precipitation on Reservoirs	413	402	275	827	401	732	751
(6)	Inflow	Between Systems	Runoff	59,591	60,050	32,684	146,180	55,652	138,285	141,027
(7)	Inflow	Between Systems	Return Flow	4,988	5,520	6,128	4,458	5,633	4,437	4,946
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*201,836*	*332,797*	*116,764*	*790,908*	*230,482*	*1,082,654*	*985,391*
(18)	Outflow	Out of Basin	Stream Outflow	114,222	233,452	20,949	679,625	133,636	910,698	848,509
(19)	Outflow	Out of Basin	Conveyance Evaporation	46	49	50	50	51	46	48
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	75,481	81,148	86,327	75,721	83,120	71,972	76,728
(21)	Outflow	Between Systems	Stream Loss to Groundwater	10,363	16,407	7,612	33,734	11,849	98,262	58,331
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	719	720	781	752	785	682	751
(24)	Outflow	Out of Basin	Stream Evaporation	381	397	421	402	418	371	400
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*201,836*	*332,797*	*116,764*	*790,908*	*230,482*	*1,082,654*	*985,391*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2047	2048	2049	2050	2051	2052	2053
(8)	Inflow	Between Systems	Recharge of Applied Water	13,076	14,095	15,061	12,961	14,429	12,381	13,254
(9)	Inflow	Between Systems	Recharge of Precipitation	1,597	1,486	1,271	2,387	1,615	1,842	1,921
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	10,363	16,407	7,612	33,734	11,849	98,262	58,331
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*25,661*	*32,613*	*24,569*	*49,707*	*28,518*	*113,109*	*74,131*
(3)	Outflow	Between Systems	Groundwater Extraction	44,408	49,085	54,406	39,876	50,096	39,618	44,076
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*44,408*	*49,085*	*54,406*	*39,876*	*50,096*	*39,618*	*44,076*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(18,748)	(16,471)	(29,836)	9,832	(21,578)	73,491	30,055

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2047	2048	2049	2050	2051	2052	2053
(1)	Inflow	Into Basin	Precipitation on Land System	112,828	109,588	75,064	225,757	109,477	199,671	205,058
(14)	Inflow	Into Basin	Precipitation on Reservoirs	413	402	275	827	401	732	751
(13)	Inflow	Into Basin	Stream Inflow	136,845	266,826	77,677	639,443	168,796	939,201	838,666
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*250,087*	*376,817*	*153,017*	*866,029*	*278,675*	*1,139,604*	*#######*
(5)	Outflow	Out of Basin	Evapotranspiration	153,467	158,670	160,652	175,368	165,364	154,317	164,713
(24)	Outflow	Out of Basin	Stream Evaporation	381	397	421	402	418	371	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	719	720	781	752	785	682	751
(19)	Outflow	Out of Basin	Conveyance Evaporation	46	49	50	50	51	46	48
(18)	Outflow	Out of Basin	Stream Outflow	114,222	233,452	20,949	679,625	133,636	910,698	848,509
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*268,834*	*393,288*	*182,853*	*856,197*	*300,253*	*1,066,113*	*#######*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(18,748)	(16,471)	(29,836)	9,832	(21,578)	73,491	30,055

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2054	2055	2056	2057	2058	2059	2060
(1)	Inflow	Into Basin	Precipitation on Land System	181,148	240,300	165,297	145,585	86,442	130,562	161,922
(2)	Inflow	Between Systems	Surface Water Delivery	81,726	69,567	80,770	82,627	87,201	86,559	80,563
(3)	Inflow	Between Systems	Groundwater Extraction	46,992	36,069	46,825	47,959	53,321	51,640	46,430
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*309,865*	*345,936*	*292,892*	*276,171*	*226,963*	*268,760*	*288,915*
(5)	Outflow	Out of Basin	Evapotranspiration	171,815	162,194	168,075	173,482	164,756	169,002	167,314
(6)	Outflow	Between Systems	Runoff	116,731	165,574	103,752	81,087	39,646	77,352	100,633
(7)	Outflow	Between Systems	Return Flow	5,274	4,029	5,257	5,385	5,999	5,805	5,211
(8)	Outflow	Between Systems	Recharge of Applied Water	14,113	11,896	13,962	14,283	15,158	15,005	13,917
(9)	Outflow	Between Systems	Recharge of Precipitation	1,933	2,242	1,846	1,935	1,404	1,596	1,839
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*309,865*	*345,936*	*292,892*	*276,171*	*226,963*	*268,760*	*288,915*
(12)	Storage Change	(4)-(11)	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2054	2055	2056	2057	2058	2059	2060
(13)	Inflow	Into Basin	Stream Inflow	659,533	809,502	712,444	240,135	96,425	160,946	229,397
(14)	Inflow	Into Basin	Precipitation on Reservoirs	664	881	606	533	317	478	593
(6)	Inflow	Between Systems	Runoff	116,731	165,574	103,752	81,087	39,646	77,352	100,633
(7)	Inflow	Between Systems	Return Flow	5,274	4,029	5,257	5,385	5,999	5,805	5,211
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*782,201*	*979,986*	*822,059*	*327,140*	*142,387*	*244,582*	*335,835*
(18)	Outflow	Out of Basin	Stream Outflow	663,923	859,330	702,286	227,447	44,776	144,611	238,751
(19)	Outflow	Out of Basin	Conveyance Evaporation	51	46	50	51	52	52	49
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	81,726	69,567	80,770	82,627	87,201	86,559	80,563
(21)	Outflow	Between Systems	Stream Loss to Groundwater	34,668	49,384	37,129	15,166	8,484	11,484	14,667
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	789	668	786	801	820	819	769
(24)	Outflow	Out of Basin	Stream Evaporation	420	367	414	424	430	433	412
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*782,201*	*979,986*	*822,059*	*327,140*	*142,387*	*244,582*	*335,835*
(26)	Storage Change	(17)-(25)	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2054	2055	2056	2057	2058	2059	2060
(8)	Inflow	Between Systems	Recharge of Applied Water	14,113	11,896	13,962	14,283	15,158	15,005	13,917
(9)	Inflow	Between Systems	Recharge of Precipitation	1,933	2,242	1,846	1,935	1,404	1,596	1,839
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	34,668	49,384	37,129	15,166	8,484	11,484	14,667
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*51,339*	*64,147*	*53,562*	*32,009*	*25,671*	*28,710*	*31,048*
(3)	Outflow	Between Systems	Groundwater Extraction	46,992	36,069	46,825	47,959	53,321	51,640	46,430
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*46,992*	*36,069*	*46,825*	*47,959*	*53,321*	*51,640*	*46,430*
(31)	Storage Change	(28)-(30)	Change in Groundwater Storage	4,347	28,079	6,736	(15,950)	(27,650)	(22,930)	(15,382)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2054	2055	2056	2057	2058	2059	2060
(1)	Inflow	Into Basin	Precipitation on Land System	181,148	240,300	165,297	145,585	86,442	130,562	161,922
(14)	Inflow	Into Basin	Precipitation on Reservoirs	664	881	606	533	317	478	593
(13)	Inflow	Into Basin	Stream Inflow	659,533	809,502	712,444	240,135	96,425	160,946	229,397
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*841,345*	*#######*	*878,347*	*386,254*	*183,184*	*291,987*	*391,913*
(5)	Outflow	Out of Basin	Evapotranspiration	171,815	162,194	168,075	173,482	164,756	169,002	167,314
(24)	Outflow	Out of Basin	Stream Evaporation	420	367	414	424	430	433	412
(23)	Outflow	Out of Basin	Reservoir Evaporation	789	668	786	801	820	819	769
(19)	Outflow	Out of Basin	Conveyance Evaporation	51	46	50	51	52	52	49
(18)	Outflow	Out of Basin	Stream Outflow	663,923	859,330	702,286	227,447	44,776	144,611	238,751
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*836,998*	*#######*	*871,611*	*402,204*	*210,835*	*314,917*	*407,295*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	4,347	28,079	6,736	(15,950)	(27,650)	(22,930)	(15,382)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2061	2062	2063	2064	2065	2066	2067
(1)	Inflow	Into Basin	Precipitation on Land System	146,572	148,701	232,665	118,707	132,516	149,197	135,123
(2)	Inflow	Between Systems	Surface Water Delivery	85,780	77,131	76,997	84,401	82,618	83,095	77,644
(3)	Inflow	Between Systems	Groundwater Extraction	51,324	44,577	42,403	51,384	48,300	47,652	44,474
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*283,677*	*270,410*	*352,064*	*254,491*	*263,434*	*279,943*	*257,241*
(5)	Outflow	Out of Basin	Evapotranspiration	166,689	158,629	169,465	173,250	170,923	176,605	166,236
(6)	Outflow	Between Systems	Runoff	94,789	91,736	162,505	59,003	70,946	81,620	70,674
(7)	Outflow	Between Systems	Return Flow	5,770	5,003	4,750	5,780	5,425	5,348	4,990
(8)	Outflow	Between Systems	Recharge of Applied Water	14,876	13,333	13,240	14,667	14,293	14,344	13,407
(9)	Outflow	Between Systems	Recharge of Precipitation	1,554	1,709	2,105	1,791	1,847	2,027	1,933
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*283,677*	*270,410*	*352,064*	*254,491*	*263,434*	*279,943*	*257,241*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	-	-	-	-	-	-	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2061	2062	2063	2064	2065	2066	2067
(13)	Inflow	Into Basin	Stream Inflow	321,321	372,195	798,642	131,362	254,574	150,766	106,628
(14)	Inflow	Into Basin	Precipitation on Reservoirs	537	545	853	435	486	547	495
(6)	Inflow	Between Systems	Runoff	94,789	91,736	162,505	59,003	70,946	81,620	70,674
(7)	Inflow	Between Systems	Return Flow	5,770	5,003	4,750	5,780	5,425	5,348	4,990
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*422,417*	*469,479*	*966,750*	*196,580*	*331,430*	*238,280*	*182,788*
(18)	Outflow	Out of Basin	Stream Outflow	315,780	369,247	841,604	100,139	231,086	142,278	94,373
(19)	Outflow	Out of Basin	Conveyance Evaporation	51	47	49	51	51	50	48
(20)	Outflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(2)	Outflow	Between Systems	Surface Water Delivery	85,780	77,131	76,997	84,401	82,618	83,095	77,644
(21)	Outflow	Between Systems	Stream Loss to Groundwater	18,941	21,307	46,323	10,108	15,838	11,011	8,958
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596	596	596	596	596	596	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	811	730	750	823	793	797	742
(24)	Outflow	Out of Basin	Stream Evaporation	429	393	403	434	420	427	399
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*422,417*	*469,479*	*966,750*	*196,580*	*331,430*	*238,280*	*182,788*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2061	2062	2063	2064	2065	2066	2067
(8)	Inflow	Between Systems	Recharge of Applied Water	14,876	13,333	13,240	14,667	14,293	14,344	13,407
(9)	Inflow	Between Systems	Recharge of Precipitation	1,554	1,709	2,105	1,791	1,847	2,027	1,933
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	18,941	21,307	46,323	10,108	15,838	11,011	8,958
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596	596	596	596	596	596	596
(20)	Inflow	Between Systems	Conveyance Seepage	27	27	27	27	27	27	27
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*35,995*	*36,973*	*62,292*	*27,191*	*32,602*	*28,006*	*24,924*
(3)	Outflow	Between Systems	Groundwater Extraction	51,324	44,577	42,403	51,384	48,300	47,652	44,474
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*51,324*	*44,577*	*42,403*	*51,384*	*48,300*	*47,652*	*44,474*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(15,329)	(7,604)	19,889	(24,192)	(15,698)	(19,646)	(19,550)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2061	2062	2063	2064	2065	2066	2067
(1)	Inflow	Into Basin	Precipitation on Land System	146,572	148,701	232,665	118,707	132,516	149,197	135,123
(14)	Inflow	Into Basin	Precipitation on Reservoirs	537	545	853	435	486	547	495
(13)	Inflow	Into Basin	Stream Inflow	321,321	372,195	798,642	131,362	254,574	150,766	106,628
(27)	Inflow	Into Basin	Subsurface Inflow	1	1	1	1	1	1	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*468,431*	*521,442*	*#######*	*250,505*	*387,576*	*300,511*	*242,247*
(5)	Outflow	Out of Basin	Evapotranspiration	166,689	158,629	169,465	173,250	170,923	176,605	166,236
(24)	Outflow	Out of Basin	Stream Evaporation	429	393	403	434	420	427	399
(23)	Outflow	Out of Basin	Reservoir Evaporation	811	730	750	823	793	797	742
(19)	Outflow	Out of Basin	Conveyance Evaporation	51	47	49	51	51	50	48
(18)	Outflow	Out of Basin	Stream Outflow	315,780	369,247	841,604	100,139	231,086	142,278	94,373
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*483,760*	*529,046*	*#######*	*274,697*	*403,274*	*320,156*	*261,797*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(15,329)	(7,604)	19,889	(24,192)	(15,698)	(19,646)	(19,550)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2068
(1)	Inflow	Into Basin	Precipitation on Land System	198,737
(2)	Inflow	Between Systems	Surface Water Delivery	73,214
(3)	Inflow	Between Systems	Groundwater Extraction	39,935
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*311,886*
(5)	Outflow	Out of Basin	Evapotranspiration	162,359
(6)	Outflow	Between Systems	Runoff	130,426
(7)	Outflow	Between Systems	Return Flow	4,471
(8)	Outflow	Between Systems	Recharge of Applied Water	12,581
(9)	Outflow	Between Systems	Recharge of Precipitation	2,049
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*311,886*
(12)	Storage Change	(4)-(11)	Change in Land System Storage	-

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	2068
(13)	Inflow	Into Basin	Stream Inflow	652,832
(14)	Inflow	Into Basin	Precipitation on Reservoirs	728
(6)	Inflow	Between Systems	Runoff	130,426
(7)	Inflow	Between Systems	Return Flow	4,471
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*788,457*
(18)	Outflow	Out of Basin	Stream Outflow	679,139
(19)	Outflow	Out of Basin	Conveyance Evaporation	46
(20)	Outflow	Between Systems	Conveyance Seepage	27
(2)	Outflow	Between Systems	Surface Water Delivery	73,214
(21)	Outflow	Between Systems	Stream Loss to Groundwater	34,357
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	596
(23)	Outflow	Out of Basin	Reservoir Evaporation	697
(24)	Outflow	Out of Basin	Stream Evaporation	380
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*788,457*
(26)	Storage Change	(17)-(25)	Change in Surface Water Storage	-

GROUNDWATER SYSTEM WATER BUDGET

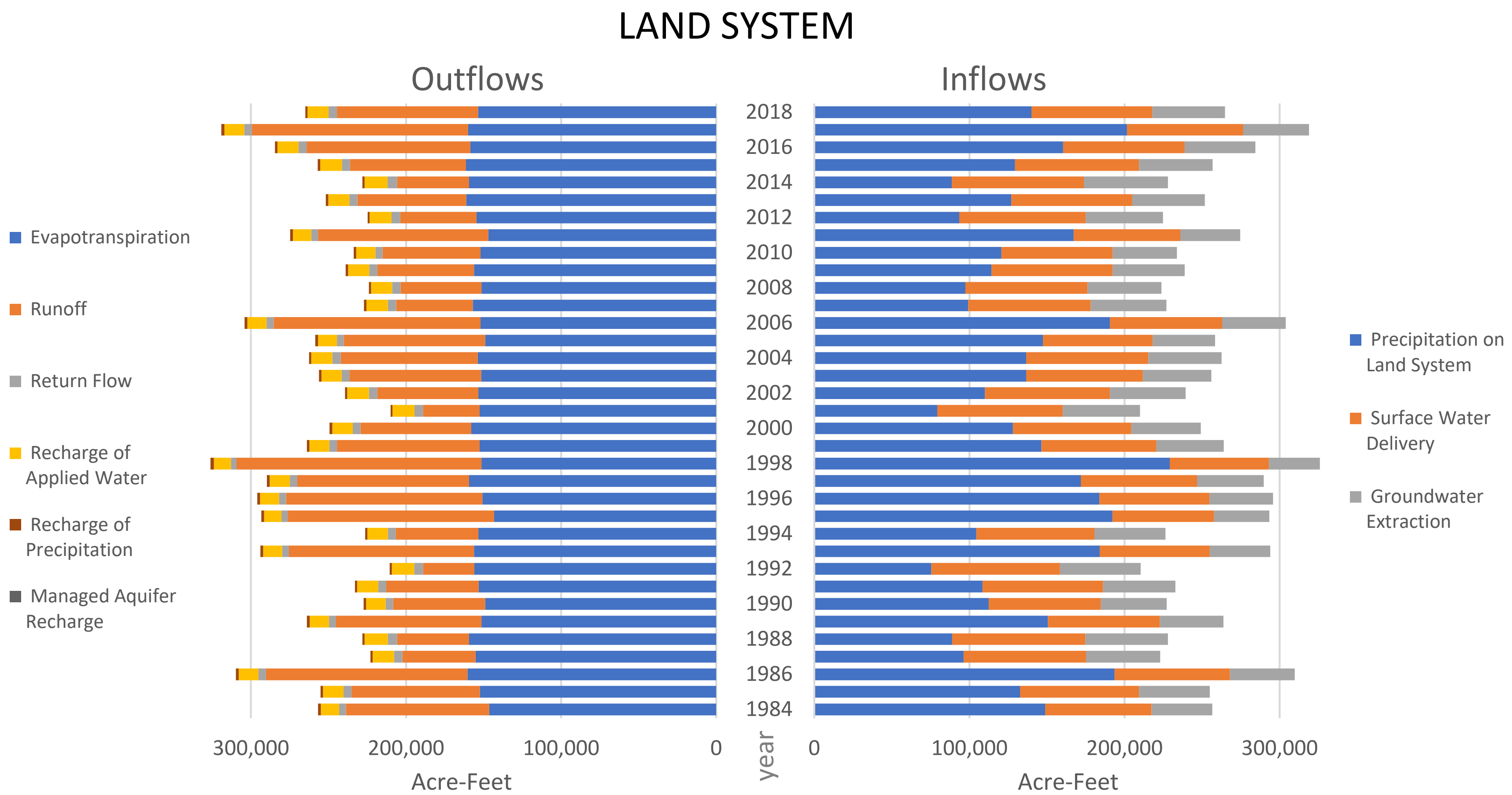
item	Flow Type	Origin/ Destination	Component	2068
(8)	Inflow	Between Systems	Recharge of Applied Water	12,581
(9)	Inflow	Between Systems	Recharge of Precipitation	2,049
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	34,357
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	596
(20)	Inflow	Between Systems	Conveyance Seepage	27
(27)	Inflow	Into Basin	Subsurface Inflow	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*49,612*
(3)	Outflow	Between Systems	Groundwater Extraction	39,935
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir s	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*39,935*
(31)	Storage Change	(28)-(30)	Change in Groundwater Storage	9,676

TOTAL BASIN WATER BUDGET

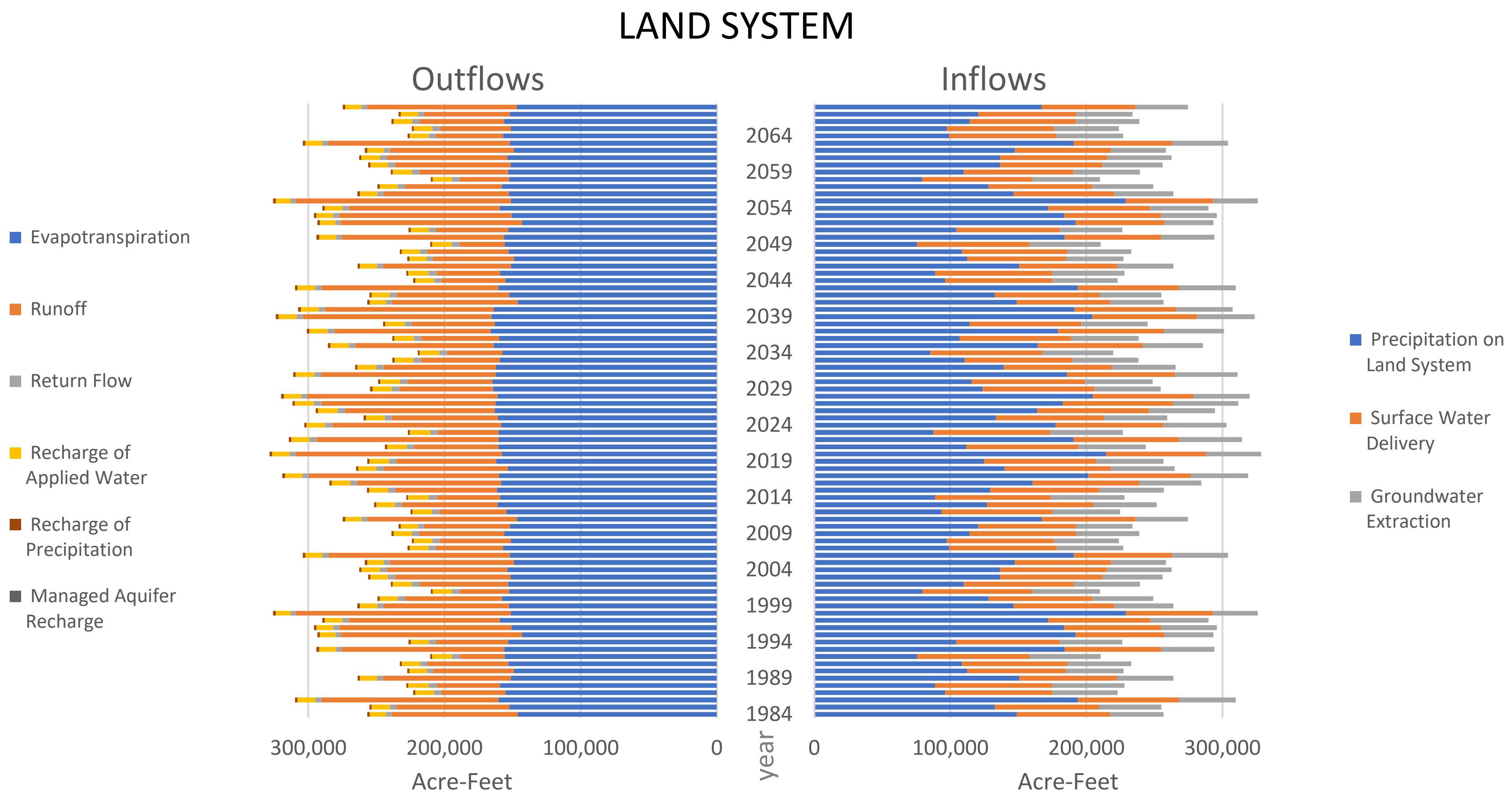
item	Flow Type	Origin/ Destination	Component	2068
(1)	Inflow	Into Basin	Precipitation on Land System	198,737
(14)	Inflow	Into Basin	Precipitation on Reservoirs	728
(13)	Inflow	Into Basin	Stream Inflow	652,832
(27)	Inflow	Into Basin	Subsurface Inflow	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*852,297*
(5)	Outflow	Out of Basin	Evapotranspiration	162,359
(24)	Outflow	Out of Basin	Stream Evaporation	380
(23)	Outflow	Out of Basin	Reservoir Evaporation	697
(19)	Outflow	Out of Basin	Conveyance Evaporation	46
(18)	Outflow	Out of Basin	Stream Outflow	679,139
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*842,621*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	9,676

Appendix 6C Water Budget Bar Charts

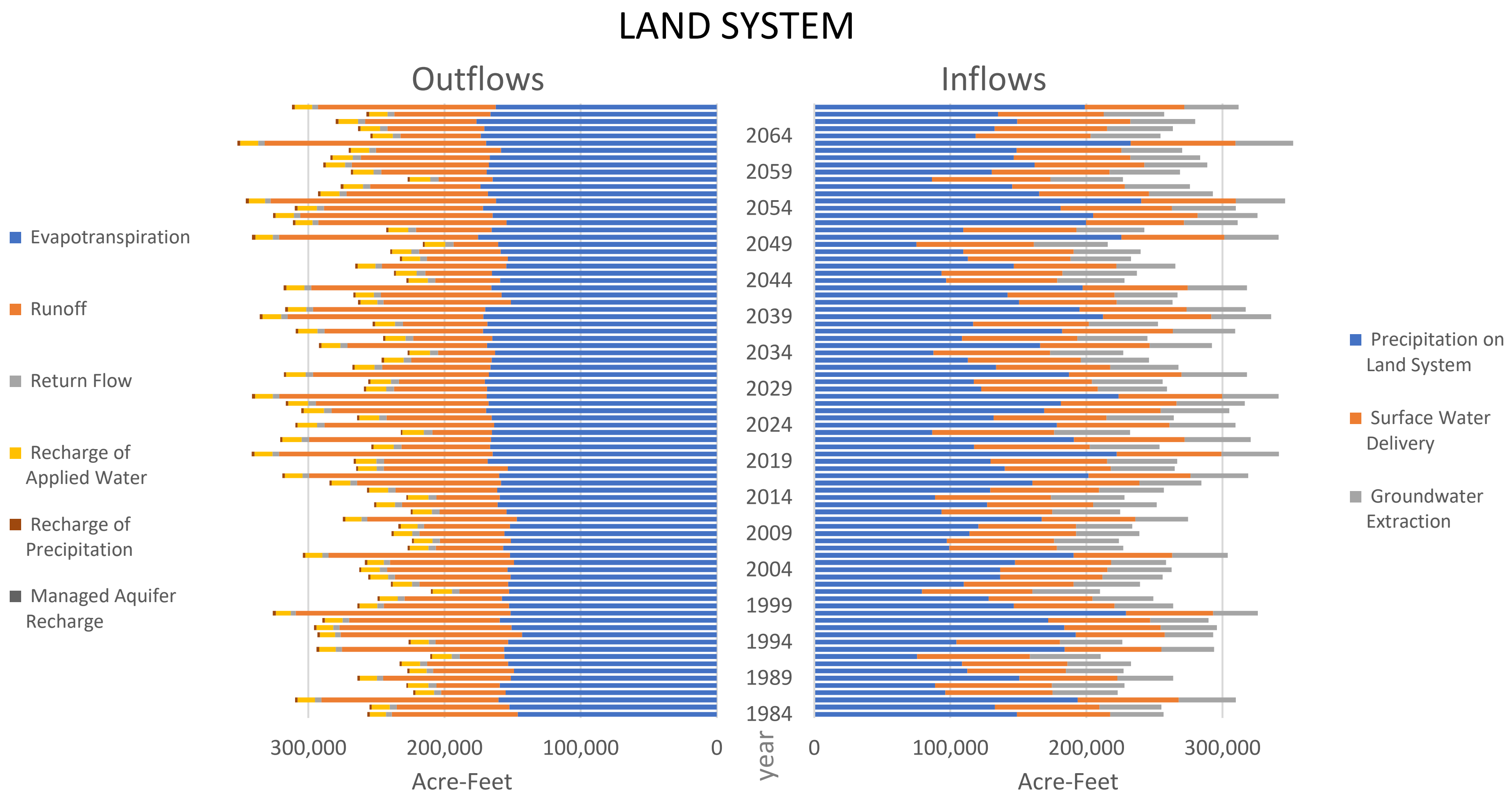
Historic Water Budget



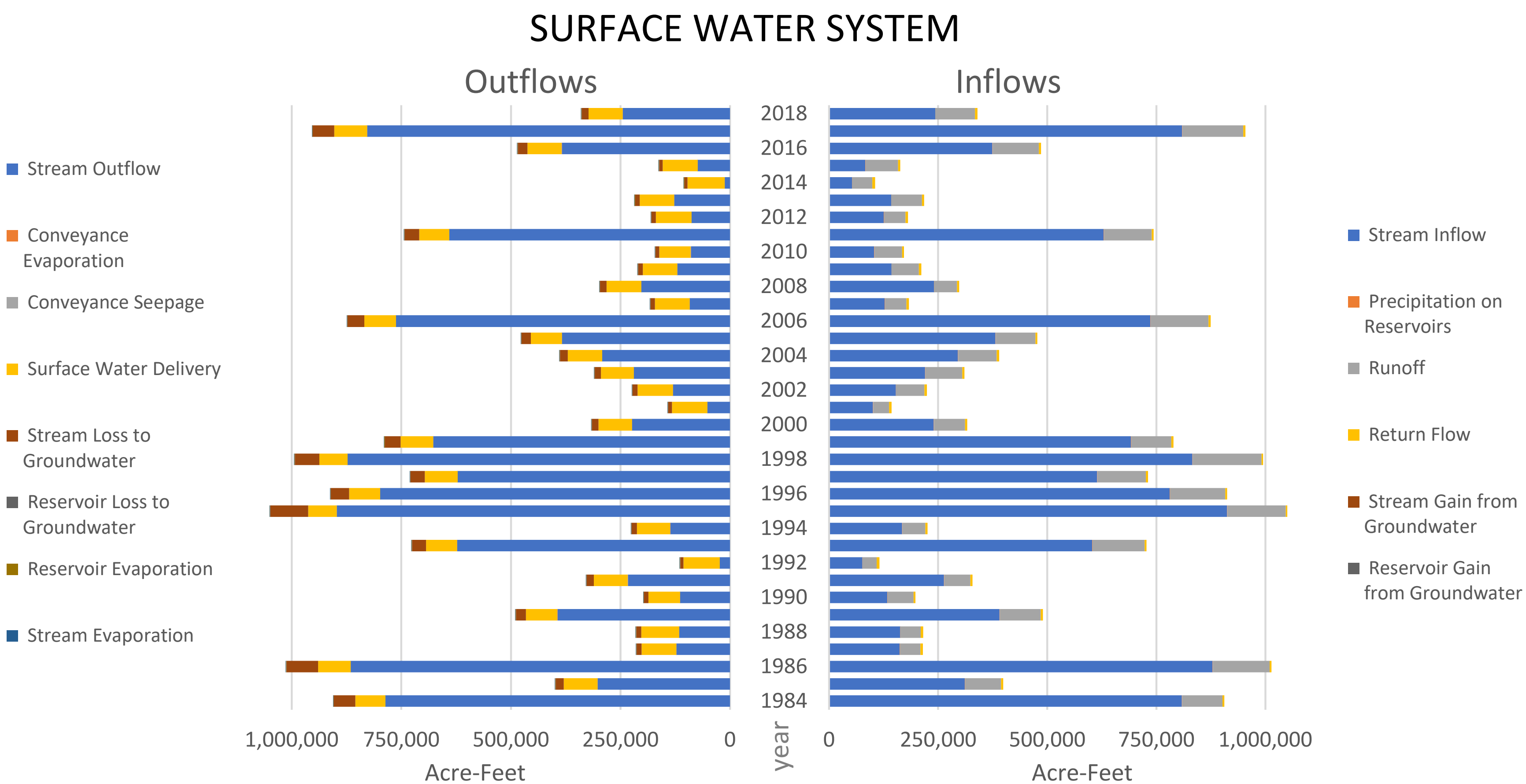
Future Water Budget



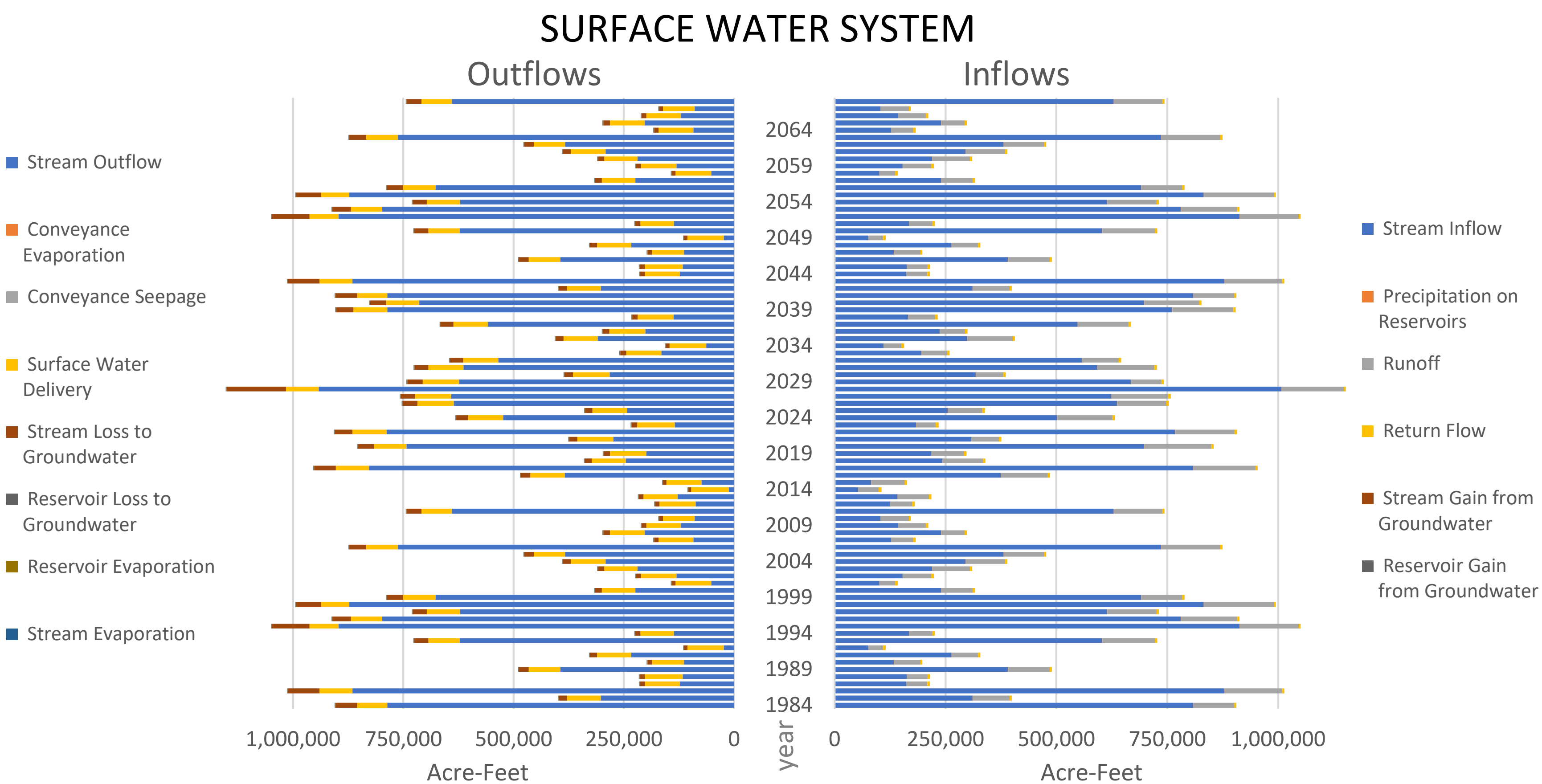
Future Water Budget With Climate Change



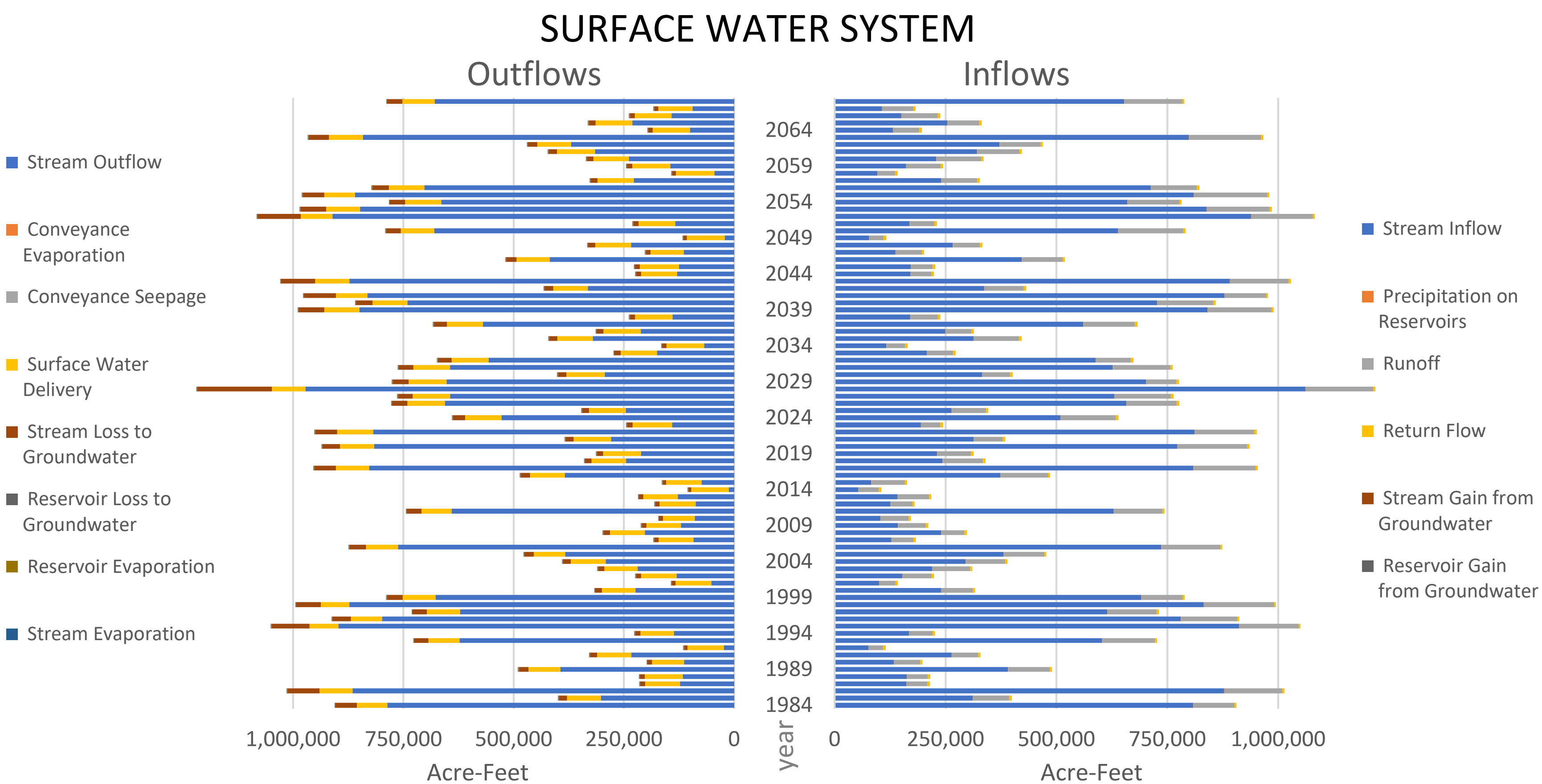
Historic Water Budget



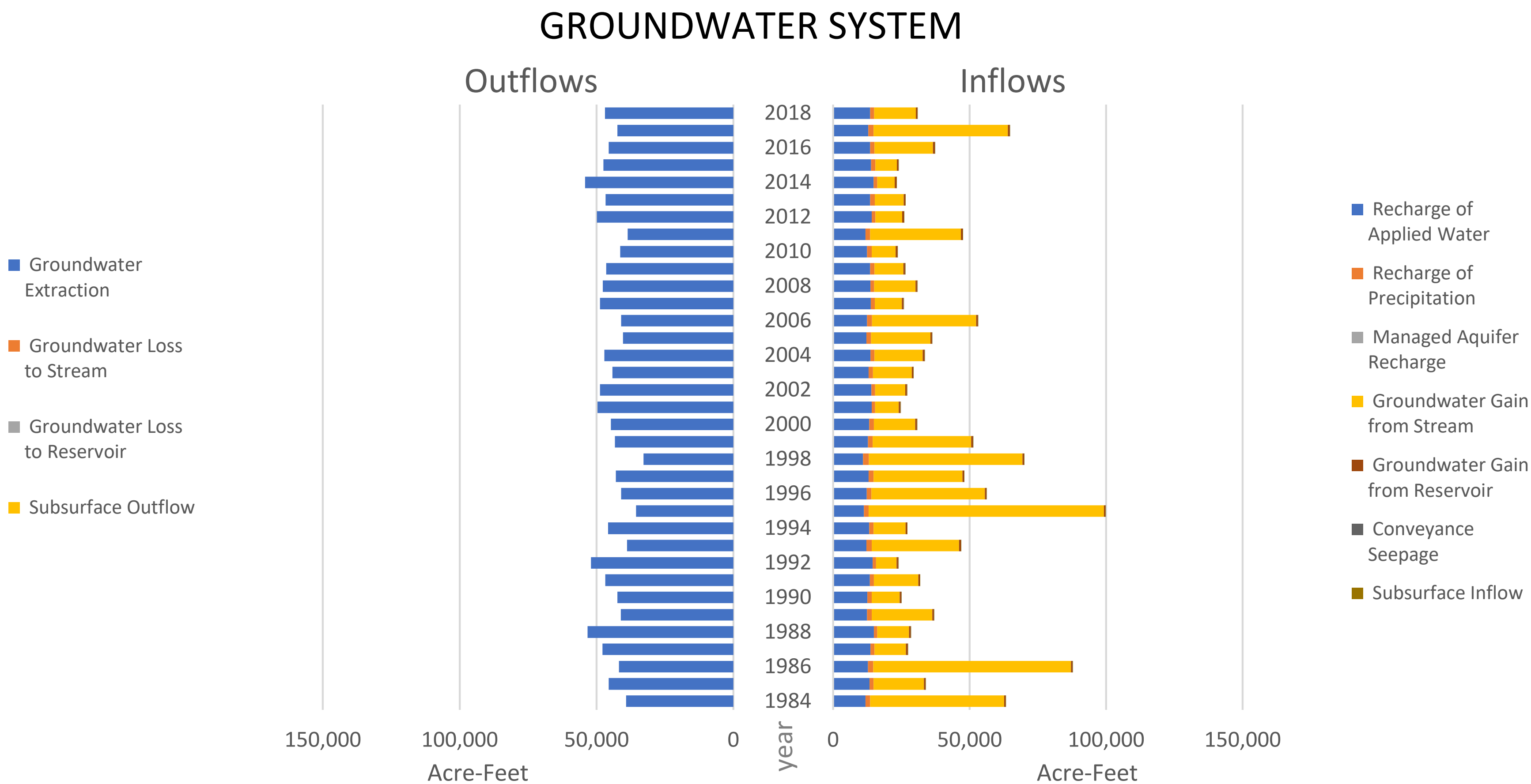
Future Water Budget



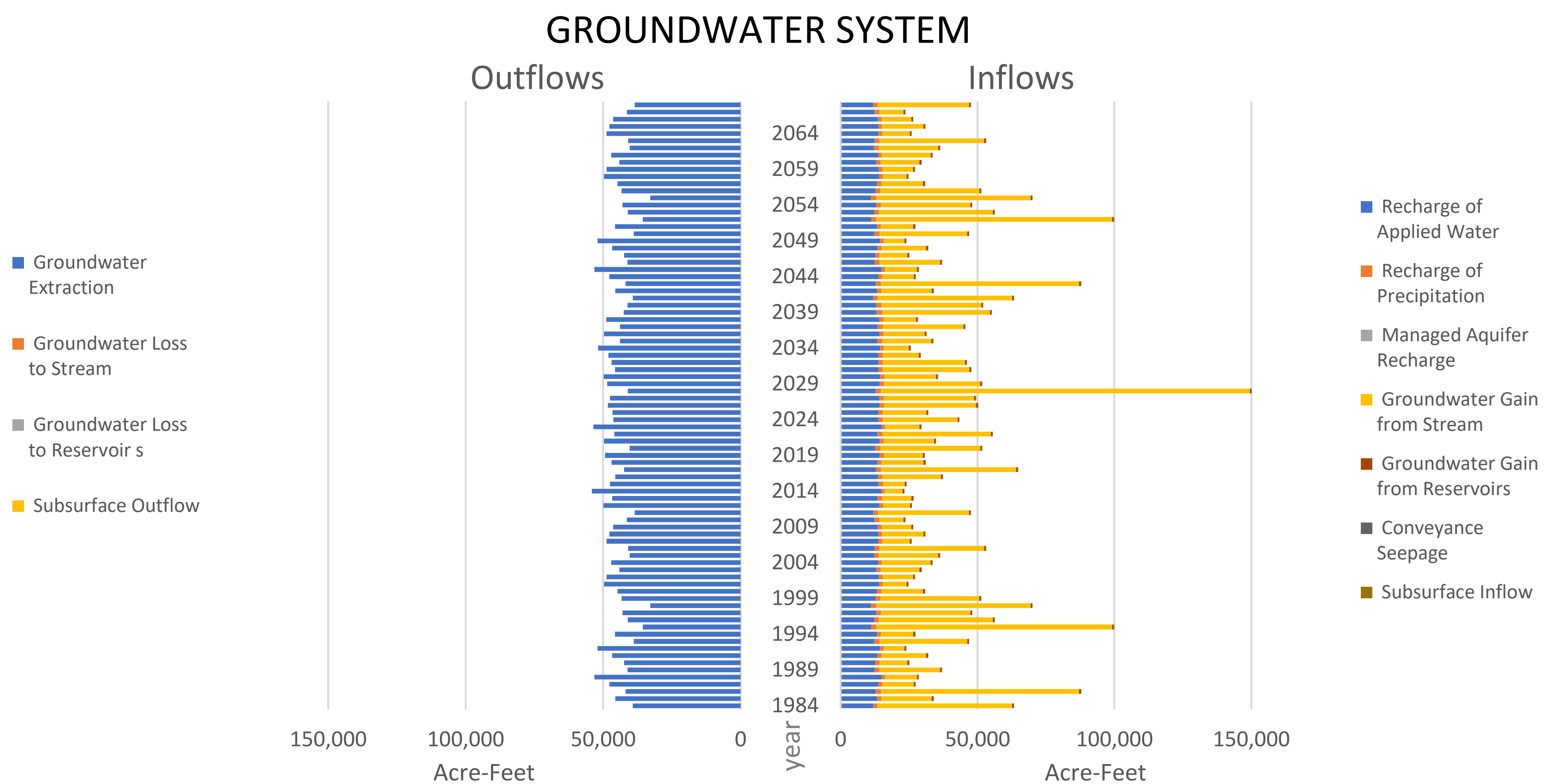
Future Water Budget With Climate Change



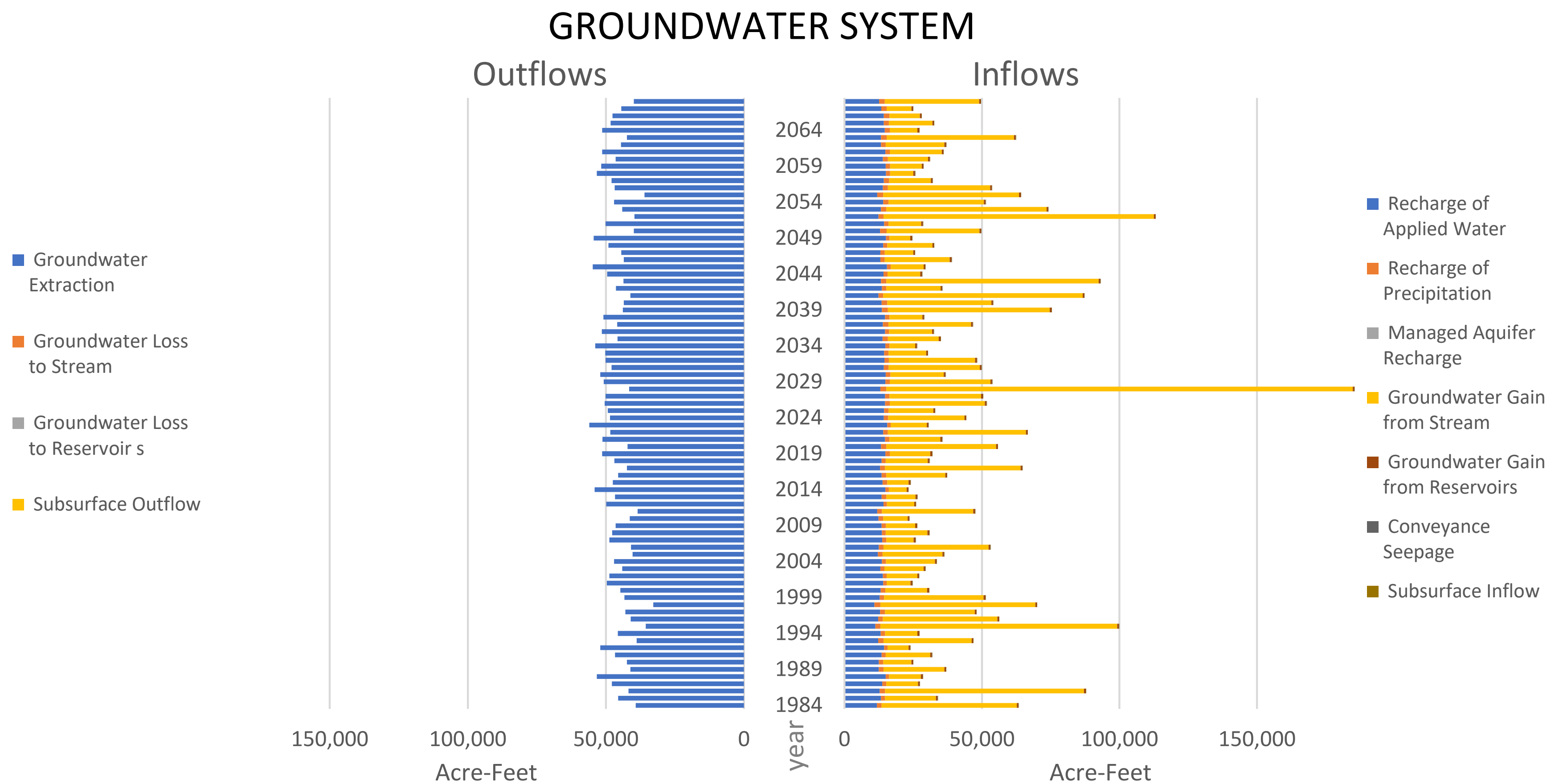
Historic Water Budget



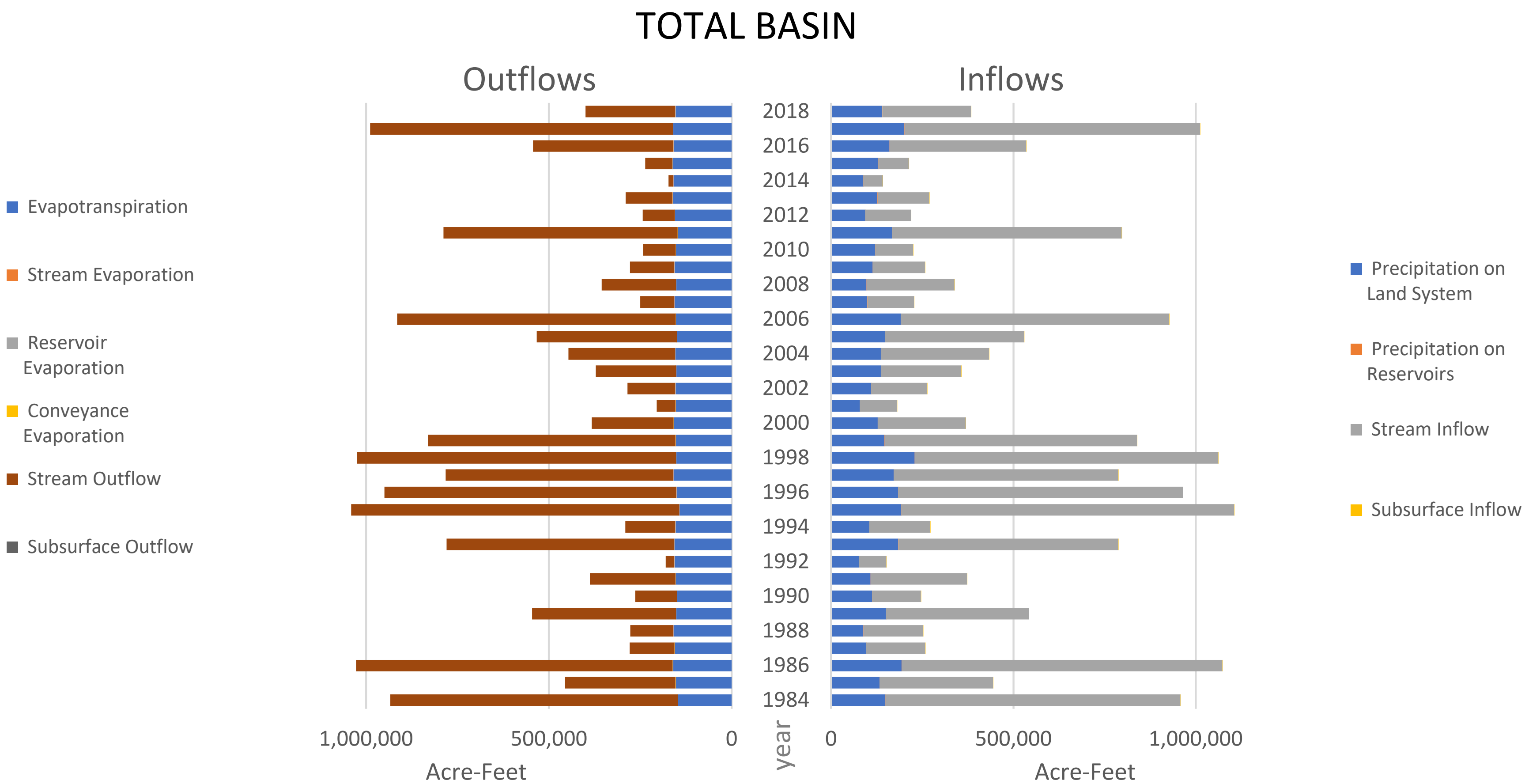
Future Water Budget



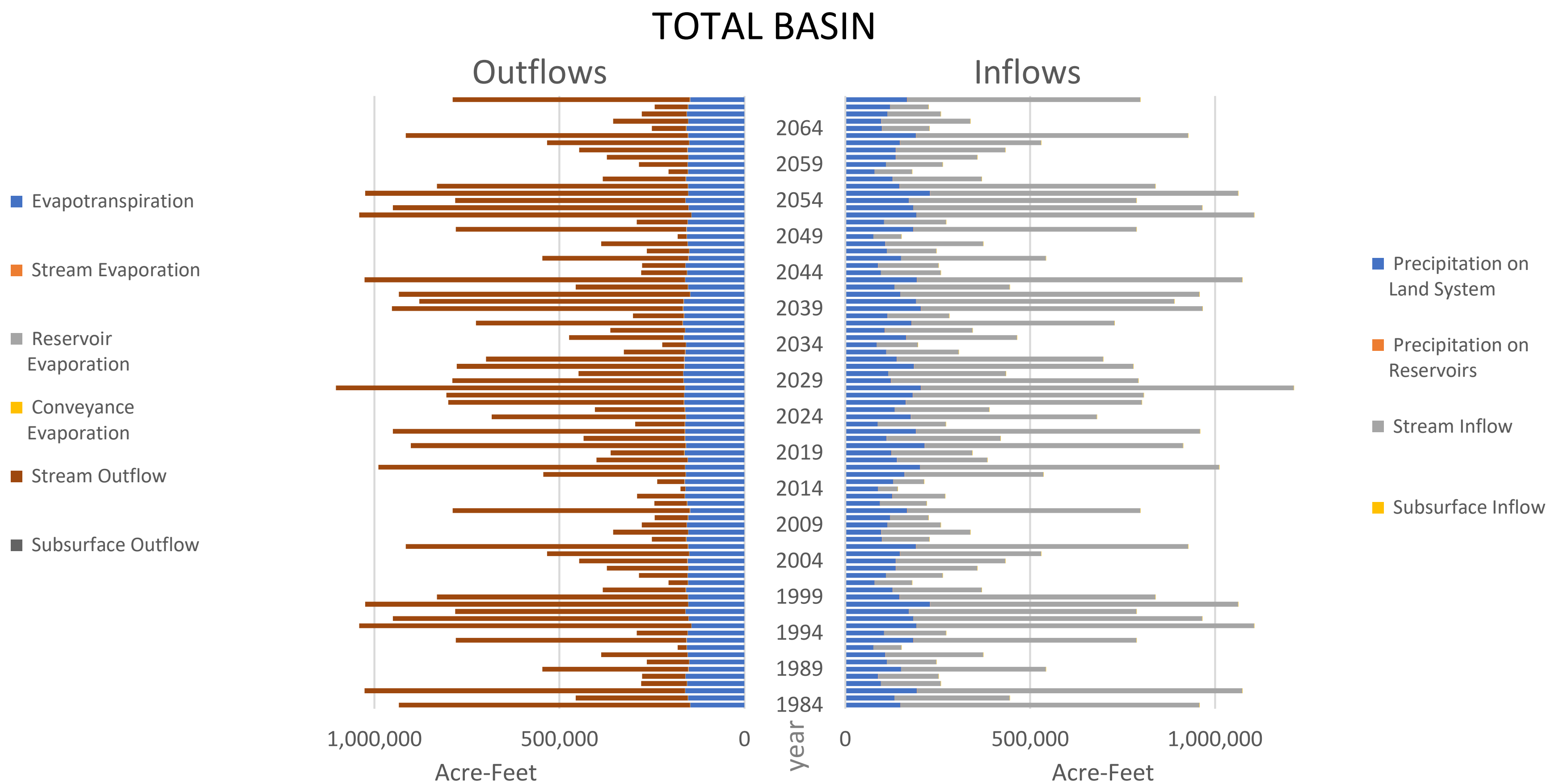
Future Water Budget With Climate Change



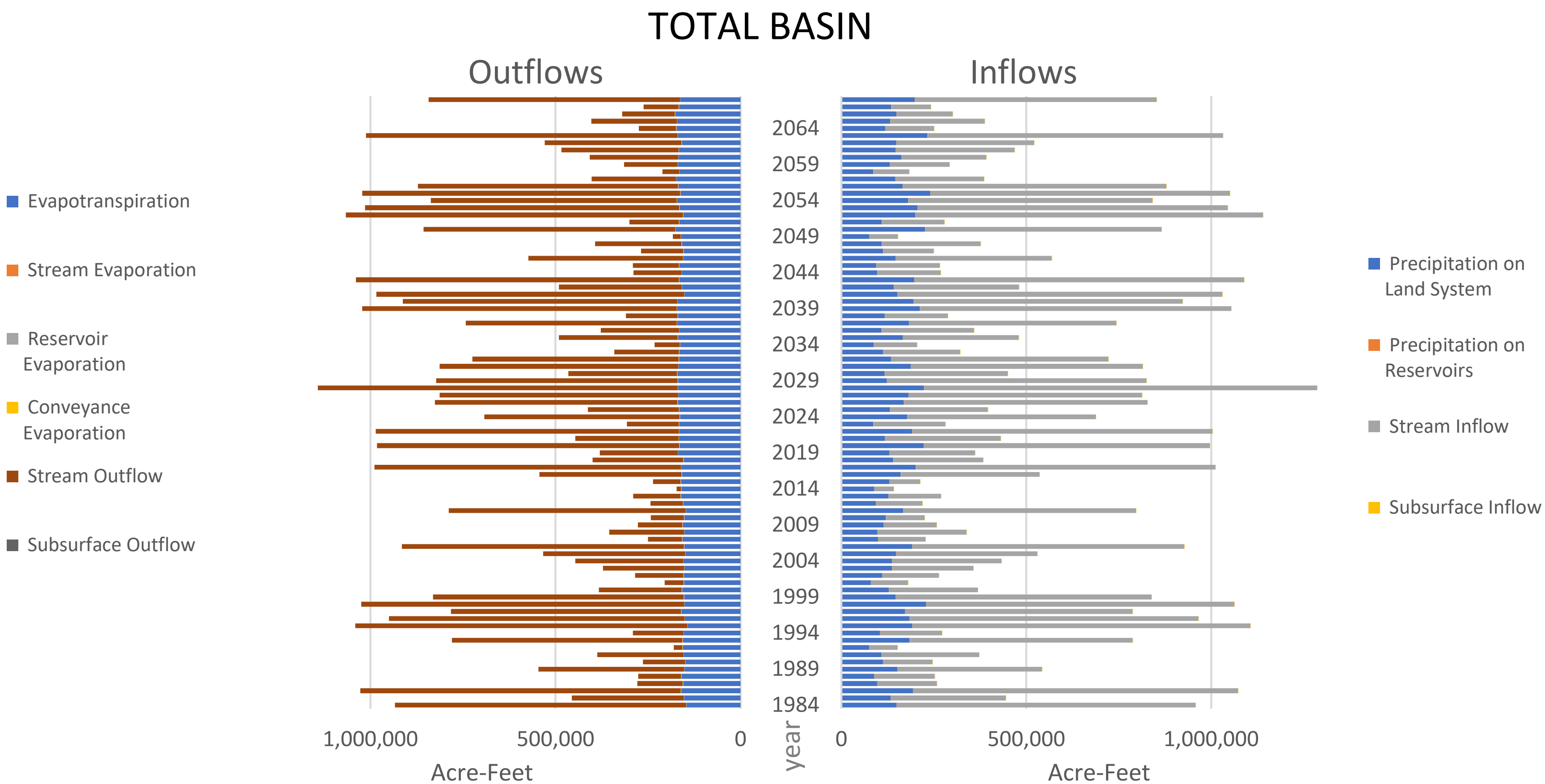
Historic Water Budget



Future Water Budget



Future Water Budget With Climate Change



Appendix 7A Pumping Cost Calculations

Example of Typical Well Pumps And Capabilities

Horsepower	Gallons per minute	Pumping head or lift
50 HP	500 GPM	304’
75 HP	500 GPM	456’
		(152’ drop)
100 HP	1000 GPM	320’
150 HP	1000 GPM	480’
		(160’ drop)
144 HP	1500 GPM	328’
216 HP	1500 GPM	492’
		(164’ drop)

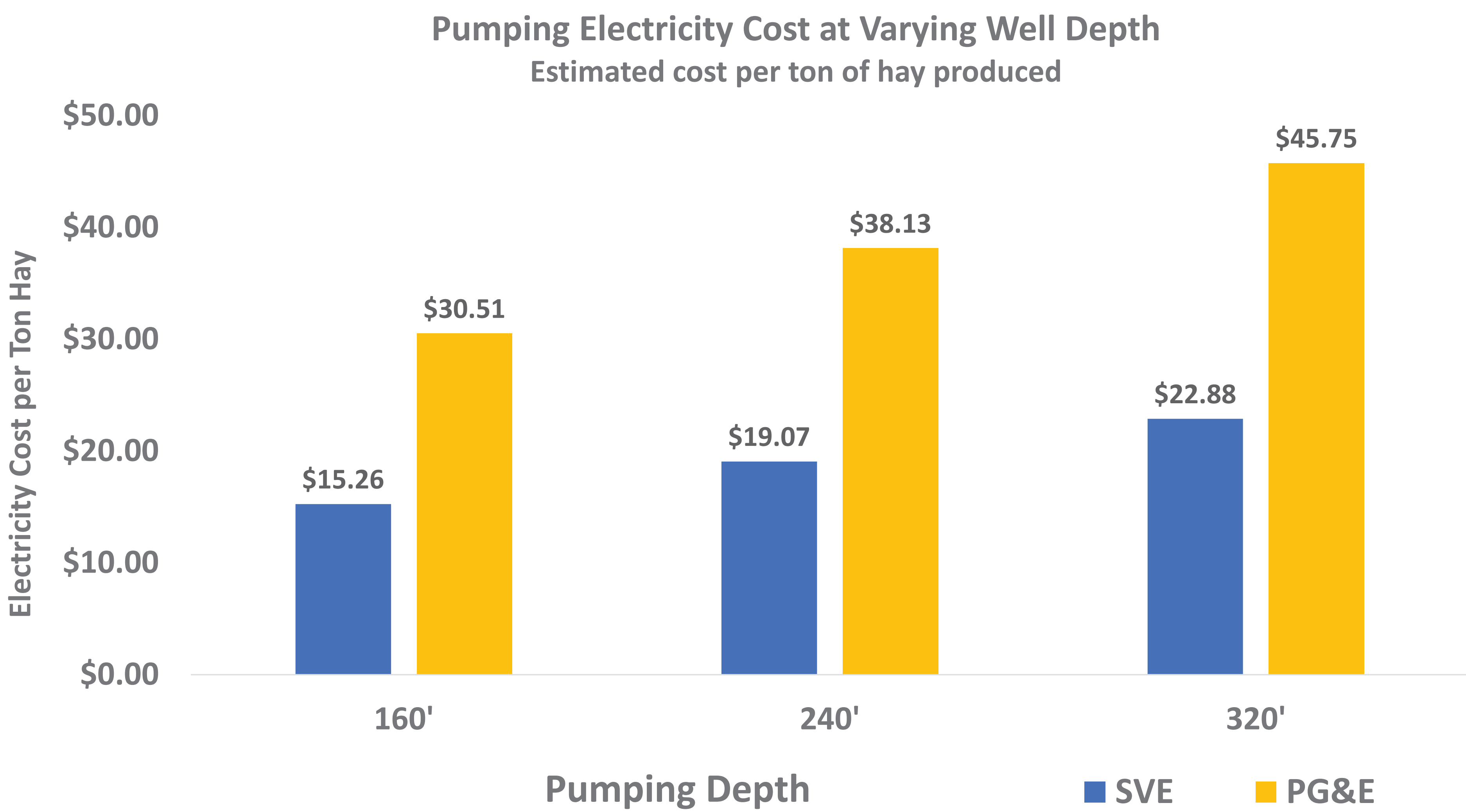
- For every 50 ft of drop in pumping level 16.66% increase in horsepower or cost. 150 ft drop = 50 HP increase in HP or cost

Surprise Valley Electric
Cost to Pump 2021

50 HP uses	41.45 kWh per hour so 41.45 X 24 =	994.80 kWh
75 HP uses	62.18 kWh per hour so 62.18 X 24 =	1492.32 kWh
100 HP uses	82.90 kWh per hour so 82.90 X 24 =	1989.6 kWh
125 HP uses	103.63 kWh per hour so 103.63 X24 =	2487.12 kWh
150 HP uses	124.35 kWh per hour so 124.36 X 24 =	2984.64 kWh
200 HP uses	165.80 kWh per hour so 165.80 X 24 =	3979.20 kWh

*Basic Charge for irrigation accounts is $2.67 per HP

	BASIC/MONTH	KWh/DAY	IRRIGATION RATE	DAILY COST
50 HP	$133.50	994.80	$.069	$68.64
75 HP	$200.25	1492.32	$.069	$102.97
100 HP	$267.00	1989.60	$.069	$137.28
125 HP	$333.75	2487.12	$.069	$171.61
150 HP	$400.50	2984.64	$.069	$205.94
200 HP	$534.00	3979.20	$.069	$274.56


Pumping Electricity Cost at Varying Well Depth
Estimated cost per ton of hay produced
Electricity Cost per Ton Hay
$50.00
$40.00
$30.00
$20.00
$10.00
$0.00
$15.26
$30.51
$19.07
$38.13
$22.88
$45.75
160'
240'
320'
Pumping Depth
SVE
PG&E

Appendix 8A Water Level Monitoring Well Details

Well Name	State Well Number	DWR Site Code	DWR Well Completion Report Number	Well Use	Ground Surface Elevation (feet msl)	Reference Point Elevation (feet msl)	Reference Point Description	Well Depth (feet bgs)	Open Hole	Screen[1] Interval (feet bgs)	Period of Record Start (water year)	Period of Record End (water year)	Highest Depth to Water (feet bgs)	Lowest Depth to Water (feet bgs)	Depth to Water Range (feet bgs)	Groundwater Elevation Range (feet msl)	Comments
01A1	39N07E01A001M	412539N1211050W001	14565	Stockwatering	4183.40	4184.40	Hole in plate at TOC.	300	yes	40 - 300	1979	2021	19.50	148.00	20 - 148	4164 - 4035	
03D1	38N08E03D001M	411647N1210358W001	16564	Irrigation	4163.40	4163.40	TOC below pump base, west side.	280	no	50 - 280	1982	2021	14.80	91.80	15 - 92	4149 - 4072	
06C1	37N08E06C001M	410777N1210986W001	14580	Irrigation	4133.40	4133.90	Hole in pump base on NW side.	400	yes	20 - 400	1982	2016	6.60	67.20	7 - 67	4127 - 4066	
08F1	38N09E08F001M	411493N1209656W001	49934	Other	4253.40	4255.40	Top of casing below welded plate.	217	yes	26 - 217	1979	2021	23.60	32.90	24 - 33	4230 - 4221	
12G1	38N07E12G001M	411467N1211110W001	--	Residential	4143.38	4144.38	None Provided	116	no	--	1979	1994	4.70	12.40	5 - 12	4139 - 4131	Measurements stopped in 1994
13K2	37N07E13K002M	410413N1211147W001	090029	Irrigation	4127.40	4127.90	Hole in pump base NE side; remove bolt.	260	yes	20 - 260	1982	2021	17.70	65.50	18 - 66	4110 - 4062	
16D1	38N08E16D001M	411359N1210625W001	090143	Irrigation	4171.40	4171.60	2" access tube, SW side.	491	yes	100 - 491	1982	2021	9.00	92.67	9 - 93	4162 - 4079	
17K1	38N08E17K001M	411320N1210766W001	218	Residential	4153.30	4154.30	TOC	180	yes	30 - 180	1957	2021	3.30	38.20	3 - 38	4150 - 4115	
18E1	38N09E18E001M	411356N1209900W001	138559	Irrigation	4248.40	4249.50	Hole in pumpbase, SE side.	520	yes	21 - 520	1981	2021	14.30	86.40	14 - 86	4234 - 4162	
18M1	38N09E18M001M	411305N1209896W001	138563	Irrigation	4288.40	4288.90	Under cap plate, southwest side.	525	yes	40 - 525	1981	2021	55.70	96.10	56 - 96	4233 - 4192	Located next to 18E1
18N2	39N08E18N002M	412144N1211013W001	127457	Residential	4163.40	4164.40	TOC	250	yes	40 - 250	1979	2021	3.20	26.80	3 - 27	4160 - 4137	Located next to BVMW-3
20B6	38N07E20B006M	411242N1211866W001	128135	Residential	4126.30	4127.30	TOC where rope goes in well.	183	yes	41 - 183	1979	2021	9.70	49.40	10 - 49	4117 - 4077	
21C1	39N08E21C001M	412086N1210574W001	127008	Irrigation	4161.40	4161.70	TOC; remove bolt from 3/8" hole in steel plate SE side	300	yes	30 - 300	1979	2021	12.90	79.30	13 - 79	4149 - 4082	
22G1	39N07E22G001M	412074N1211497W001	5322	Residential	4143.40	4144.40	TOC under plate -- SW side.	260	yes	115 - 260	1979	2021	6.70	38.20	7 - 38	4137 - 4105	In Lookout, outside basin
23E1	38N07E23E001M	411207N1211395W001	38108	Residential	4123.40	4123.40	TOC where rope goes in.	84	yes	28 - 84	1979	2021	14.30	53.00	14 - 53	4109 - 4070	In Bieber next to BVMW-5
24J2	38N07E24J002M	411228N1211054W001	--	Irrigation	4138.40	4139.40	Hole in pump base.	192	yes	1 - 192	1979	2021	0.70	81.70	1 - 82	4138 - 4057	
26E1	39N07E26E001M	411911N1211354W001	127484	Irrigation	4133.40	4135.00	Hole inside SE corner of pumpbase.	400	no	20 - 400	1979	2021	2.10	44.50	2 - 45	4131 - 4089	
28F1	39N09E28F001M	411907N1209447W001	--	Residential	4206.60	4207.10	None Provided	73	no	--	1982	2021	4.50	12.03	5 - 12	4202 - 4195	In Adin next to BVMW-1
32A2	38N07E32A002M	410950N1211839W001	--	Other	4118.80	4119.50	TOC	49	no	--	1959	2021	0.00	12.10	0 - 12	4119 - 4107	
32R1	39N09E32R001M	411649N1209569W001	--	Irrigation	4243.40	4243.60	Hole in pumpbase, south side.	--	no	--	1981	2021	37.90	82.20	38 - 82	4206 - 4161	
ACWA-1	38N08E07A001M	411508N1210900W001	0962825	Irrigation	4142.00	4142.75	Access port on NE side of wellhead.	780	no	60 - 780	2016	2021	15.65	102.85	16 - 103	4126 - 4039	
ACWA-2	39N08E33P002M	411699N1210579W001	484622	Irrigation	4153.00	4153.20	Access on SE side of well casing	800	no	50 - 800	2016	2021	13.65	26.60	14 - 27	4139 - 4126	
ACWA-3	39N08E28A001M	411938N1210478W001	0951365	Irrigation	4159.00	4159.83	Hole in pump base, remove plug. Same access as airline.	720	no	60 - 720	2016	2021	8.42	23.07	8 - 23	4151 - 4136	
BVMW 1-1	--	411880N1209599W001	2020-006214	Observation	4214.17	4213.84	Notch on PVC casing	265	no	175 - 265	2020	2021	29.66	52.66	30 - 53	4185 - 4162	
BVMW 1-2	--	411881N1209598W001	2020-006283	Observation	4214.54	4214.21	Notch on PVC casing	52	no	32 - 52	2020	2021	28.69	36.82	29 - 37	4186 - 4178	
BVMW 1-3	--	411878N1209593W001	2020-006285	Observation	4218.50	4218.17	Notch on PVC casing	50	no	30 - 50	2020	2021	32.69	40.84	33 - 41	4186 - 4178	
BVMW 1-4	--	411880N1209590W001	2020-006328	Observation	4218.39	4218.06	Notch on PVC casing	49	no	29 - 49	2020	2021	32.38	40.36	32 - 40	4186 - 4178	
BVMW 2-1	--	412119N1210286W001	2020-006667	Observation	4216.51	4216.18	Notch on PVC casing	250	no	210 - 250	2020	2021	21.66	22.33	22 - 22	4195 - 4194	
BVMW 2-2	--	412118N1210286W001	2020-006670	Observation	4216.77	4216.44	Notch on PVC casing	70	no	50 - 70	2020	2021	17.48	20.82	17 - 21	4199 - 4196	
BVMW 2-3	--	412110N1210287W001	2020-006674	Observation	4214.26	4213.93	Notch on PVC casing	70	no	50 - 70	2020	2021	31.30	34.73	31 - 35	4183 - 4180	
BVMW 2-4	--	412120N1210294W001	2020-006677	Observation	4209.95	4209.62	Notch on PVC casing	60	no	40 - 60	2020	2021	19.77	23.63	20 - 24	4190 - 4186	
BVMW 3-1	--	412169N1211050W001	2020-006592	Observation	4164.75	4164.41	Notch on PVC casing	185	no	135 - 185	2020	2021	14.86	18.34	15 - 18	4150 - 4146	
BVMW 3-2	--	412170N1211050W001	2020-006595	Observation	4164.92	4164.58	Notch on PVC casing	40	no	25 - 40	2020	2021	9.96	13.60	10 - 14	4155 - 4151	
BVMW 3-3	--	412157N1211051W001	2020-006593	Observation	4164.36	4164.02	Notch on PVC casing	50	no	25 - 50	2020	2021	5.70	8.56	6 - 9	4159 - 4156	
BVMW 3-4	--	412157N1211054W001	2020-006596	Observation	4165.31	4164.97	Notch on PVC casing	50	no	25 - 50	2020	2021	6.83	9.81	7 - 10	4158 - 4156	
BVMW 4-1	--	412029N1211587W001	2019-017359	Observation	4152.73	4152.40	Notch on PVC casing	425	no	385 - 415	2020	2021	37.43	64.75	37 - 65	4115 - 4088	
BVMW 4-2	--	412029N1211588W001	2019-017360	Observation	4153.06	4152.73	Notch on PVC casing	74	no	54 - 74	2020	2021	29.77	48.57	30 - 49	4123 - 4104	
BVMW 4-3	--	412030N1211579W001	2019-017361	Observation	4152.66	4152.33	Notch on PVC casing	80	no	60 - 80	2020	2021	29.68	48.96	30 - 49	4123 - 4104	
BVMW 4-4	--	412035N1211578W001	2019-017362	Observation	4161.65	4161.32	Notch on PVC casing	93	no	73 - 93	2020	2021	39.06	58.80	39 - 59	4123 - 4103	
BVMW 5-1	--	411219N1211339W001	2020-006658	Observation	4129.05	4129.05	Notch on PVC casing	540	no	485 - 535	2020	2021	40.35	46.65	40 - 47	4089 - 4082	
BVMW 5-2	--	411220N1211339W001	2020-006659	Observation	4128.92	4128.92	Notch on PVC casing	115	no	65 - 115	2020	2021	20.40	25.80	20 - 26	4109 - 4103	
BVMW 5-3	--	411212N1211366W001	2020-006661	Observation	4131.73	4131.73	Notch on PVC casing	85	no	65 - 85	2020	2021	34.86	45.02	35 - 45	4097 - 4087	
BVMW 5-4	--	411206N1211340W001	2020-006663	Observation	4130.23	4130.23	Notch on PVC casing	90	no	70 - 90	2020	2021	33.67	43.27	34 - 43	4097 - 4087	

Notes:

-- = information not available

feet bgs = feet below ground surface (depth to water)

feet msl = feet above mean sea level (groundwater elevation NAVD88)

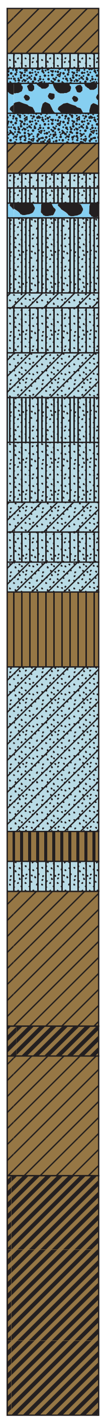
water year = October 1 to September 30

[1] For the purposes of this GSP, the terms "screen" or "perforation" encompases any interval that allows water to enter the well from the aquifer, including casing perforations, well screens, or open hole.

Appendix 8B New Monitoring Well As-Built Drawings

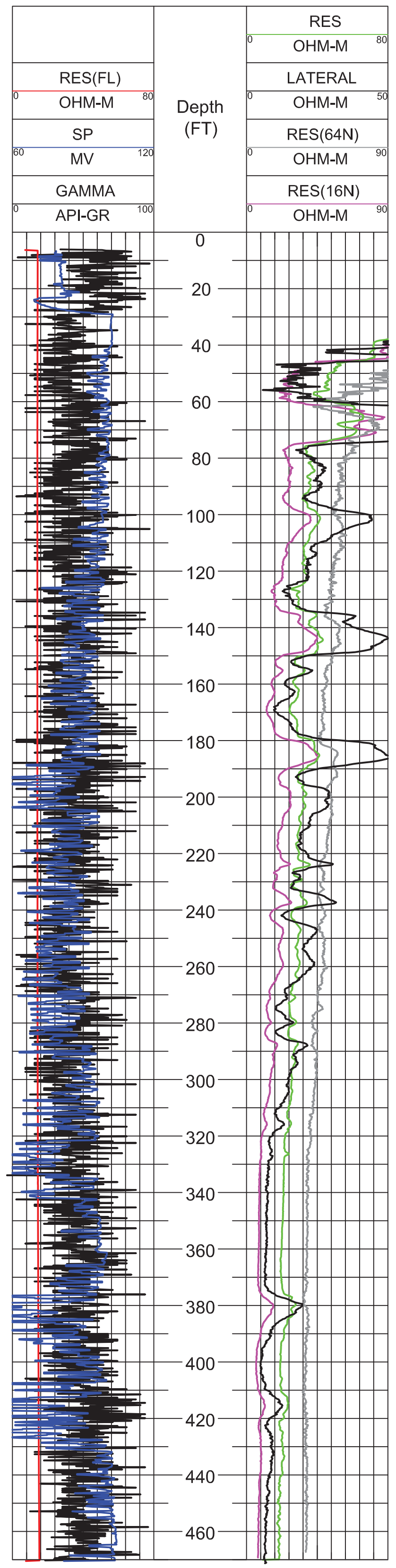
1 2 3 4 5 6 7 8

LITHOLOGIC LOG



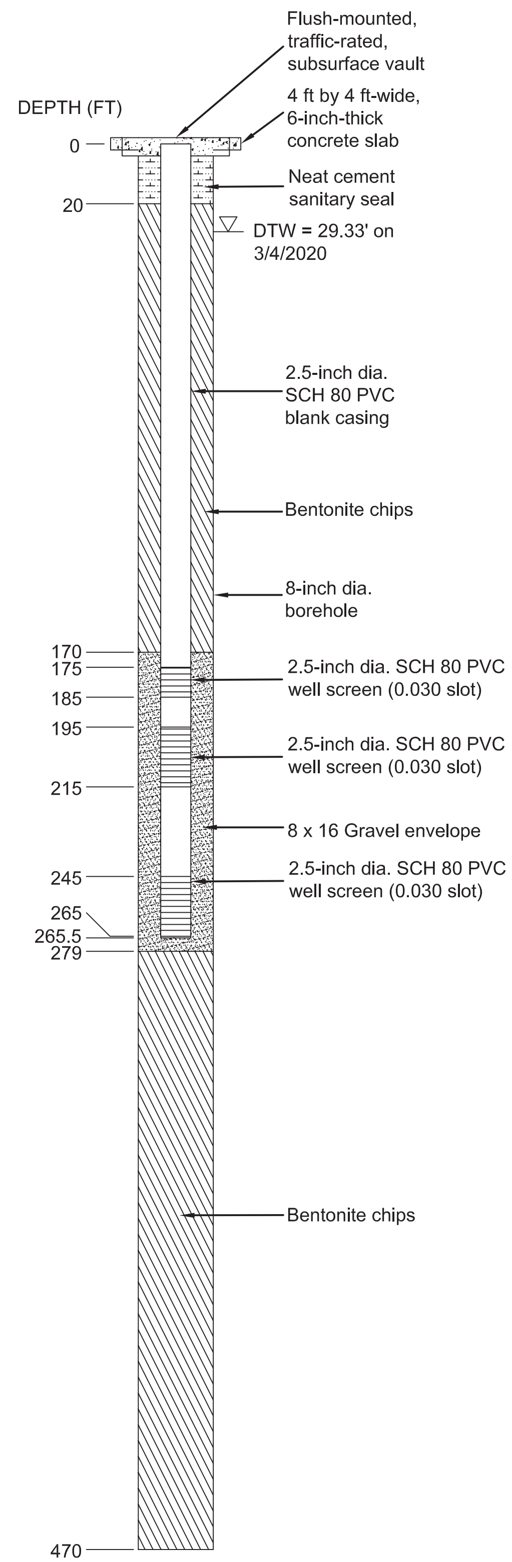
Depth (FT)	DESCRIPTION
0	Sandy Lean Clay (CL), dark yellowish brown
15	Silty Sand (SM)
20	Well Graded Sand (SW)
25	Well Graded Gravel (GW), very dark gray
35	Well Graded Sand with Gravel (SW), dark grayish brown
45	Sandy Lean Clay (CL), brown
55	Silty Sand (SM), brown
60	Poorly Graded Sand with Silt (SP-SM)
65	Well Graded Gravel with Sand (GW)
70	Poorly Graded Sand with Silt (SP-SM), fine to coarse grained sand, dark yellowish brown to dark grayish brown
95	Clayey Sand (SC), brown
100	Silty Sand (SM), dark yellowish brown and dark grayish brown
115	Clayey Sand (SC), dark grayish brown and brown
130	Poorly Graded Sand with Silt (SP-SM)
145	Silty Sand (SM), very dark gray and very dark grayish brown
165	Clayey Sand (SC), dark gray
175	Silty Sand (SM), dark gray
185	Clayey Sand (SC)vey dark grayish brown
195	Sandy Silt (ML), very dark grayish brown and very dark brown
220	Clayey Sand (SC), dark grayish brown
275	Elastic Silt (MH), very dark gray
285	Sandy Sily (SM), sand is fine
295	Sandy Lean Clay (CL), very dark gray, sand is fine grained
340	Fat Clay (CH), very dark graysih brown, high plasticity
350	Lean Clay (CL), very dark graysih brown
390	Fat Clay (CH), very dark graysih brown and very dark gray
470	

E-LOGS



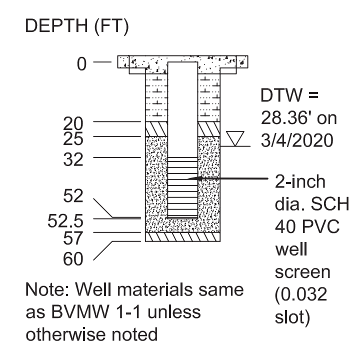
BVMW 1-1

Latitude (WGS84): 41.1880325
Longitude (WGS84): -120.9598526
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4213.84
Top of Well Vault: 4214.17



BVMW 1-2

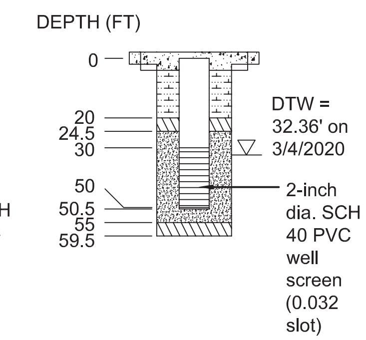
Latitude (WGS84): 41.1881034
Longitude (WGS84): -120.9597792
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4214.21
Top of Well Vault: 4214.54



Note: Well materials same as BVMW 1-1 unless otherwise noted

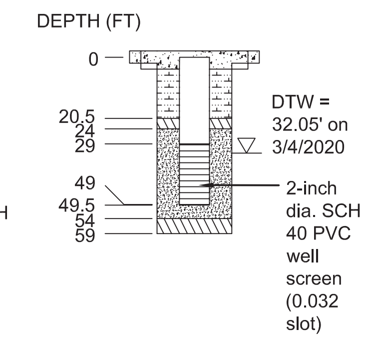
BVMW 1-3

Latitude (WGS84): 41.1877928
Longitude (WGS84): -120.9593371
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4218.17
Top of Well Vault: 4218.50

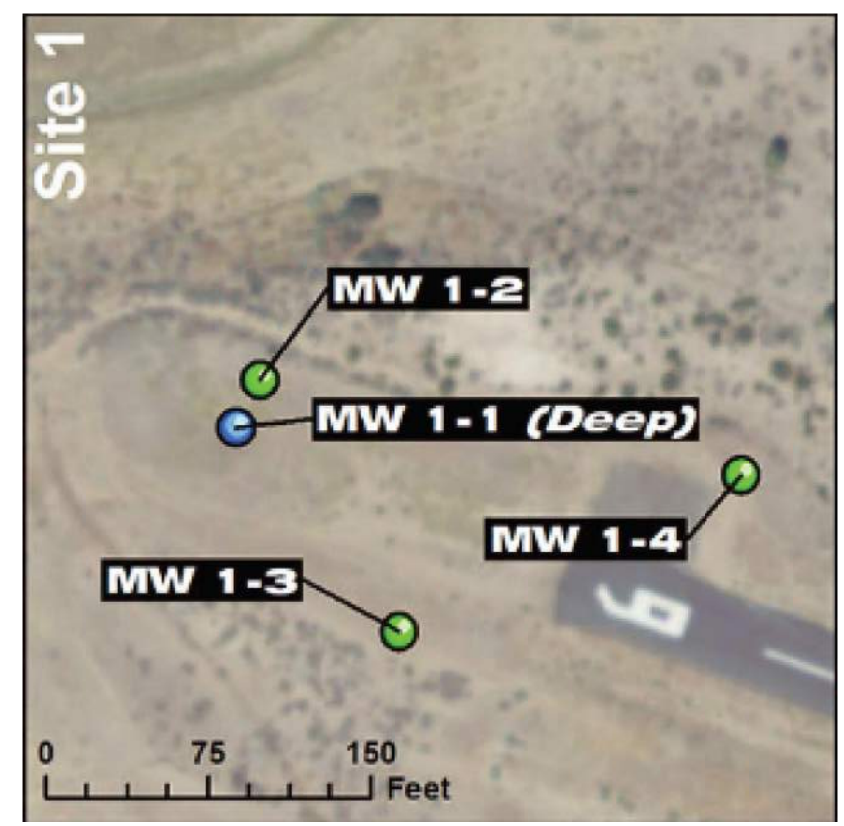


BVMW 1-4

Latitude (WGS84): 41.1880422
Longitude (WGS84): -120.9589947
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4218.06
Top of Well Vault: 4218.39



SITE MAP



NORTH CAL-NEVA RESOURCE CONSERVATION AND DEVELOPMENT COUNCIL

ON BEHALF OF:

FUNDED BY:

PROJECT ENGINEER:

GEI Consultants
2868 PROSPECT PARK DRIVE
SUITE 400
RANCHO CORDOVA, CA 95670
(916)631-4500

DESIGNED: D. Fairman	CHECKED: J. Zumbro
DRAWN: F. Olson / V. Yap	REVIEWED: D. Fairman

PROFESSIONAL GEOLOGIST DAVID FAIRMAN No. 9025 STATE OF CALIFORNIA

Date: 4/13/2021

Drilling Completed By:
Maggiora Brothers Drilling, Inc.
Nov-Dec 2019

BIG VALLEY GROUNDWATER BASIN

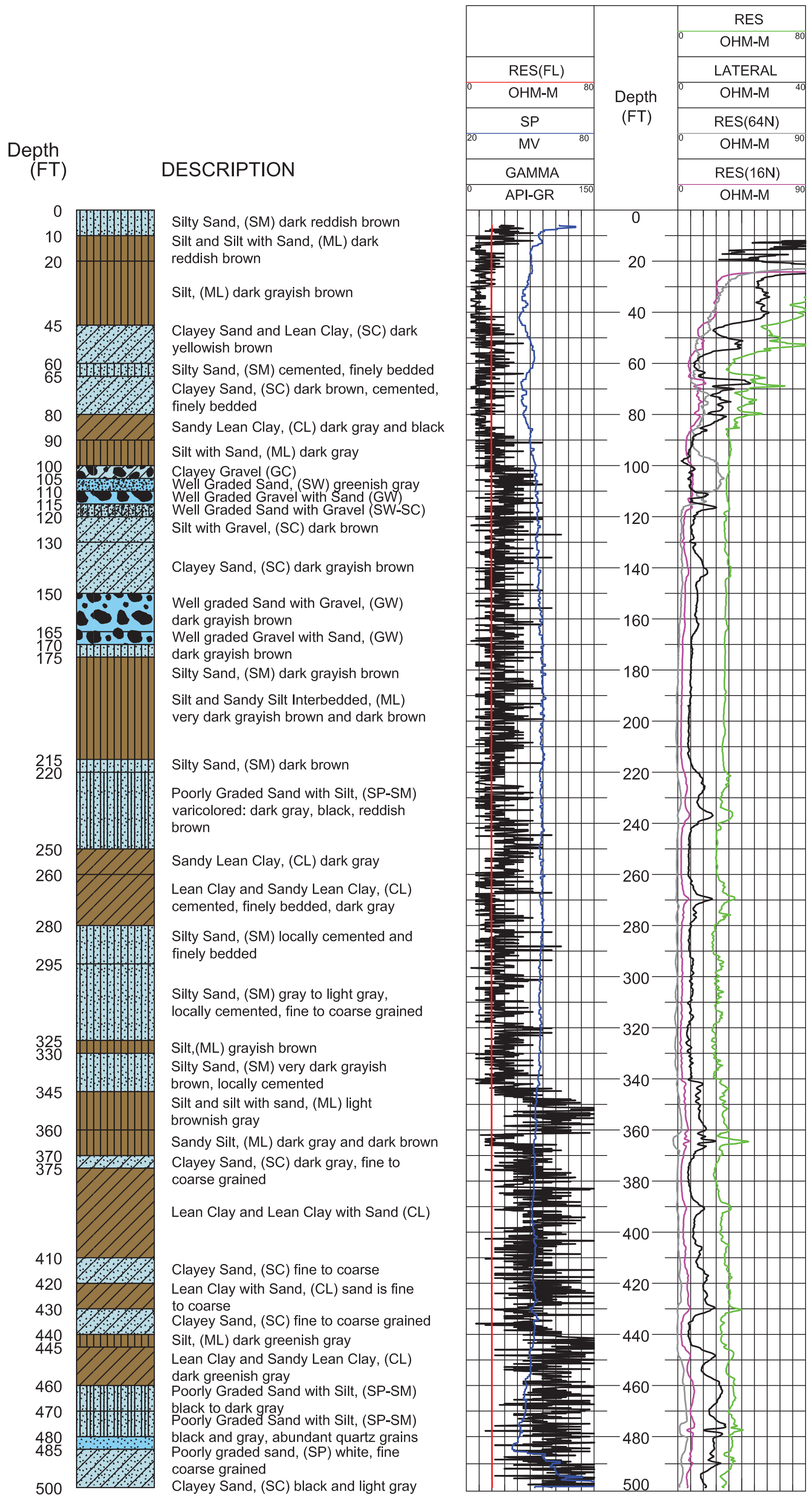
AS-BUILT MONITORING WELL CONSTRUCTION DETAILS: SITE 1 ADIN AIRPORT

DRAWING 1

1 2 3 4 5 6 7 8

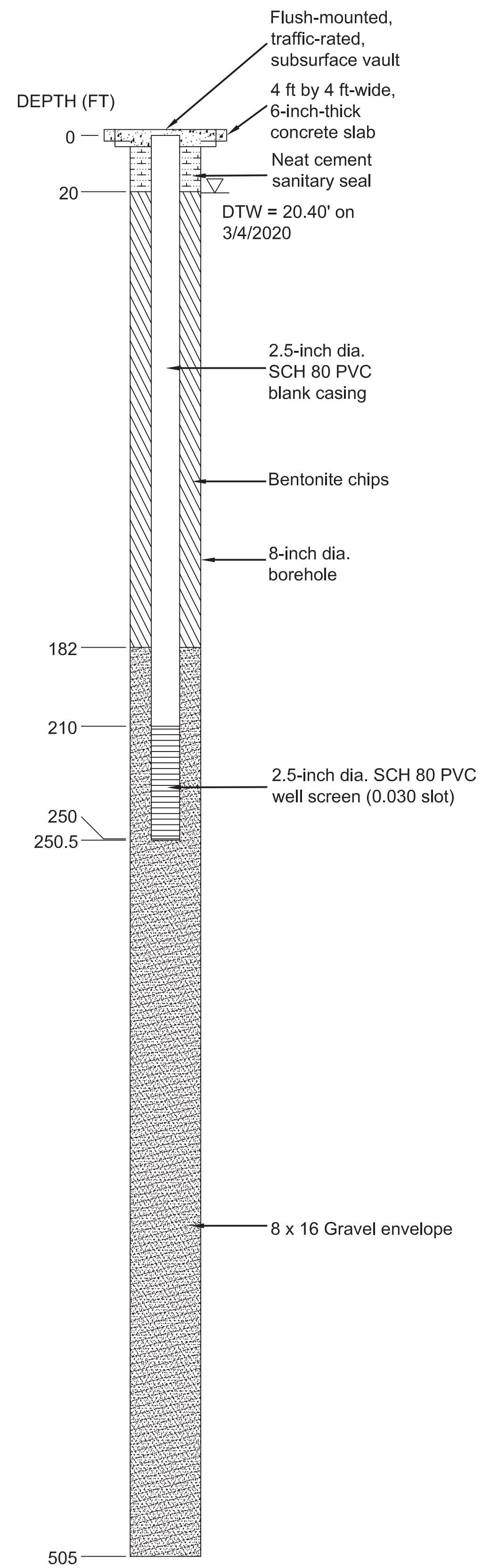
LITHOLOGIC LOG

E-LOGS



BVMW 2-1

Latitude (WGS84): 41.2118591
Longitude (WGS84): -121.0286214
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4216.18
Top of Well Vault: 4216.51



BVMW 2-2

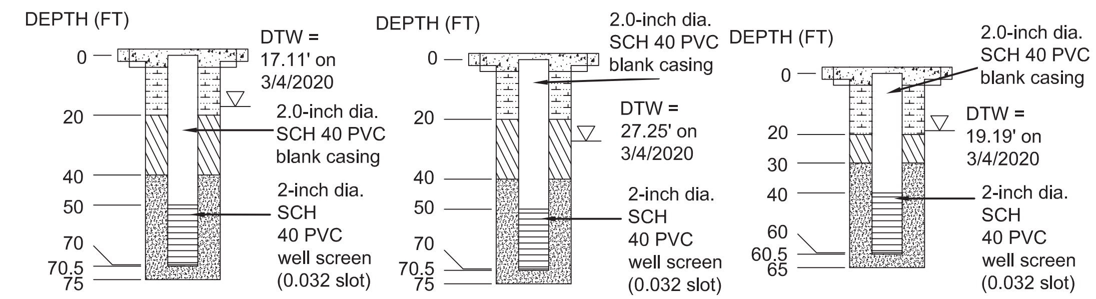
Latitude (WGS84): 41.2118382
Longitude (WGS84): -121.0285515
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4216.44
Top of Well Vault: 4216.77

BVMW 2-3

Latitude (WGS84): 41.2109506
Longitude (WGS84): -121.0286823
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4213.93
Top of Well Vault: 4214.26

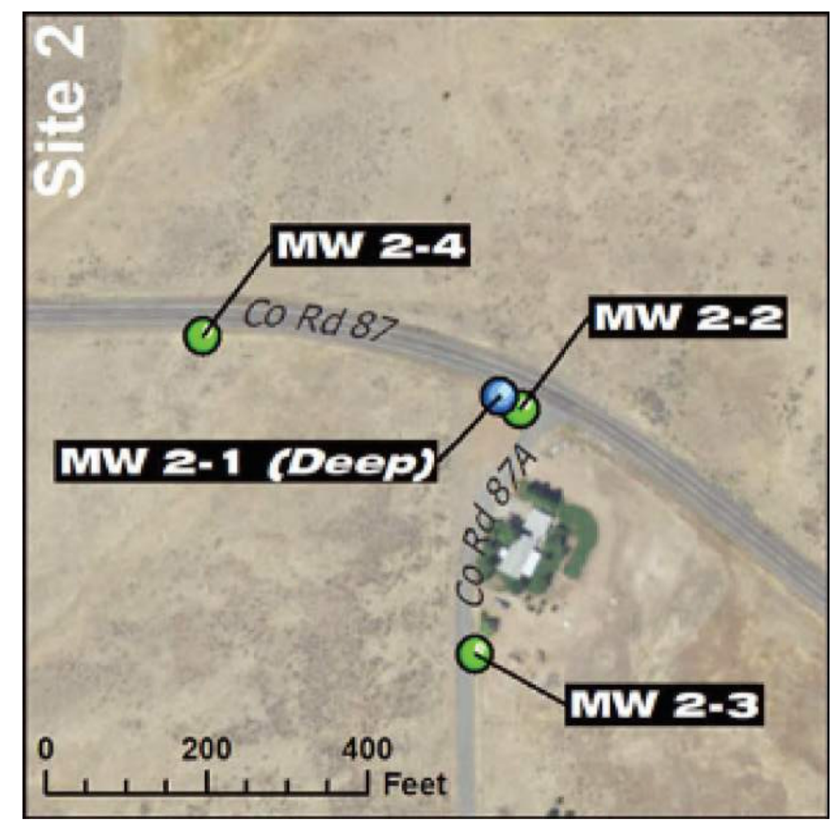
BVMW 2-4

Latitude (WGS84): 41.2119971
Longitude (WGS84): -121.0293786
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4209.62
Top of Well Vault: 4209.95



Note: Well materials same as BVMW 2-1 unless otherwise noted

SITE MAP



NORTH CAL-NEVA RESOURCE CONSERVATION AND DEVELOPMENT COUNCIL

ON BEHALF OF:

FUNDED BY:

PROJECT ENGINEER:

GEI Consultants
2868 PROSPECT PARK DRIVE
SUITE 400
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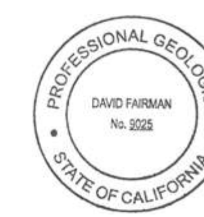
(916)631-4500

DESIGNED: D. Fairman	CHECKED: J. Zumbro
DRAWN: F. Olson / V. Yap	REVIEWED: D. Fairman



Date: 4/13/2021

Drilling Completed By:
Maggiora Brothers Drilling, Inc.
Feb 2020

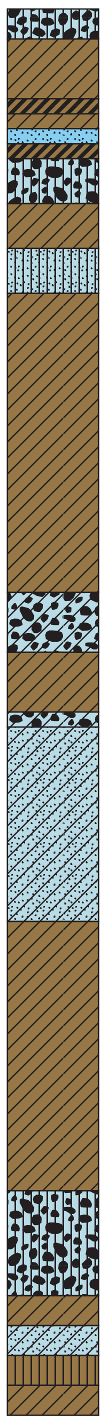
BIG VALLEY GROUNDWATER BASIN

AS-BUILT MONITORING WELL CONSTRUCTION DETAILS: SITE 2 ROADS 87 & 87A

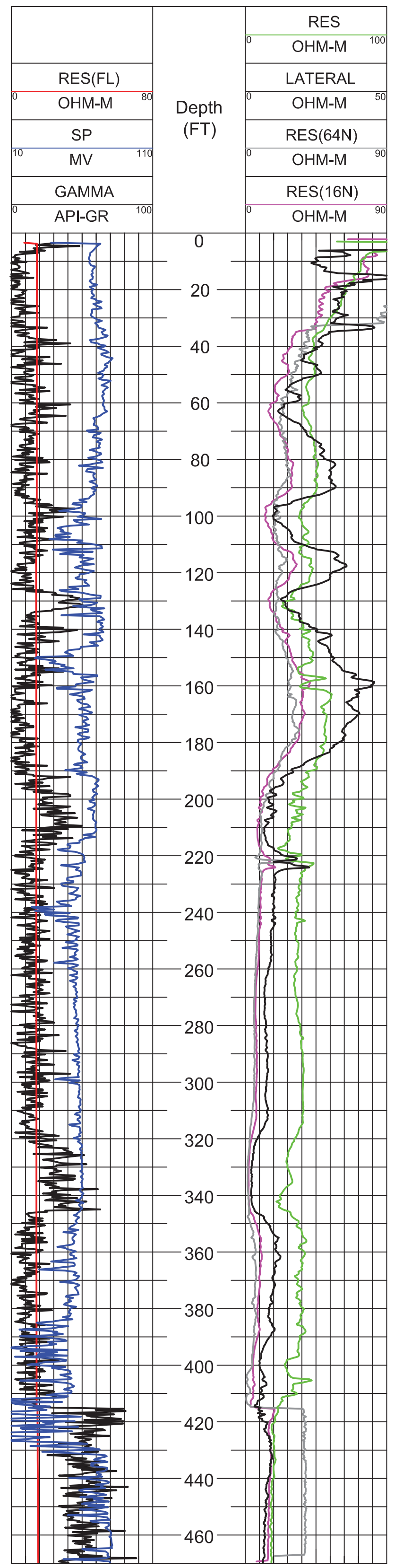
DRAWING 2

LITHOLOGIC LOG

Depth (FT)	DESCRIPTION
0	Silty Gravel, (GM) light yellowish brown
10	Lean Clay, (CL) trace fine gravel
30	Fat Clay (CH)
35	Lean Clay, (CL) yellowish brown
40	Poorly Graded Sand with Gravel (SP)
45	Fat Clay (CH)
50	Silty Gravel (GM)
65	Lean Clay, (CL) grayish brown
80	Silty Sand, (SM) grayish brown
95	Lean Clay, Lean Clay with Gravel, and Lean Clay with Sand, (CL) gray and grayish brown
195	Clayey Gravel, (GC) dark gray
215	Lean Clay with Sand and Lean Clay with Gravel, (CL) dark brown
235	Clayey Gravel (GC)
240	Clayey Sand, (SC) brown
305	Lean Clay and Lean Clay with Sand, (CL) blueish gray, light gray, and brownish gray
395	Silty Gravel, (GM) grayish brown and reddish brown
430	Sandy Lean Clay, (CL) light gray
440	Clayey Sand, (SC) light gray
450	Silt, (ML) bluish gray
460	Gravelly Lean Clay, (CL) light bluish gray
470	

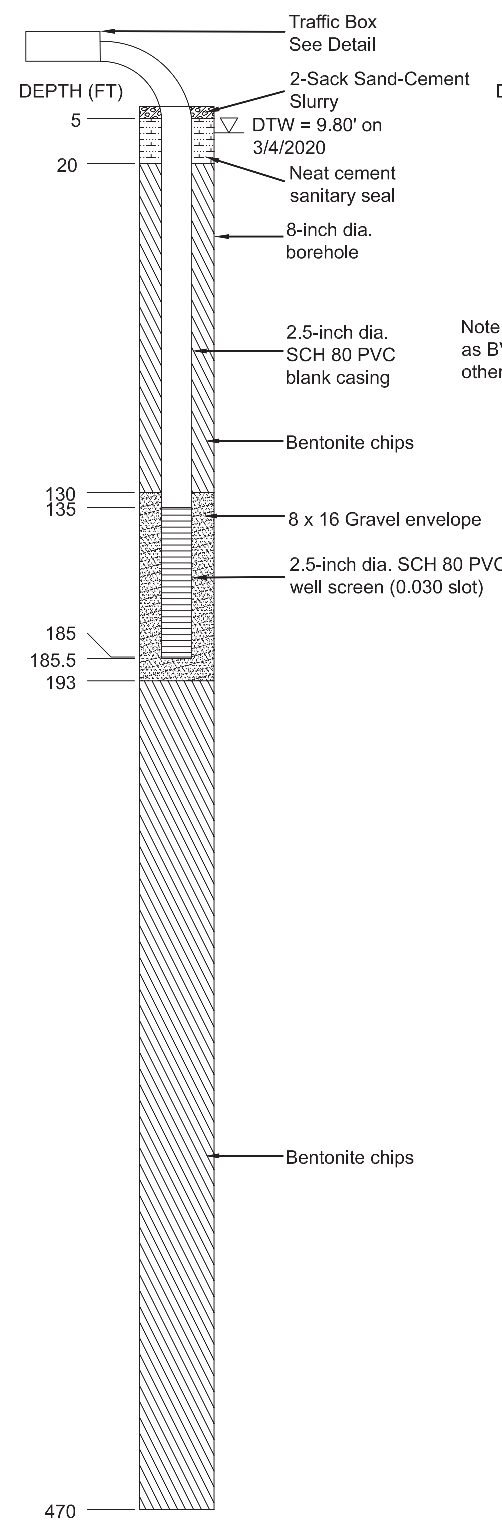


E-LOGS



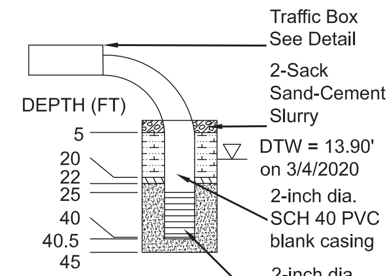
BVMW 3-1

Latitude (WGS84): 41.2169400
Longitude (WGS84): -121.1049557
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4164.41
Corrected Reference Pt.: 4167.41
Top of Well Vault: 4164.75



BVMW 3-2

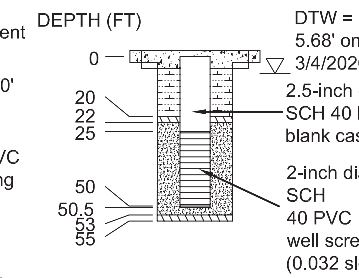
Latitude (WGS84): 41.2170083
Longitude (WGS84): -121.1049570
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4164.58
Corrected Reference Pt.: 4167.58
Top of Well Vault: 4164.92



Note: Well materials same as BVMW 3-1 unless otherwise noted

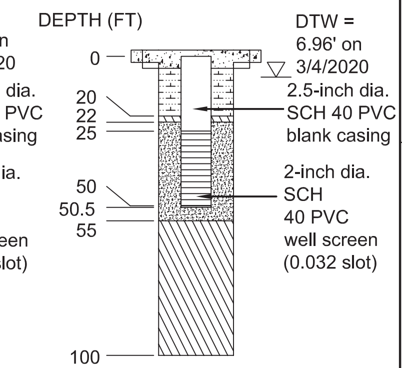
BVMW 3-3

Latitude (WGS84): 41.2157185
Longitude (WGS84): -121.1050902
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4164.02
Top of Well Vault: 4164.36

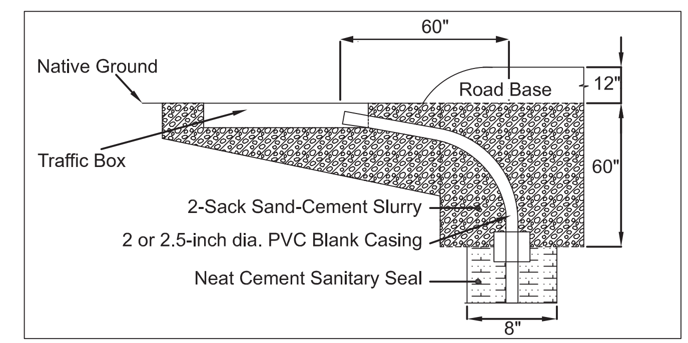


BVMW 3-4

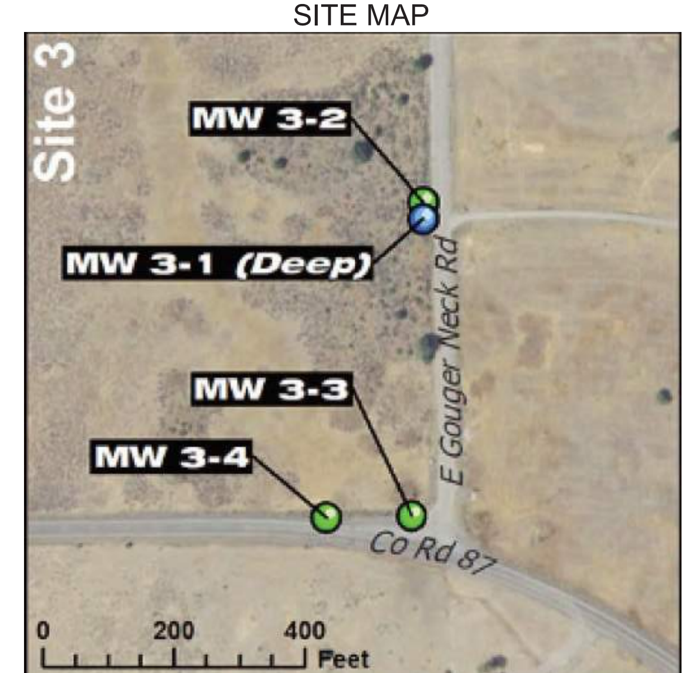
Latitude (WGS84): 41.2157230
Longitude (WGS84): -121.1054095
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4164.97
Top of Well Vault: 4165.31



Traffic Box Detail



SITE MAP



*Corrected reference point elevation should be used for water level measurements and accounts for horizontal offset and curvature of casing.

NORTH CAL-NEVA RESOURCE CONSERVATION AND DEVELOPMENT COUNCIL

ON BEHALF OF:

COUNTY OF MODOC · 1874 · CALIFORNIA

FUNDED BY:

DEPARTMENT OF WATER RESOURCES · STATE OF CALIFORNIA

PROJECT ENGINEER:

GEI Consultants
2868 PROSPECT PARK DRIVE
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(916)631-4500

DESIGNED: D. Fairman	CHECKED: J. Zumbro
DRAWN: F. Olson / V. Yap	REVIEWED: D. Fairman

PROFESSIONAL GEOLOGIST · DAVID FAIRMAN · No. 9025 · STATE OF CALIFORNIA

Date: 4/13/2021

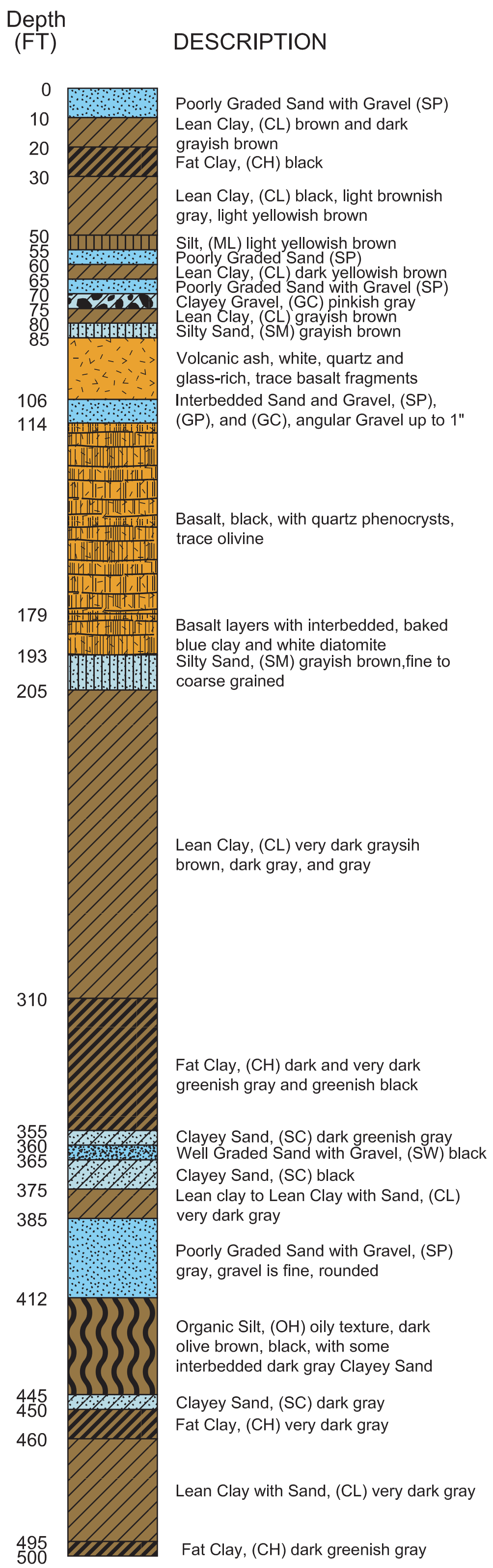
Drilling Completed By:
Maggiora Brothers Drilling, Inc.
Jan-Feb 2020

BIG VALLEY GROUNDWATER BASIN

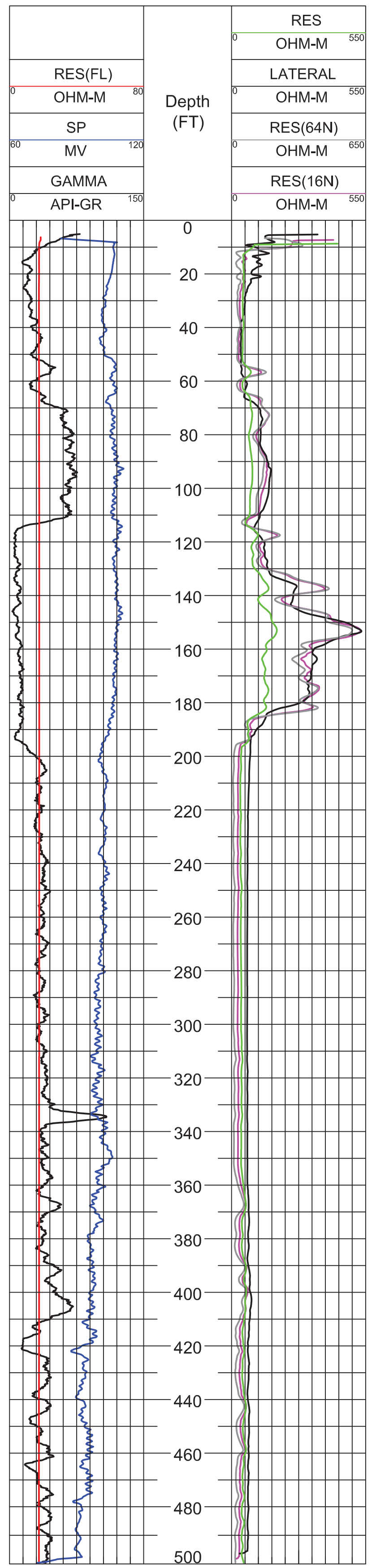
AS-BUILT MONITORING WELL CONSTRUCTION DETAILS: SITE 3 ROADS 87 & 90

DRAWING 3

LITHOLOGIC LOG

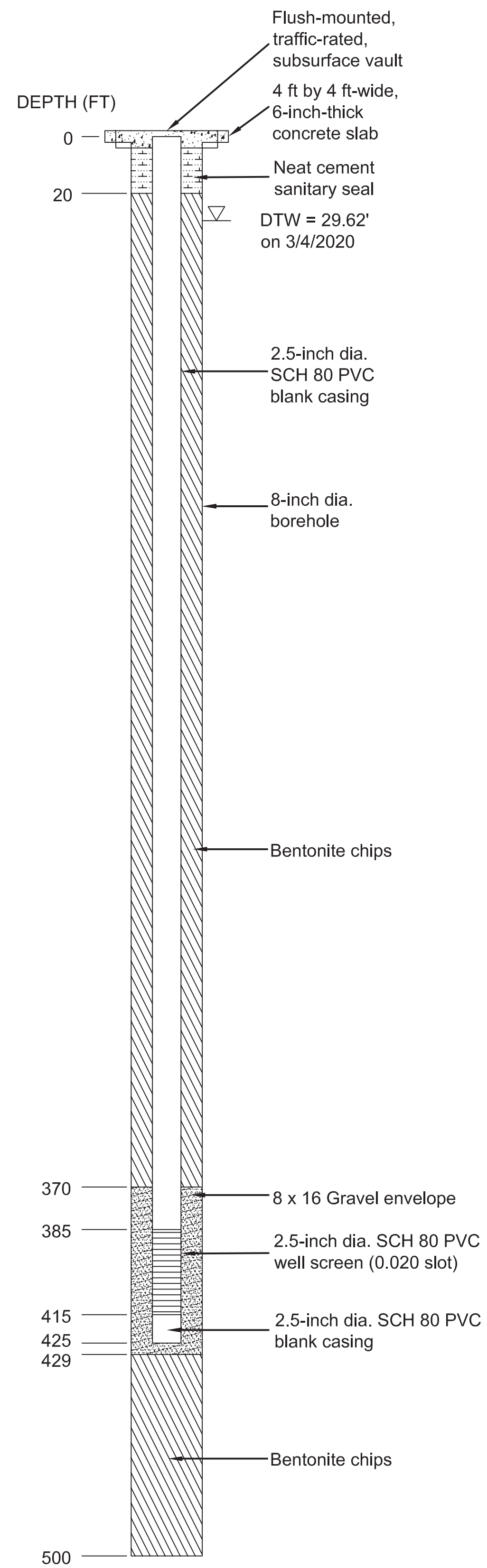


E-LOGS



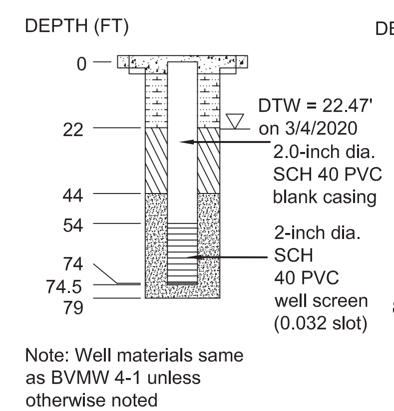
BVMW 4-1

Latitude (WGS84): 41.2029277
Longitude (WGS84): -121.1586996
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4152.40
Top of Well Vault: 4152.73



BVMW 4-2

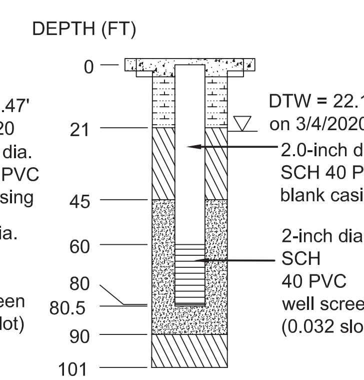
Latitude (WGS84): 41.2029353
Longitude (WGS84): -121.1587904
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4152.73
Top of Well Vault: 4153.06



Note: Well materials same as BVMW 4-1 unless otherwise noted

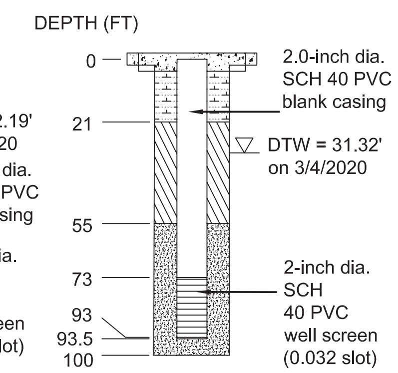
BVMW 4-3

Latitude (WGS84): 41.2029911
Longitude (WGS84): -121.1578593
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4152.33
Top of Well Vault: 4152.66

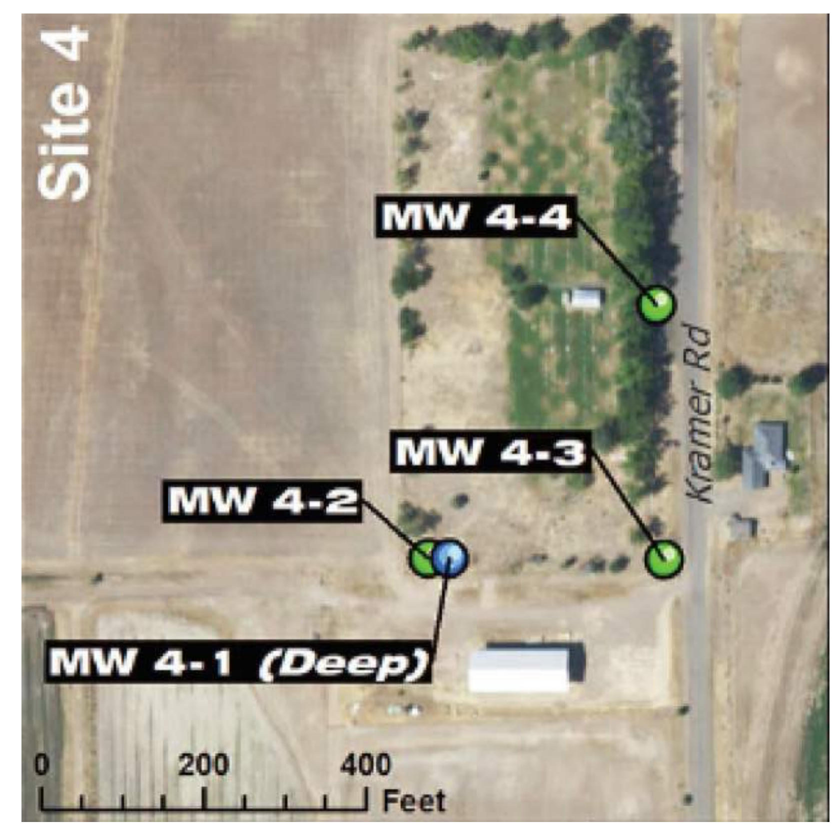


BVMW 4-4

Latitude (WGS84): 41.2035397
Longitude (WGS84): -121.1578433
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4161.32
Top of Well Vault: 4161.65



SITE MAP



NORTH CAL-NEVA RESOURCE CONSERVATION AND DEVELOPMENT COUNCIL

ON BEHALF OF:

COUNTY OF MODOC CALIFORNIA 1874

FUNDED BY:

DEPARTMENT OF WATER RESOURCES STATE OF CALIFORNIA

PROJECT ENGINEER:

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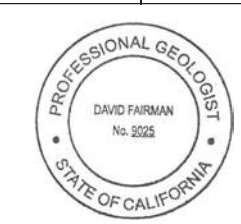
DRAWN: F. Olson / V. Yap	REVIEWED: D. Fairman



Date: 4/13/2021

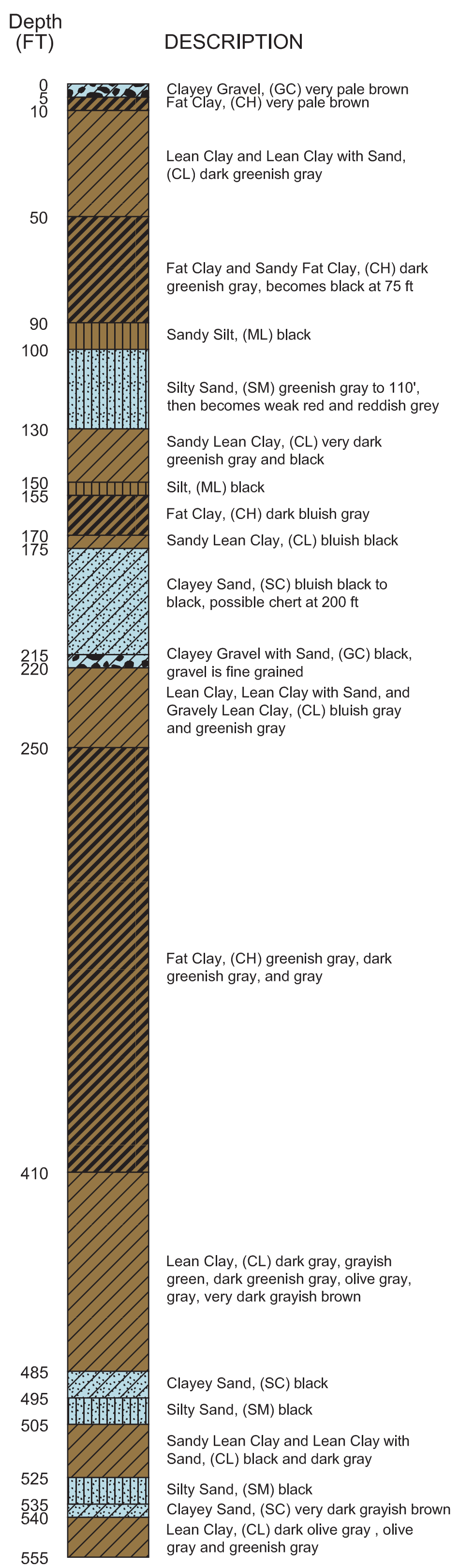
Drilling Completed By:
Maggiora Brothers Drilling, Inc.
Nov 2019

BIG VALLEY GROUNDWATER BASIN

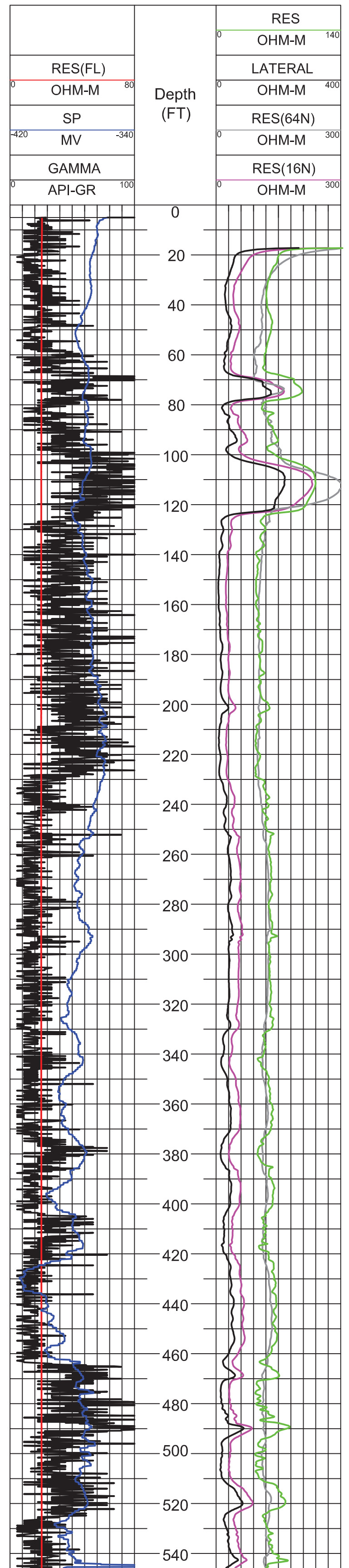
AS-BUILT MONITORING WELL CONSTRUCTION DETAILS: SITE 4 LOOKOUT CEMETERY

DRAWING 4

LITHOLOGIC LOG

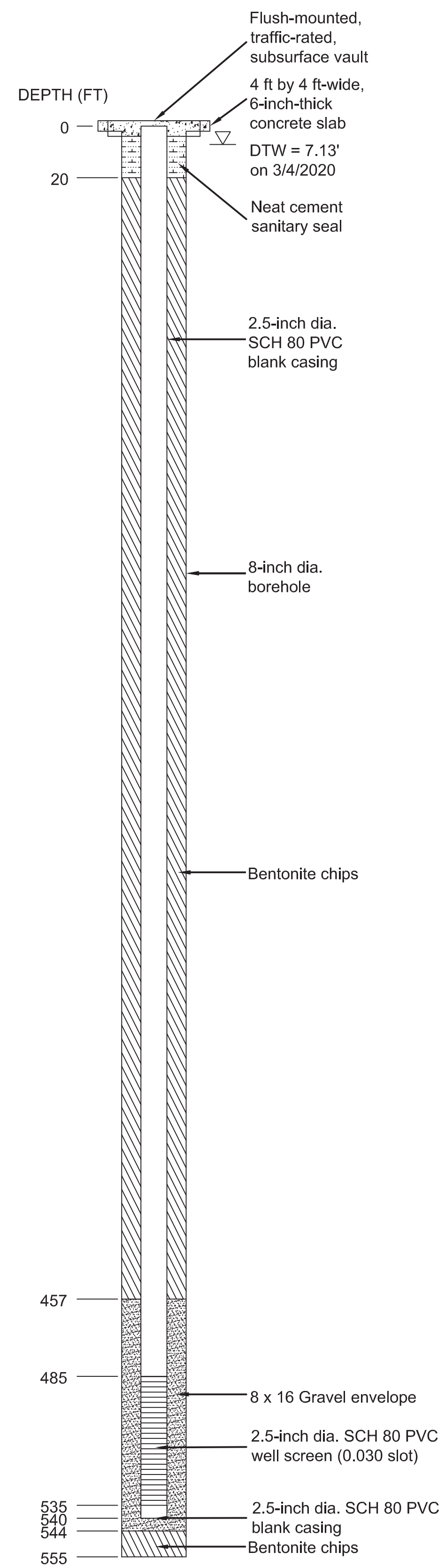


E-LOGS



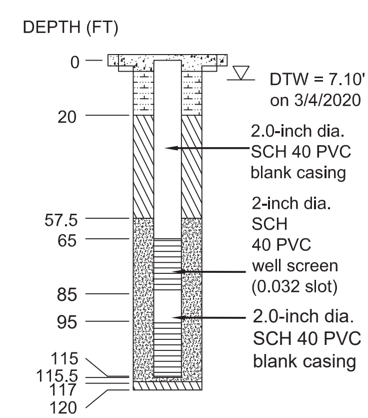
BVMW 5-1

Latitude (WGS84): 41.1218808
Longitude (WGS84): -121.1338666
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4128.72
Top of Well Vault: 4129.05



BVMW 5-2

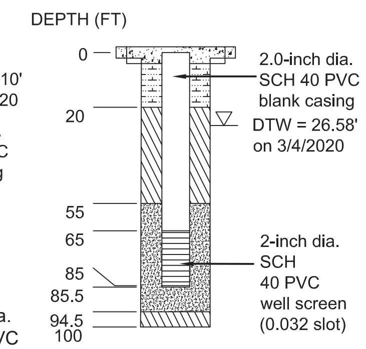
Latitude (WGS84): 41.1219508
Longitude (WGS84): -121.1338622
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4128.59
Top of Well Vault: 4128.92



Note: Well materials same as BVMW 5-1 unless otherwise noted

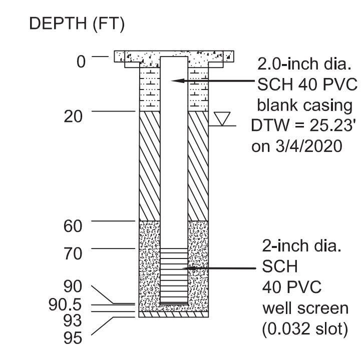
BVMW 5-3

Latitude (WGS84): 41.1211843
Longitude (WGS84): -121.1366445
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4131.40
Top of Well Vault: 4131.73

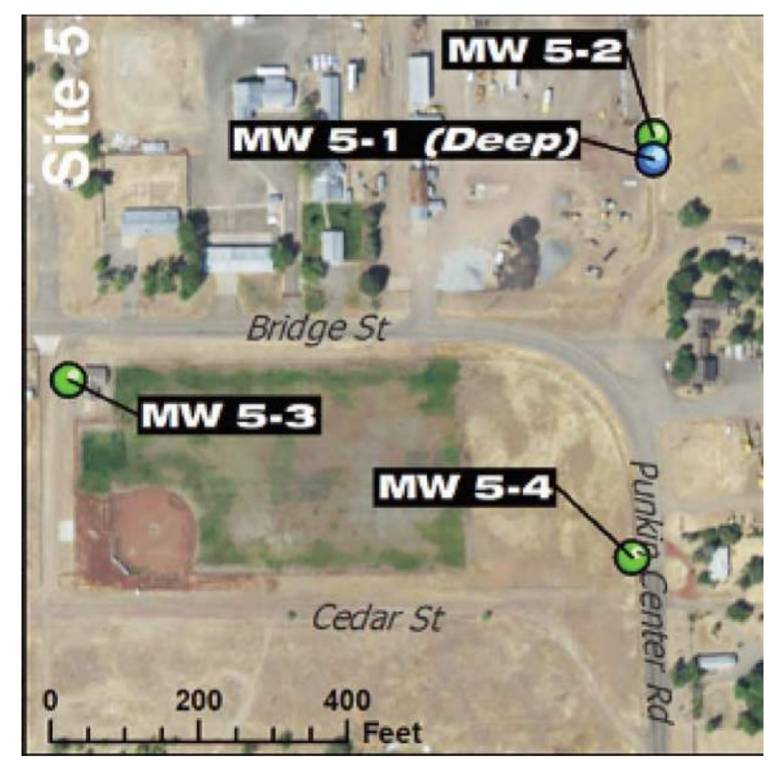


BVMW 5-4

Latitude (WGS84): 41.1205603
Longitude (WGS84): -121.1339942
Elevation in US Survey Feet (NAVD88)
Top of PVC Casing: 4129.90
Top of Well Vault: 4130.23



SITE MAP



FUNDED BY:

PROJECT ENGINEER:

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DESIGNED: D. Fairman	CHECKED: J. Zumbro
DRAWN: F. Olson / V. Yap	REVIEWED: D. Fairman

PROFESSIONAL GEOLOGIST
DAVID FAIRMAN
No. 9025
STATE OF CALIFORNIA

Date: 4/13/2021

Drilling Completed By:
Maggiora Brothers Drilling, Inc.
Dec 2019 - Jan 2020

BIG VALLEY
GROUNDWATER BASIN

AS-BUILT MONITORING WELL CONSTRUCTION DETAILS: SITE 5 BIEBER

DRAWING 5

Appendix 8C Selection from DWR Monitoring BMP

PROTOCOLS FOR MEASURING GROUNDWATER LEVELS

This section presents considerations for the methodology of collection of groundwater level data such that it meets the requirements of the GSP Regulations and the DQOs of the specific GSP. Groundwater levels are a fundamental measure of the status of groundwater conditions within a basin. In many cases, relationships of the sustainability indicators may be able to be correlated with groundwater levels. The quality of this data must consider the specific aquifer being monitored and the methodology for collecting these levels.

The following considerations for groundwater level measuring protocols should ensure the following:

- Groundwater level data are taken from the correct location, well ID, and screen interval depth
- Groundwater level data are accurate and reproducible
- Groundwater level data represent conditions that inform appropriate basin management DQOs
- All salient information is recorded to correct, if necessary, and compare data
- Data are handled in a way that ensures data integrity

General Well Monitoring Information

The following presents considerations for collection of water level data that include regulatory required components as well as those which are recommended.

- Groundwater elevation data will form the basis of basin-wide water-table and piezometric maps, and should approximate conditions at a discrete period in time. Therefore, all groundwater levels in a basin should be collected within as short a time as possible, preferably within a 1 to 2 week period.
- Depth to groundwater must be measured relative to an established Reference Point (RP) on the well casing. The RP is usually identified with a permanent marker, paint spot, or a notch in the lip of the well casing. By convention in open casing monitoring wells, the RP reference point is located on the north side of the well casing. If no mark is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing.
- The elevation of the RP of each well must be surveyed to the North American Vertical Datum of 1988 (NAVD88), or a local datum that can be converted to NAVD88. The elevation of the RP must be accurate to within 0.5 foot. It is preferable for the RP elevation to be accurate to 0.1 foot or less. Survey grade global navigation satellite system (GNSS) global positioning system (GPS) equipment can achieve similar vertical accuracy when corrected. Guidance for use of GPS can be found at USGS http://water.usgs.gov/osw/gps/. Hand-held GPS units likely will not produce reliable vertical elevation measurement accurate enough for the casing elevation consistent with the DQOs and regulatory requirements.
- The sampler should remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a release is observed, the measurement should follow a period of time to allow the water level to equilibrate.
- Depth to groundwater must be measured to an accuracy of 0.1 foot below the RP. It is preferable to measure depth to groundwater to an accuracy of 0.01 foot. Air lines and acoustic sounders may not provide the required accuracy of 0.1 foot.
- The water level meter should be decontaminated after measuring each well.

Where existing wells do not meet the base standard as described in the GSP Regulations or the considerations provided above, new monitoring wells may need to be constructed to meet the DQOs of the GSP. The design, installation, and documentation of new monitoring wells must consider the following:

- Construction consistent with California Well Standards as described in Bulletins 74-81 and 74-90, and local permitting agency standards of practice.
- Logging of borehole cuttings under the supervision of a California Professional Geologist and described consistent with the Unified Soil Classification System methods according to ASTM standard D2487-11.
- Written criteria for logging of borehole cuttings for comparison to known geologic formations, principal aquifers and aquitards/aquicludes, or specific marker beds to aid in consistent stratigraphic correlation within and across basins.
- Geophysical surveys of boreholes to aid in consistency of logging practices. Methodologies should include resistivity, spontaneous potential, spectral gamma, or other methods as appropriate for the conditions. Selection of geophysical methods should be based upon the opinion of a professional geologist or professional engineer, and address the DQOs for the specific borehole and characterization needs.
- Prepare and submit State well completion reports according to the requirements of §13752. Well completion report documentation should include geophysical logs, detailed geologic log, and formation identification as attachments. An example well completion as-built log is illustrated in **Figure 2.** DWR well completion reports can be filed directly at the Online System for Well Completion Reports (OSWCR) http://water.ca.gov/oswcr/index.cfm.

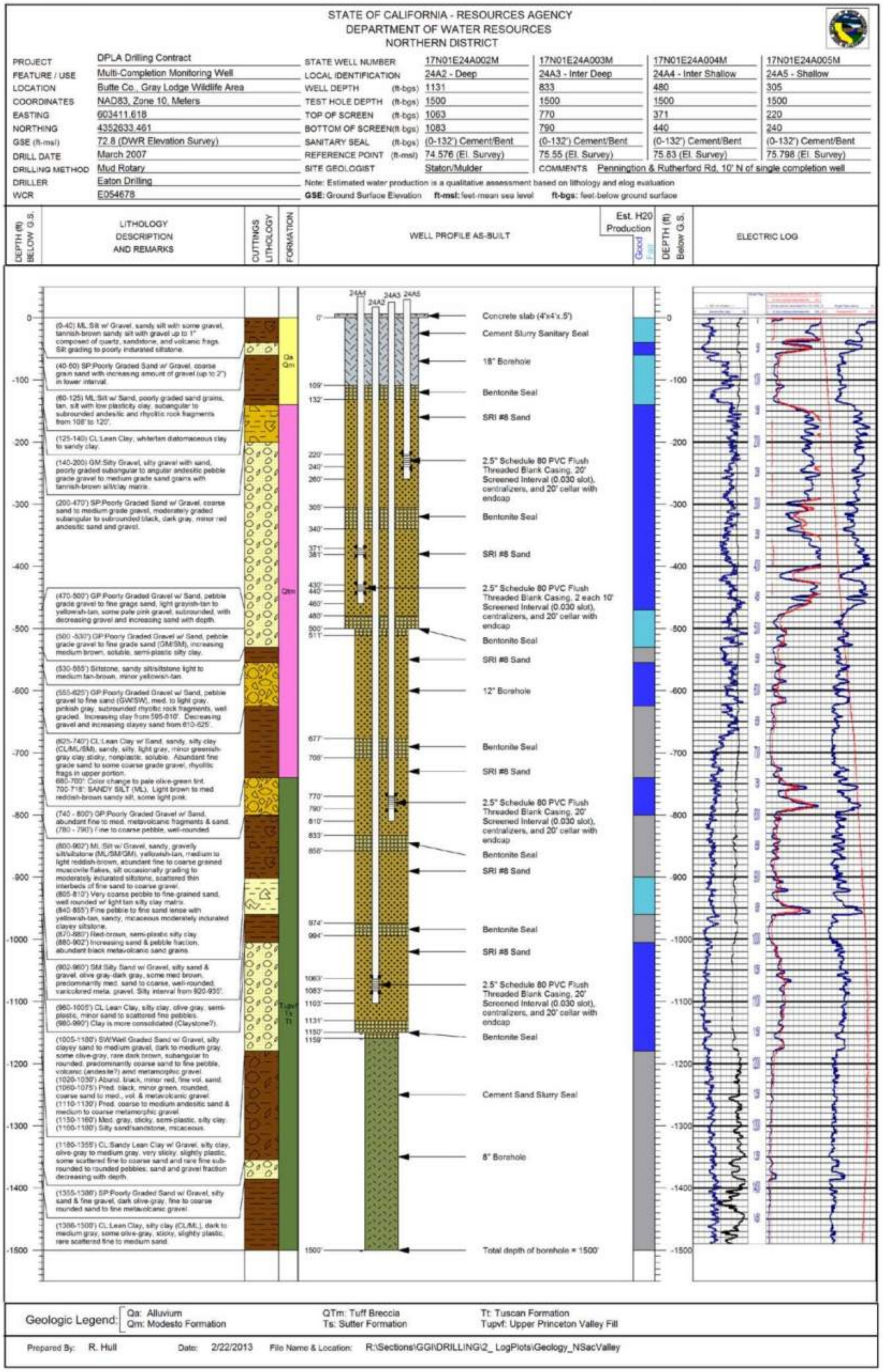

Figure 2 – Example As-Built Multi-Completion Monitoring Well Log

Measuring Groundwater Levels

Well construction, anticipated groundwater level, groundwater level measuring equipment, field conditions, and well operations should be considered prior collection of the groundwater level measurement. The USGS *Groundwater Technical Procedures* (Cunningham and Schalk, 2011) provide a thorough set of procedures which can be used to establish specific Standard Operating Procedures (SOPs) for a local agency. **Figure 3** illustrates a typical groundwater level measuring event and simultaneous pressure transducer download.

Figure 3 – Collection of Water Level Measurement and Pressure Transducer Download

The following points provide a general approach for collecting groundwater level measurements:

- Measure depth to water in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions. Groundwater levels should be measured to the nearest 0.01 foot relative to the RP.
- For measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize. In these cases, multiple measurements should be collected to ensure the well has reached equilibrium such that no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the value should be appropriately qualified as a

questionable measurement. In the event that a well is artesian, site specific procedures should be developed to collect accurate information and be protective of safety conditions associated with a pressurized well. In many cases, an extension pipe may be adequate to stabilize head in the well. Record the dimension of the extension and document measurements and configuration.

- The sampler should calculate the groundwater elevation as:

$$GWE = RPE - DTW$$

Where:

GWE = Groundwater Elevation
RPE = Reference Point Elevation
DTW = Depth to Water

The sampler must ensure that all measurements are in consistent units of feet, tenths of feet, and hundredths of feet. Measurements and RPEs should not be recorded in feet and inches.

Recording Groundwater Levels

- The sampler should record the well identifier, date, time (24-hour format), RPE, height of RP above or below ground surface, DTW, GWE, and comments regarding any factors that may influence the depth to water readings such as weather, nearby irrigation, flooding, potential for tidal influence, or well condition. If there is a questionable measurement or the measurement cannot be obtained, it should be noted. An example of a field sheet with the required information is shown in **Figure 4**. It includes questionable measurement and no measurement codes that should be noted. This field sheet is provided as an example. Standardized field forms should be used for all data collection. The aforementioned USGS *Groundwater Technical Procedures* offers a number of example forms.
- The sampler should replace any well caps or plugs, and lock any well buildings or covers.
- All data should be entered into the GSA data management system (DMS) as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by a second person for compliance with the DQOs.

STATE OF CALIFORNA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WELL DATA

STATE WELL NUMBER	COUNTY	REFERENCE POINT ELEV.	MEASURING AGENCY
			DWR

NO MEASUREMENT	QUESTIONABLE MEASUREMENT
0. Measurement discontinued	0. Caved or deepened
1. Pumping	1. Pumping
2. Pump house locked	2. Nearby pump operating
3. Tape hung up	3. Casing leaky or wet
4. Can't get tape in casing	4. Pumped recently
5. Unable to locate well	5. Air or pressure gauge measurement
6. Well has been destroyed	6. Other
7. Special	7. Recharge operation at or nearby well
8. Casing leaky or wet	8. Oil in casing
9. Temporarily inaccessible	

DATE	N M	Q M	TAPE AT RP	TAPE AT WS	RP to WS	OBSR VR	COMMENTS

DWR 1213

Figure 4 – Example of Water Level Well Data Field Collection Form

Pressure Transducers

Groundwater levels and/or calculated groundwater elevations may be recorded using pressure transducers equipped with data loggers installed in monitoring wells. When installing pressure transducers, care must be exercised to ensure that the data recorded by the transducers is confirmed with hand measurements.

The following general protocols must be followed when installing a pressure transducer in a monitoring well:

- The sampler must use an electronic sounder or chalked steel tape and follow the protocols listed above to measure the groundwater level and calculate the groundwater elevation in the monitoring well to properly program and reference the installation. It is recommended that transducers record measured groundwater level to conserve data capacity; groundwater elevations can be calculated at a later time after downloading.
- The sampler must note the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and cable serial number.
- Transducers must be able to record groundwater levels with an accuracy of at least 0.1 foot. Professional judgment should be exercised to ensure that the data being collected is meeting the DQO and that the instrument is capable. Consideration of the battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers should be included in the evaluation.
- The sampler must note whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented units provide accurate data if properly corrected for natural barometric pressure changes. This requires the consistent logging of barometric pressures to coincide with measurement intervals.
- Follow manufacturer specifications for installation, calibration, data logging intervals, battery life, correction procedure (if non-vented cables used), and anticipated life expectancy to assure that DQOs are being met for the GSP.
- Secure the cable to the well head with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker. This will allow estimates of future cable slippage.
- The transducer data should periodically be checked against hand measured groundwater levels to monitor electronic drift or cable movement. This should happen during routine site visits, at least annually or as necessary to maintain data integrity.

- The data should be downloaded as necessary to ensure no data is lost and entered into the basin's DMS following the QA/QC program established for the GSP. Data collected with non-vented data logger cables should be corrected for atmospheric barometric pressure changes, as appropriate. After the sampler is confident that the transducer data have been safely downloaded and stored, the data should be deleted from the data logger to ensure that adequate data logger memory remains.

PROTOCOLS FOR SAMPLING GROUNDWATER QUALITY

The following protocols can be incorporated into a GSP's monitoring protocols for collecting groundwater quality data. More detailed sampling procedures and protocols are included in the standards and guidance documents listed at the end of this BMP. A GSP that adopts protocols that deviate from these BMPs must demonstrate that the adopted protocols will yield comparable data.

In general, the use of existing water quality data within the basin should be done to the greatest extent possible if it achieves the DQOs for the GSP. In some cases it may be necessary to collect additional water quality data to support monitoring programs or evaluate specific projects. The USGS *National Field Manual for the Collection of Water Quality Data* (Wilde, 2005) should be used to guide the collection of reliable data. **Figure 5** illustrates a typical groundwater quality sampling setup.

Figure 5 – Typical Groundwater Quality Sampling Event

Appendix 11A GSA Letters to Governor and Legislature

County of Lassen
Board of Supervisors

CHRIS GALLAGHER
District 1
DAVID TEETER
District 2
JEFF HEMPHILL
District 3
AARON ALBAUGH
District 4
TOM HAMMOND
District 5

County Administration Office
221 S. Roop Street, Suite 4
Susanville, CA 96130
Phone: 530-251-8333
Fax: 530-251-2663

August 11, 2020

Gavin Newsom
Governor, State of California
1303 10th Street, Suite 1173
Sacramento, CA 95814

RE: Request for Extension for Submittal of a Groundwater Sustainability Plan for the Big Valley Groundwater Basin

Dear Governor Newsom:

COVID-19 has had (and continues to have) a monumental impact on the ability of State and local government to conduct the people's business. Accordingly, as the Governor of the State of California, you have, on multiple occasions, exercised authority granted to you pursuant to the State's police power and through the Emergency Services Act to issue Executive Orders in response to the COVID-19 emergency. As discussed herein, these orders have often altered the implementation of various Statutes and Regulations. This letter is to request that you use your authority to extend the January 31, 2022, deadline to submit a Groundwater Sustainability Plan (GSP) to the Department of Water Resources (DWR) for the Big Valley Groundwater Basin (DWR Bulletin 118 Basin 5-004) as required by the Sustainable Groundwater Management Act (SGMA).

The Big Valley Groundwater Basin is located in two counties (Lassen and Modoc), and the counties have stepped forward to act as the Groundwater Sustainability Agencies (GSAs) for their respective portions of the Basin. Big Valley is a rural, agricultural area where ranching and farming make up the bulk of the economy by producing alfalfa, hay, wild rice, pasture and range. Ranching and farming have a long history in Big Valley and many current, active ranchers are the same families that homesteaded here. In addition, there is a state wildlife refuge in the middle of the Basin that supports important species and acts as part of the Pacific flyway. Big Valley is designated as a disadvantaged community. To say that there is a high level of interest in how the GSP for Big Valley is developed is an understatement.

The GSAs have been unable to successfully conduct the public outreach expected by stakeholders and required by the SGMA during the COVID-19 emergency. Further, the ability to conduct telephonic or web-based participation is highly limited in Big Valley because there is inadequate internet access and in some cases no internet access at all for stakeholders to participate in public meetings.

While the GSP deadline is still 16 months away, it is clear that we do not have enough time to meet the robust public participation requirements found in the SGMA (summarized in this letter) while also meeting the current submittal deadline. The combination of complex GSP Regulations which require highly technical content and the need for public participation mean that the outreach process will take a lot of time for all parties to come to a shared understanding of what the Regulations require and what the content of the GSP means to them. Decisions that will have a huge impact in the Basin will be made and implemented through the GSP.

The public outreach and participation plan we developed prior to COVID-19 requires frequent public meetings between now and January 31, 2022, to prepare a draft GSP that the GSAs can approve and submit to DWR as required by the SGMA. Between now and the due date, we will be working chapter by chapter, requirement by requirement, attempting to develop a shared understanding and make reasoned decisions. Even before COVID-19, the schedule was tight and the GSAs were challenged to accommodate adequate public involvement, which is focused through the Big Valley Groundwater Basin Advisory Committee (BVAC). The BVAC is formed through a memorandum of understanding between the two GSAs and is proving ineffective because COVID-19 requirements and health considerations have made it difficult or impossible to conduct public meetings. Given the realities of the COVID-19 emergency, many will be left out of the conversation unless additional time is provided.

You have responded to difficulties that agencies are experiencing conducting public meetings during COVID-19 by relaxing certain Brown Act meeting requirements. Through Executive Order Numbers N-25-20 and N-29-20, your Administration has taken important steps to ensure that public meetings are able to convene and conduct necessary public business during the COVID-19 emergency. Again, you issued the above and many other executive orders, as authorized by the State's police power and through the Emergency Services Act to maintain proper functioning of state and local governments. In summary, said Executive Orders modified certain requirements for noticing and conducting public meetings, as described in Government Code sections 54950-54963 (Chapter 9, Meetings). In part, provisions of these orders allow remote (web or phone-based) meetings to be conducted from multiple locations, without meeting all of the requirements of the above sections. This includes allowing elected or appointed representatives to participate remotely.

The intent for meeting in this fashion is to allow government to continue functioning while those that need to can maintain isolation. This is necessary and prudent for routine functions, but the SGMA is different. This legislation is new territory for all involved and has wide reaching impacts on stakeholders of all varieties. Because of the long-term nature of the SGMA, the GSAs and stakeholders want to develop a GSP off the bat that stakeholders can live with and reduces the uncertainty that the future holds.

Unfortunately, the above orders are not enough in the Big Valley Groundwater Basin because this remote area of rural, mountainous, northeastern California does not have the digital connectivity required to successfully conduct remote meetings. As discussed herein, attempts to conduct remote meetings in Big Valley have been unsuccessful due to the exceptionally poor internet connectivity. Allowing the public to attend meetings through the internet may be a good strategy for areas that have reliable internet connectivity, but not in rural mountain areas. For internet-based meetings to be successful, infrastructure is needed. This infrastructure is severely lacking in Big Valley and surrounding areas.

In addition to the lack of internet capability, Big Valley is already recognized by the DWR and other State Departments as an economically disadvantaged area. The reality is that many of the citizens in Big Valley do not have the resources, both technical and financial, to access the internet, even if adequate internet connectivity were available. The internet access disparity between urban and rural areas is well-documented. Further, many of the residents are not familiar with the mechanics of participating in meetings electronically. They have had no training or exposure to this technology and meeting venue. Another challenge is staff availability to facilitate internet-based meetings. The two Big Valley Groundwater Basin GSAs, like many rural governments, have very limited staff, especially technical staff.

On July 1, 2020, the GSAs attempted to conduct a combined live and internet-based meeting in lieu of a traditional live-only public outreach meeting. We attempted to conduct the meeting with "Go-To-Webinar" and failed miserably with unintelligible audio. After thirty minutes, one stakeholder who tried to participate from home decided to take the risk of coming to the live portion of the meeting because of the webinar problems even though her spouse has health concerns that make him high risk.

As stated, the fundamental issue we are working through is that, because of COVID-19, there are now two sections of the SGMA that conflict with each other. The legislation provides a deadline, but the same legislation also requires meaningful public involvement. Because of COVID-19, the public in the Big Valley Groundwater Basin has shown a reluctance to attend public meetings to discuss development of the GSP. Further, and again as a direct result of COVID-19, limitations and requirements have been placed on local governments on how public meetings are to be conducted. Below is a summary of some of the public participation requirements found in the SGMA that, as a result of this health emergency, are at odds with the January 31, 2022, deadline:

- In part, Water Code section 10723.2 states *"[t]he groundwater sustainability agency shall consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans. These interests include, but are not limited to, all of the following..."* Without providing an effective means of participation and in the current COVID-19 environment, it is not possible to consider the interest of all beneficial users or to work with our professional staff on the implementation of whatever plan is ultimately adopted. More time is necessary or an important part of the SGMA will be meaningless. This weakens the resulting GSP, making it more difficult to implement and subjecting the GSP to added scrutiny and challenge. Again, we cannot meet the above public participation requirement while also meeting the January 31, 2022, deadline.

- In part, Water Code section 10727.8 states *"Prior to initiating the development of a groundwater sustainability plan, the groundwater sustainability agency shall make available to the public and the department a written statement describing the manner in which interested parties may participate in the development and implementation of the groundwater sustainability plan..."* In accordance with said section, the GSA's have adopted a memorandum of understanding that establishes an Advisory Committee. A primary function of the Advisory Committee is to facilitate public comment. A meeting format has been established to incorporate public comment. In light of COVID-19, the above process has proved itself insufficient to capture and facilitate public comment regarding development of the GSP.

Clearly it was the intent of the legislature in adopting the SGMA that GSPs be prepared with broad public participation. Unfortunately, COVID-19 has restricted the ways in which public meetings can be conducted. The GSP will have a huge impact on the lives of the residents and their children. As such, the SGMA rightfully provides the requirement to include the public in the preparation of the GSP. COVID-19, is jeopardizing the public's participation in the very process that the SGMA assured them they could be part of. It is not realistic to expect the public to be satisfied with our limited ability to conduct internet and phone-based meetings for a process they were assured by the legislature that they would be allowed to participate in. Given the lack of alternatives we have for engaging the public in the GSP development process, it seems clear that we will not be able to meet the January 31, 2022, deadline the legislature established for submittal of the GSP to DWR.

We owe it to the public to provide an opportunity to meaningfully participate. In the end, allowing additional time to prepare the GSP is not likely to have as profound an impact as preparing and submitting a GSP without involving the affected public. The GSP is a major undertaking that will affect the lives of the residents and generations to come. For the GSP to be implemented successfully, the legislature recognized the importance of public participation. Submittal of a plan that will take more than 20 years to implement without the involvement and participation of the very people it will affect is not a good way to start.

As stated, an Executive Order is an appropriate mechanism to grant our request to provide additional time for the GSAs to more fully engage the public in this process as intended by the SGMA. The authority of the Executive to temporarily modify the implementation of Statute and Regulation is demonstrated through the many other Executive Orders you have issued in response to the COVID-19 pandemic. Examples of Statutes affected by Executive Orders you have issued include the Elections Code, Insurance Code, Education Code, Penal Code, Civil Code, Code of Civil Procedure, Vehicle Code, Labor Code, Welfare and Institutions Code, Health and Safety Code, Public Resources Code, Government Code, Unemployment Insurance Code and others. As said, there are also examples of Regulations that have been affected by your Executive Orders.

As a result of this health emergency, you are authorized to issue an Executive Order allowing more time to submit the required GSP to DWR. The COVID-19 emergency has directly hindered our ability to conduct the public outreach and participation required by the SGMA to prepare said GSP. You continue to issue executive orders in response to this pandemic that affect our ability to properly engage the public. Thus, such an order falls under your authority pursuant to the State police power and through the Emergency Services Act. There are various ways in which such an order could implemented:

- You could simply issue an Executive Order extending the deadline to submit a GSP by one year (until January 31, 2023, or further). In summary, support for such an order is demonstrated through the continued quarantine limitations that are in effect and in the continued advice from health professionals for at risk segments of the population to avoid public gatherings. After a year, the need for any further extension could be evaluated based on the status of the COVID-19 pandemic at that time.

- Another (or additional), more specific way, to implement such an Order is through section 10735.2 of the Water Code. Said section requires the Water Resources Control Board to schedule a public hearing to designate Big Valley as a "probationary basin" if the GSP is not submitted by January 31, 2022. In summary, your Executive Order could direct the Water Resources Control Board to postpone scheduling said public hearing, should we not meet the January 31, 2022, GSP submittal deadline.

Thank you for considering our request.

Sincerely,

David Teeter, Chairman
Lassen County Board of Supervisors

DT:MLA:gfn

cc: Toni G. Atkins, President pro Tempore, California Senate
Anthony Rendon, California State Assembly, Speaker
Brian Dahle, Senator, California Senate
Megan Dahle, Assembly Member, California State Assembly
Modoc County Board of Supervisors as the Big Valley Modoc GSA
Big Valley Groundwater Basin Advisory Committee
Department of Water Resources

c/sustainable groundwater management/extend deadline

County of Lassen
Board of Supervisors

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DAVID TEETER
District 2
JEFF HEMPHILL
District 3
AARON ALBAUGH
District 4
TOM HAMMOND
District 5

County Administration Office
221 S. Roop Street, Suite 4
Susanville, CA 96130
Phone: 530-251-8333
Fax: 530-251-2663

November 17, 2020

CERTIFIED MAIL/RETURN RECEIPT
7017 1070 0000 7544 8450
Gavin Newsom
Governor, State of California
1303 10th Street
Sacramento, CA 95814

RE: Inquiry Regarding an August 11, 2020, Letter Requesting an Extension for Submittal of a Groundwater Sustainability Plan for the Big Valley Groundwater Basin (DWR Bulletin 118 Basin 5-004)

Dear Governor Gavin Newsom:

This letter is to request a response from you to our letter to you dated August 11, 2020 (attached), in regard to preparation of the Groundwater Sustainability Plan (GSP) required to be submitted to the Department of Water Resources by January 31, 2022, pursuant to the Sustainable Groundwater Management Act of 2014 (SGMA), for the Big Valley Groundwater Basin. To date, we have not received communication of any type regarding said letter (by telephone, letter or email).

As stated in more detail in our previous letter, COVID-19 has drastically limited our ability, and the public's willingness, to have the in-person public meetings necessary to prepare the required GSP. This has left both the Lassen and Modoc Groundwater Sustainability Agencies (GSAs) with few options. Many around the state have turned to internet-based meetings during this pandemic. However, conducting meetings through the internet is a poor substitution in Big Valley because there is not sufficient internet access. Further, we do not have sufficient resources to conduct internet-based meetings in a meaningful way. Again, our letter to you describes our challenges in great detail.

Even though the GSP deadline is still a little over a year away, it is clear that we do not have enough time to prepare a GSP supported by the level of public participation a plan of this magnitude deserves. Lassen County and the residents of Big Valley have accepted the responsibility required by SGMA to prepare the GSP when no one else would. Neither Lassen County or Modoc County were required by SGMA to accept the responsibility (financially and in terms of land use responsibility) to serve as the GSAs for Big Valley, but that is exactly what we have done. We have more than demonstrated our willingness to meet the challenges presented by SGMA head-on. That said, if we are going to prepare this GSP, it is in the interest of everyone, including you, that it be done right.

This was a serious enough subject to warrant passage of SGMA and signature by the prior Governor. We can assure you that preparation of the GSP for the Basin is certainly a matter of direct concern to the citizens of Big Valley. As such, this Board deserves an answer to our letter, and, even more so, the citizens of Big Valley deserve the courtesy of an answer, even if the answer is contrary to our request. To give the GSP the service it truly deserves, we simply need a little more time. That's all.

Thank you for considering our request and we look forward to your prompt response.

Thank you in advance,

David Teeter, Chairman
Lassen County Board of Supervisors

DT:MLA:gfn

cc: Brian Dahle, Senator, California Senate
Megan Dahle, Assembly Member, California State Assembly
Modoc County Board of Supervisors as the Big Valley Modoc GSA
Big Valley Groundwater Basin Advisory Committee
Department of Water Resources

County of Lassen
Board of Supervisors

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District 4
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Susanville, CA 96130
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Fax: 530-251-2663

February 16, 2021

CERTIFIED RETURN RECEIPT
7020 1290 0000 0270 7632
Gavin Newsom
Governor, State of California
1303 10th Street
Sacramento, CA 95814

RE: Inquiry Regarding an August 11, 2020, Letter Requesting an Extension for Submittal of a Groundwater Sustainability Plan for the Big Valley Groundwater Basin (DWR Bulletin 118 Basin 5-004)

Dear Governor Gavin Newsom:

This letter is to request a response from you to our letters to you dated August 11, 2020 and November 17, 2020 (attached), in regard to preparation of the Groundwater Sustainability Plan (GSP) required to be submitted to the Department of Water Resources by January 31, 2022, pursuant to the Sustainable Groundwater Management Act of 2014 (SGMA), for the Big Valley Groundwater Basin. To date, we have not received communication of any type regarding said letter (by telephone, letter or email).

As stated in more detail in our previous letter, COVID-19 has drastically limited our ability, and the public's willingness, to have the in-person public meetings necessary to prepare the required GSP. This has left both the Lassen and Modoc Groundwater Sustainability Agencies (GSAs) with few options. Many around the state have turned to internet-based meetings during this pandemic. However, conducting meetings through the internet is a poor substitution in Big Valley because there is not sufficient internet access. Further, we do not have sufficient resources to conduct internet-based meetings in a meaningful way. Again, our letter to you describes our challenges in great detail.

Even though the GSP deadline is still a little over a year away, it is clear that we do not have enough time to prepare a GSP supported by the level of public participation a plan of this magnitude deserves. Lassen County and the residents of Big Valley have accepted the responsibility required by SGMA to prepare the GSP when no one else would. Neither Lassen County or Modoc County were required by SGMA to accept the responsibility (financially and in terms of land use responsibility) to serve as the GSAs for Big Valley, but that is exactly what we have done. We have more than demonstrated our willingness to meet the challenges presented by SGMA head-on. That said, if we are going to prepare this GSP, it is in the interest of everyone, including you, that it be done right.

This was a serious enough subject to warrant passage of SGMA and signature by the prior Governor. We can assure you that preparation of the GSP for the Basin is certainly a matter of direct concern to the citizens of Big Valley. As such, this Board deserves an answer to our letter, and, even more so, the citizens of Big Valley deserve the courtesy of an answer, even if the answer is contrary to our request. To give the GSP the service it truly deserves, we simply need a little more time. That's all.

Thank you for considering our request and we look forward to your prompt response.

Thank you in advance,

Aaron Albaugh

Aaron Albaugh, Chairman
Lassen County Board of Supervisors

DT:MLA:gfn

cc: Brian Dahle, Senator, California Senate
Megan Dahle, Assembly Member, California State Assembly
Modoc County Board of Supervisors as the Big Valley Modoc GSA
Big Valley Groundwater Basin Advisory Committee
Department of Water Resources

County of Lassen
Board of Supervisors

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March 23, 2021

CERTIFIED RETURN RECEIPT
7017 0660 0000 6271 1758
Gavin Newsom
Governor, State of California
1303 10th Street
Sacramento, CA 95814

COPY

RE: Inquiry Regarding the February 16, 2020, Letter Requesting an Extension for Submittal of a Groundwater Sustainability Plan for the Big Valley Groundwater Basin (DWR Bulletin 118 Basin 5-004)

Dear Governor Gavin Newsom:

This letter is to request a response from you to our letters to you dated February 16, 2021, August 11, 2020 and November 17, 2020 (attached), in regard to preparation of the Groundwater Sustainability Plan (GSP) required to be submitted to the Department of Water Resources by January 31, 2022, pursuant to the Sustainable Groundwater Management Act of 2014 (SGMA), for the Big Valley Groundwater Basin. To date, we have not received communication of any type regarding said letter (by telephone, letter or email).

As stated in more detail in our previous letter, Government imposed COVID-19 restrictions have drastically limited our ability, and the public's willingness, to have the in-person public meetings necessary to prepare the required GSP. This has left both the Lassen and Modoc Groundwater Sustainability Agencies (GSAs) with few options. Many around the state have turned to internet-based meetings during this pandemic. However, conducting meetings through the internet is a poor substitution in Big Valley because there is not sufficient internet access. Further, we do not have sufficient resources to conduct internet-based meetings in a meaningful way. Again, our letter to you describes our challenges in great detail.

The GSP deadline is approximately 7 months away and it is clear that we do not have enough time to prepare a GSP supported by the level of public participation a plan of this magnitude deserves. Lassen County and the residents of Big Valley have accepted the responsibility required by SGMA to prepare the GSP when no one else would. Neither Lassen County or Modoc County were required by SGMA to accept the responsibility (financially and in terms of land use responsibility) to serve as the GSAs for Big Valley, but that is exactly what we have done. We have more than demonstrated our willingness to meet the challenges presented by SGMA head-on. That said, if we are going to prepare this GSP, it is in the interest of everyone, including you, that it be done right.

This was a serious enough subject to warrant passage of SGMA and signature by the prior Governor. We can assure you that preparation of the GSP for the Basin is certainly a matter of direct concern to the citizens of Big Valley. As such, this Board deserves an answer to our letter, and, even more so, the citizens of Big Valley deserve the courtesy of an answer, even if the answer is contrary to our request. To give the GSP the service it truly deserves, we simply need a little more time or simply remove the Government imposed regulations. That's all.

Thank you for considering our request and we look forward to your prompt response.

Thank you in advance,

Aaron Albaugh

Aaron Albaugh, Chairman
Lassen County Board of Supervisors

AA:MLA:gfn

cc: Brian Dahle, Senator, California Senate
Megan Dahle, Assembly Member, California State Assembly
Modoc County Board of Supervisors as the Big Valley Modoc GSA
Big Valley Groundwater Basin Advisory Committee
Department of Water Resources

County of Lassen
Board of Supervisors

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County Administration Office
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April 13, 2021

CERTIFIED RETURN RECEIPT
7017 0660 0000 6271 3752 & 7017 0660 0000 6271 3745

Assembly Member Eduardo Garcia
Chair of the Water, Parks, and Wildlife Committee
Legislative Office Building
1020 N. Street, Room 160
Sacramento, CA 95814

Assembly Member Megan Dahle
Vice Chair of the Water, Parks, and Wildlife Committee
Legislative Office Building
1020 N. Street, Room 160
Sacramento, CA 95814

Dear Chair Garcia and Vice Chair Dahle:

This letter is in support of Assembly Bill 754, which was introduced by Assembly Member Devon Mathis. Said Assembly Bill was referred to the Water, Parks, and Wildlife Committee on March 15, 2021. In summary, this bill would extend the due date to January 31, 2023, for Groundwater Sustainability Agencies (GSA) in basins that are not critically over drafted to submit a Groundwater Sustainability Plan (GSP) to the Department of Water Resources.

Lassen County and Modoc County serve as the GSAs for the Big Valley Groundwater Basin, for the portion of the basin within their respective jurisdiction. Said GSAs have been working cooperatively (through a memorandum of understanding) to prepare a single GSP for the entire basin.

Preparation of said GSP has been negatively impacted by the Governor's Executive Orders. Specifically, the Governor's order has made it difficult to conduct the public outreach needed to prepare the plan. Over the last year, the public has been less inclined to meet physically because of the Executive Orders. We have attempted to accommodate by conducting more internet and phone-based meetings. However, internet connectivity in Big Valley is exceedingly poor and the basin is not well situated to allow online type public meetings. We were very pleased to see proposed legislation to provide more time to submit the required GSP. In fact, on August 11, 2020, we sent a letter to the legislature requesting additional time (see attached) for this very reason (lack of ability to have meaningful public dialogue because of COVID-19). We have also sent multiple letters to the Governor, requesting an executive order allowing more time.

If adopted, this legislation will greatly improve upon the GSP that is ultimately adopted by ensuring the time needed for adequate public participation. The above said, please understand that we support this legislation only to the extent that it will provide more time to submit the required GSP. We are not supportive at all of the bill becoming a vehicle to legislate additional requirements. It is our position that the requirements of the Sustainable Groundwater Management Act are already too onerous, especially in basins like ours that were only designated a "medium priority basin" by half of one point.

Sincerely,

Aaron Albaugh

Aaron Albaugh, Chairman,
Lassen County Board of Supervisors
Big Valley Lassen Groundwater Sustainability Agency

AA:MLA:gfn
Enclosure

cc: Devon Mathis, Assembly Member, California State Assembly
Modoc County Board of Supervisors as the Big Valley Modoc GSA
Rural County Representatives of California (RCRC)
California State Association of Counties (CSAC)

County of Lassen
Board of Supervisors

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Susanville, CA 96130
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April 27, 2021

CERTIFIED RETURN RECEIPT
7020 1290 0000 0270 7649

Gavin Newsom
Governor, State of California
1303 10th Street
Sacramento, CA 95814

RE: Inquiry Regarding the March 23, 2021, Letter Requesting an Extension for Submittal of a Groundwater Sustainability Plan for the Big Valley Groundwater Basin (DWR Bulletin 118 Basin 5-004)

Dear Governor Gavin Newsom:

This letter is to request a response from you to our letters to you dated March 23, 2021, February 9, 2021, November 17, 2020, and August 11, 2020 (attached), in regard to preparation of the Groundwater Sustainability Plan (GSP) required to be submitted to the Department of Water Resources by January 31, 2022, pursuant to the Sustainable Groundwater Management Act of 2014 (SGMA), for the Big Valley Groundwater Basin. To date, we have not received communication of any type regarding said letter (by telephone, letter or email).

As stated in more detail in our previous letter, your Executive Orders have drastically limited our ability, and the public's willingness, to have the in-person public meetings necessary to prepare the required GSP. This has left both the Lassen and Modoc Groundwater Sustainability Agencies (GSAs) with few options. Many around the state have turned to internet-based meetings during this pandemic. However, conducting meetings through the internet is a poor substitution in Big Valley because there is not sufficient internet access. Further, we do not have sufficient resources to conduct internet-based meetings in a meaningful way. Again, our letter to you describes our challenges in great detail.

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **GAVIN NEWSOM**, *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

June 3, 2021

County of Lassen
Board of Supervisors
ATTN: Chairman David Teeter
221 S. Roop Street, Suite 4
Susanville, CA 96130

Dear Chaiman Teeter,

On behalf of Governor Newsom, I first want to thank you for your dedicated leadership in your community during these challenging times. The COVID-19 pandemic is a continuing and unprecedented global crisis and it has impacted our communities across California in many ways. I appreciate your attention to these impacts weighing on your community.

Your recent letter(s) submitted to the Governor requests an extension of the deadline for submitting your groundwater sustainability plan (GSP) to the Department of Water Resources (DWR) and highlights your concerns over your ability to ensure robust public outreach and stakeholder engagement with the limitations on public interaction resulting from COVID-19. We recognize the limitations all state and local entities have experienced with holding meetings virtually, especially in rural and mountainous areas where internet connectivity is less available and reliable. Despite these COVID-19 challenges, public agencies, such as yours, are continuing to provide their best efforts to ensure public engagement and oversight of activities in the public's interest.

With this in mind, a suspension or change to the submittal deadline cannot be granted. The GSP submittal process and deadline is in the Sustainable Groundwater Management Act (SGMA), which cannot be changed without an amendment to the law and approval by the Legislature. If a local agency does not submit a GSP by the statutory deadline, DWR is required to refer the basin to the State Water Board for intervention.

The Administration is committed to the central tenant of SGMA which is local control. To facilitate such, SGMA establishes a timeframe of 20 years for basins to achieve their sustainability goals and provides an outcome-based process for SGMA implementation to occur. Through this outcome-based process, local agencies have an opportunity to improve plans and continue public outreach over time. A number of DWR and other state agency assistance programs have been established to help with public outreach and to assist groundwater managers in maintaining local control throughout GSP development and implementation.

DWR values the working partnership with water managers in your basin, which have been established through continued dialogue and dedicated planning and financial assistance (summarized in Attachment A) to support your plan development and facilitate engagement among stakeholders. If you find your local outreach efforts lacking, even with this assistance and the efforts we have collectively undertaken, I encourage you to review the attached summary of state assistance (Attachment B) and reach out to my staff (identified below) so you can use all applicable programs that will aid in your local SGMA efforts.

For these reasons, I encourage you to continue working towards submitting your GSP by the statutory deadline. Within that plan, you may identify any data gaps, including how stakeholder engagement has been impacted by COVID-19, and document the next steps that will be taken to fill those gaps. As locals continue to conduct engagement efforts, GSAs can amend their plans at any time to reflect stakeholder input. This documentation in the GSP will allow DWR to understand your planning efforts and complete the evaluation of your plan. Given this information, DWR will be able to align future assistance to continue to support locals in implementing their GSP and filling the specified data gaps.

Please contact Acting Deputy Director Steven Springhorn (Steven.Springhorn@water.ca.gov) or DWR's Northern Region Office Chief Teresa Connor (Teresa.Connor@water.ca.gov) if you have any additional questions, or if you need help in navigating moving forward.

Sincerely,

Karla Nemeth

Karla A. Nemeth

cc:
The Honorable Gavin Newsom, Governor, State of California
The Honorable Toni G. Atkins, President pro Tempore, California State Senate
The Honorable Anthony Rendon, Speaker, California State Assembly
The Honorable Brian Dahle, California State Senate
The Honorable Megan Dahle, California State Assembly
Christine Hironaka, Deputy Cabinet Secretary, Office of the Governor
Angela Pontes, Deputy Legislative Secretary, Office of the Governor
Sidd Nag, Legislative Advocate, Rural County Representatives of California
Catherine Freeman, Legislative Representative, California State Association of Counties
Gaylon Norwood, Assistant Director, County of Lassen GSA

Enclosure:
Attachment A: Summary Table of DWR Facilitation and Grant Funding Support
Attachment B: Summary of Statewide SGMA Assistance (June 2021)

Attachment A:

Summary Table of DWR Facilitation and Grant Funding Support				
Subbasin	**Funding Recipient**	**DWR Facilitation Funding**	**DWR Planning Funding**	**Total DWR Funding Support**
Vina Subbasin, Butte Subbasin, Wyandotte Creek Subbasin	Butte County	$173,000	$1,498,800	**$1,725,800**
Vina Subbasin	Vina GSA	$54,000	–	
Big Valley Basin	County of Modoc GSA	$82,000	$987,660	**$2,068,845**
	Lassen County	–	$999,185	
Colusa Subbasin	Colusa County	$112,000	–	**$2,171,600**
	Colusa Groundwater Authority	$60,000	$1,999,600	

Attachment B:

Summary of Statewide SGMA Assistance
(As of June 2021)

The State is committed to supporting locals to develop and implement their Groundwater Sustainability Plans (GSPs). In addition to the two agencies (Department of Water Resources and State Water Resources Control Board) with defined roles in SGMA, there are other State agencies with existing programs that support local groundwater management. The following summarizes that assistance.

Department of Water Resources (DWR)

Since 2015 DWR has provided planning, technical, and financial assistance to support locals with SGMA implementation.

Planning Assistance

- **Basin Points of Contact/Regional Coordinators:** Each of the 94 high- and medium- priority basins are assigned a Point of Contact (POC) and a Regional Coordinator (RC) from DWR Region Offices. POCs and RCs assist Ground Sustainability Agencies and stakeholders in the basin to connect with DWR and locate resources for assistance. The following links contain each basin's POC and their respective contact information:
    - Northern Region – RC: Pat Vellines (Patricia.Vellines@water.ca.gov)
    - North Central Region – RC: Chelsea Spier (Chelsea.Spier@water.ca.gov)
    - South Central Region – RC: Amanda Peisch-Derby (Amanda.Peisch@water.ca.gov)
    - Southern Region – RC: Brian Moniz (Brian.Moniz@water.ca.gov)

- **Facilitation Support Services (FSS):** Provides professional facilitators to help Groundwater Sustainability Agencies (GSAs) foster discussions among diverse water management interest groups.
    - GSAs or other groups coordinating with the GSAs to develop GSPs, are eligible to apply on a continuous basis using the following link: https://sgma.gsae.water.ca.gov/SGMPUB/Facilitation/2020/FSSApp2020.aspx

- **Written Translation Services (WTS):** Available to help GSAs, or other groups assisting in local SGMA implementation efforts, to communicate the groundwater planning activities with their non-English speaking constituents.
    - GSAs or other groups coordinating with the GSAs to develop GSPs, are eligible to apply on a continuous basis using the following link: https://sgma.gsae.water.ca.gov/SGMPUB/Translation/TranslationServiceRequest.aspx

Technical Assistance

- **Technical Support Services (TSS):** Provides DWR technical staff and drilling and other contractors to assist GSAs with the installation of dedicated groundwater monitoring wells and other monitoring stations to fill data gaps identified in the basins.
    - For more information or help starting a TSS application, contact DWR's Region Coordinators at sgmp_rc@water.ca.gov

- **Data and Tools:** Statewide datasets and models have been developed to assist GSAs and the public by providing information to help inform the development of GSP elements. The following datasets and tools have been made available:

- Eight new online interactive maps for the public to view and download SGMA datasets: groundwater levels, wells, environmental, land use, and subsidence data
- A water resources management and planning model that simulates groundwater, surface water, stream-groundwater interaction (C2VSim-FG)
- https://water.ca.gov/Programs/Groundwater-Management/Data-and-Tools

- **Guidance and Education:**
  - Six Best Management Practices (BMPs) and five Guidance Documents to provide clarification, guidance, and examples to help GSAs develop elements of a GSP.
  - California's Groundwater Update: State's official publication on the occurrence and nature of groundwater in California.

Financial Assistance

- **Sustainable Groundwater Management (SGM) Grant Programs:**
  - **SGM Planning Grant Program:** provides funds to develop and implement sustainable groundwater planning and projects. Approximately $150 million (M) has been awarded to date through three rounds of solicitations. Funding has been provided by Proposition 1 and Proposition 68.
  - **SGM Implementation Grant Program:** designed to fund projects and programs that will assist GSAs implement their GSPs. Proposition 68 authorized ~$100M for this new program.
    - The FY 20/21 Budget directed the acceleration of $26M for the critically overdrafted (COD) basins responsible for implementing GSPs or Alternatives to a GSP. Final awards for this first round were announced April 23, 2021.
    - The second round for the remaining funds will begin in early 2022.

- **Integrated Regional Water Management (IRWM) Implementation Grant Program**: provides funding for projects and programs that implement an IRWM Plan, including groundwater management projects. Approximately $220M of Proposition 1 funding has been awarded in 2019/2020.
  - Another $180M in Proposition 1 funds will be available in 2021-2022 timeframe.

- **Drainage Reuse Grant Program**: provides funds to local public agencies, including public universities, in the state of California for research and/or programs that resolve agricultural subsurface drainage water issues. The program is funded by Proposition 204, through the California Department of Food and Agriculture (CDFA), who has entered into a memorandum of understanding to transfer the funds, as well as the responsibility for implementing the programs required by the legislation, to DWR. Approximately $1.1M was awarded in 2020.

State Water Resources Control Board (State Water Board)

SGMA requires the State Water Board protect basins that are not managed sustainably through a process called State Intervention. In addition to this responsibility, the State Water Board has initiated assistance that will support locals with SGMA implementation. Assistance has been organized and distributed by the following categories:

Planning Assistance

- **Recharge Permitting Options**: Capturing surface water to artificially recharge groundwater aquifers is a potential method for improving groundwater basin conditions. To help support this method, the Division of Water Rights has developed a streamlined permitting process for diversions of water from high flow events to underground storage.

- Streamlining is primarily achieved through identifying eligibility criteria and a simplified water availability analysis targeting diversion of high flow events during winter.
- Temporary water right permits for groundwater recharge may be appropriate for short-term projects where an urgent need exists.
- New legislation through AB 658 gave the State Water Board a new 5-year temporary permitting option, also authorizing a 5-year temporary change petition.

Technical Assistance

- **Water Availability Tool**: State Water Board staff has developed an interactive Fully Appropriated Stream Systems (FASS) GIS Web Map, which provides users with information on fully appropriated stream systems, including seasonal limitations, relevant court references, and Board decisions/orders.
  - The interactive map can be accessed online and includes an overview and quick reference guide.
  - State and Federal Wild and Scenic Rivers are included as separate layers in the web map, as those systems also have limitations on new water right applications.

Financial Assistance

- **Groundwater Grant Program**: will administer a total of $800M to prevent and cleanup contamination of groundwater that serves (or has served) as a source of drinking water. The funds are available as planning grants and construction grants.
  - Round 3 Solicitation is expected to open in Summer 2021.

- **Water Recycling Funding Program (WRFP)**: promotes the beneficial use of treated municipal wastewater to augment fresh water supplies in California, by providing technical and financial assistance to agencies and other stakeholders in support of water recycling projects and research. The funds are available as planning grants and construction grants.

- **Clean Water State Revolving Fund (CWSRF) Program**: provides low-interest loans to public agencies for planning, design, and construction of water recycling projects.

- **Small Community Funding**: is available to help small DACs, providing drinking water service to less than 10,000 people or wastewater service to less than 20,000 people, with: technical assistance needs, interim water supplies, and implement eligible drinking water or wastewater capital improvement projects. The funds are available as planning grants and construction grants.

- **Drinking Water State Revolving Fund (DWRSF) program**: assists public water systems in financing the cost of drinking water infrastructure projects needed to achieve or maintain compliance with Safe Drinking Water Act requirements. The funds are available as planning grants and construction grants.

- **Groundwater Treatment and Remediation Grant Program**: will administer $74M in grants from Proposition 68 for treatment and remediation activities that prevent or reduce the contamination of groundwater that serves as a source of drinking water.

Department of Conservation (DOC)

The DOC offers financial incentive programs to further California's goals to conserve agricultural lands, restore and manage watersheds, and reduce greenhouse gas emissions.

- **2020 Sustainable Groundwater Management Watershed Coordinator (SGMA) Grant Program**: awards funding for watershed coordinators that will build broad coalitions of government, stakeholders, and communities to develop plans and projects to improve watershed health and meet California's groundwater sustainability goals. Awarded $1.5M in January 2021.

- Sustainable Agricultural Lands Conservation (SALC) Program: SALC is a component of the SGC's Affordable Housing and Sustainable Communities (AHSC) Program. SALC complements investments made in urban areas with the purchase of agricultural conservation easements, development of agricultural land strategy plans, and other mechanisms that result in GHG reductions and a more resilient agricultural sector.
    - Draft Guidelines for Round 7 were released February 19, 2021

Department of Food and Agriculture (CDFA)

CDFA supports agricultural production by incentivizing practices resulting in a net benefit for the environment through innovation, efficient management and science.

- State Water Efficiency and Enhancement Program (SWEEP): provides grant funding to implement irrigation systems that reduce greenhouse gases and save water on California agricultural operations. Eligible system components include (among others) soil moisture monitoring, drip systems, switching to low pressure irrigation systems, pump retrofits, variable frequency drives and installation of renewable energy to reduce on-farm water use and energy. Approximately, $81.1M has been awarded to date to nearly 835 projects, covering over 137,000 acres. CDFA estimates that over 81,000 metric tons of CO_2 emissions will be reduced annually.

- Healthy Soils Program (HSP): consists of two components: the HSP Incentives Program and the HSP Demonstration Projects.
    - HSP Incentives Program provides financial assistance for implementation of conservation management that improve soil health, sequester carbon and reduce greenhouse gas emissions. The 2020 HSP Incentives Program selected 324 projects for award, requesting almost a total of $22M.
    - HSP Demonstration Projects showcase California farmers and rancher's implementation of HSP practices. The 2020 HSP Demonstration Projects selected 20 projects for award, requesting a total of over $2.9M.

Appendix 11B List of Public Meetings

Meetings Held By Lassen and Modoc Counties Related to GSP Development

Event	GSA(s)	Date	Time	Location
Special Joint Meeting of the Lassen County and Modoc County Board of Supervisors	Lassen County, Modoc County	2/23/2016	2:00:00 PM	Adin Community Building 609 Main Street Adin, CA 96006
Meeting of the Lassen-Modoc County Flood Control and Water Conservation District	Lassen County, Modoc County	2/23/2016	2:00:00 PM	Adin Community Building 609 Main Street Adin, CA 96006
Public Outreach Meeting	Lassen County, Modoc County	1/27/2017	9:00:00 AM	Bieber Veterans Memorial Hall 657-575 Bridge Street Bieber, CA 96009
Meeting of Modoc County Board of Supervisors	Modoc County	2/28/2017	10:00:00 AM	Board of Supervisors Room 204 South Court Street #203 Alturas, CA 96101
Lassen County Board of Supervisors Meeting	Lassen County	3/14/2017	9:00:00 AM	Board Chambers 707 Nevada Street Susanville, CA 96130
Public Outreach Meeting June 2019	Lassen County, Modoc County	6/3/2019	2:00:00 PM	Bieber Veterans Memorial Hall 657-575 Bridge Street Bieber, CA 96009
Public Outreach Meeting Sept 2019	Lassen County, Modoc County	9/4/2019	4:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	2/3/2020	4:00:00 PM	Bieber Veterans Memorial Hall 657-575 Bridge Street Bieber, CA 96009
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	3/4/2020	4:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	5/6/2020	4:00:00 PM	Bieber Veterans Memorial Hall 657-575 Bridge Street Bieber, CA 96009
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	7/1/2020	4:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Special Meeting	Lassen County, Modoc County	9/24/2020	4:00:00 PM	Bieber Veterans Memorial Hall 657-575 Bridge Street Bieber, CA 96009
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	11/4/2020	4:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Special Meeting	Lassen County, Modoc County	12/2/2020	4:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	2/3/2021	4:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Special Meeting	Lassen County, Modoc County	3/3/2021	4:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Groundwater Management Workshop	Lassen County, Modoc County	3/24/2021	5:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	4/7/2021	4:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Special Meeting	Lassen County, Modoc County	5/5/2021	2:00:00 PM	Bieber Veterans Memorial Hall 657-575 Bridge Street Bieber, CA 96009
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	6/2/2021	2:00:00 PM	Adin Community Center 605 Highway 299 Adin, CA 96006
Big Valley Groundwater Basin Advisory Committee (BVAC) Meeting	Lassen County, Modoc County	7/7/2021	2:00:00 PM	Bieber Veterans Memorial Hall 657-575 Bridge Street Bieber, CA 96009

Assembled 6/18/2021

Appendix 11C Brochure Summarizing the Big Valley GSP May 2021

Summary of the Big Valley Groundwater Sustainability Plan

bigvalleygsp.org

May 2021

In 2014, California's Sustainable Groundwater Management Act (SGMA) was signed into law, requiring local governments and agencies in groundwater basins designated as high and medium priority to create governance structures and develop, adopt, and implement a Groundwater Sustainability Plan (GSP) for each basin. The Big Valley Groundwater Basin (BVGB) is identified as a medium-priority basin by the California Department of Water Resources (DWR) and is therefore subject to SGMA. The "high" and "medium" designations were assigned by DWR prior to the adoption of SGMA. Local agencies in the BVGB contested the medium-priority designation, which DWR denied, and are preparing a GSP to comply with the law because non-compliance may result in intervention by the State Water Board. Intervention could include metering, reporting, and fees for pumping groundwater. All formal basin-priority challenges have been denied to-date but may be revisited in the future.

Location and Boundaries

BVGB is a small basin in the north-eastern region of California. It encompasses a 144-square-mile area located in portions of Modoc and Lassen counties, including the unincorporated communities of Adin, Lookout, Bieber, and Nubieber. SGMA applies only to the areas inside the basin boundary (**Figure 1**), but GSP projects may include areas outside the boundary. The boundary lacks accurate detail in places and does not follow the DWR boundary definition, so leaders in the BVGB submitted a basin boundary modification request to DWR in 2016 that was denied. There are plans to submit another basin boundary modification request in the future.

GSP Content and Structure

Governments and agencies in basins subject to SGMA form one or more Groundwater Sustainability Agencies (GSA) to develop a GSP and oversee its implementation. The two counties, Lassen and Modoc, have designated themselves as the GSAs for the Basin and that designation has been confirmed by DWR. The counties took on this huge responsibly because no other local agencies were able to serve as the GSAs. If the counties had not agreed to be the GSAs, the State Water Board would have assumed management responsibility (e.g.. "intervention"). Each GSA manages the portion of the basin in its county. In 2019, the Big Valley Groundwater Basin Advisory Committee (BVAC) was formed to advise the GSAs on preparation of a single GSP for the entire BVGB. The BVAC consists of representatives from each county's board of supervisors and two BVGB residents from each county who were appointed by the GSAs after extensive outreach was conducted to all residents of the BVGB. The BVAC holds regular meetings which are open to the public. Meeting information can be found on the Big Valley GSP website: https://bigvalleygsp.org.

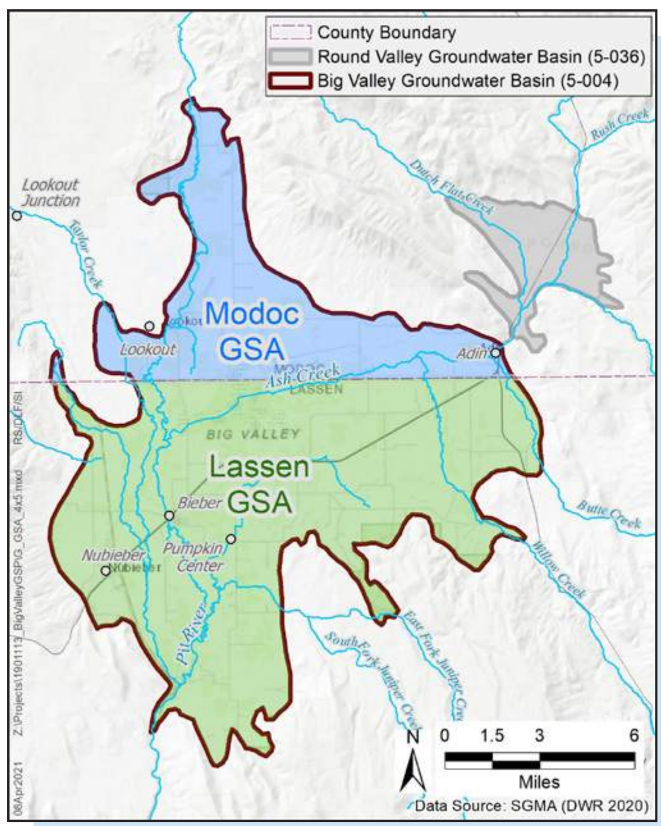

FIGURE 1: BIG VALLEY GROUNDWATER BASIN AND GSA BOUNDARIES

Physical Characteristics

The BVGB GSP follows a very specific structure because SGMA regulatory requirements dictate the information that must be contained within the document. First, the GSP must describe the general background and physical characteristics of the groundwater basin. In the BVGB GSP, this information is covered in Chapters 1 through 4 as follows:

- **Chapter 1.** Introduction to BVGB
- **Chapter 2.** Agency Information
- **Chapter 3.** Plan Area
- **Chapter 4.** Hydrogeologic Conceptual Model

Plan Area (Chapter 3) and Hydrogeologic Conceptual Model (Chapter 4) introduce important information, such as land use, geology, and hydrology, that will be used to make decisions throughout the planning process. They are based on the best available scientific data, but also include assumptions where reliable data is not available. The term 'hydrogeologic conceptual model' refers to a written description of the physical characteristics of the basin – where the water flows, the makeup of the soils, how deep the groundwater is, etc.

Drafts of Chapters 1 through 4 were developed in 2020, reviewed by the BVAC and the public, and "set aside" in order to move forward with the GSP. They will be revisited once the entire document is assembled. The "set aside" drafts are available and open for comment on the home page of the BGVB website (https://bigvalleygsp.org). Previous chapter versions, comments submitted, and other relevant information is available on the documents page. **Figures 2 and 3** show data highlights from Chapters 3 and 4 of the GSP.

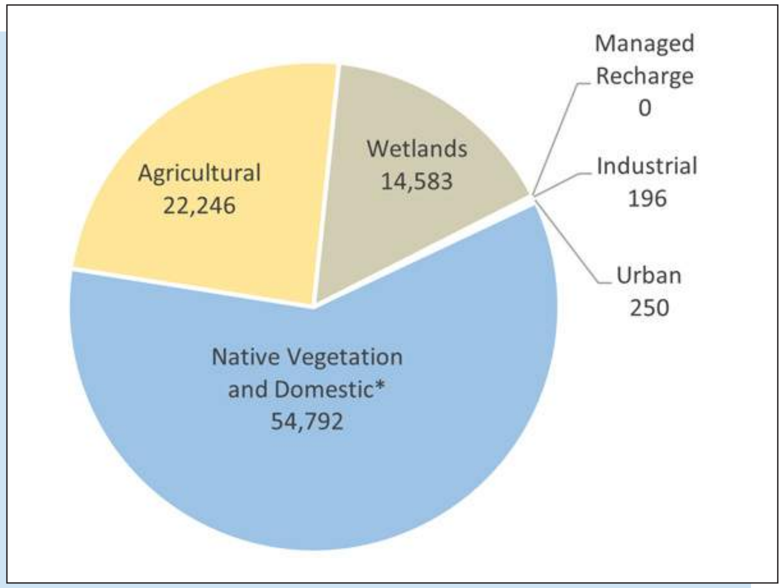

FIGURE 2: BIG VALLEY GROUNDWATER BASIN LAND USE

* Domestic use generally occurs in conjunction with agricultural and native vegetation and is best categorized with native vegetation, as most of the agricultural area is delineated by field and does not include residences.

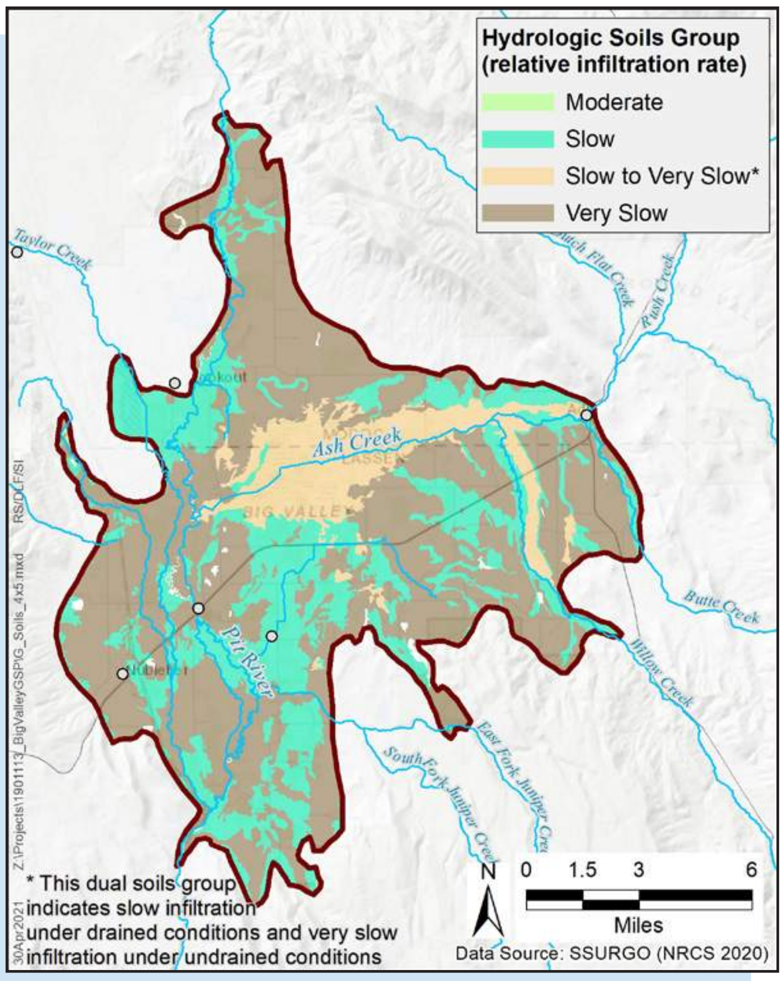

FIGURE 3: BIG VALLEY GROUNDWATER BASIN HYDROLOGIC SOILS GROUPS

Groundwater Conditions

Professional geologists and hydrogeologists examined data from wells throughout BVGB to determine groundwater conditions. They observed that most areas of the BVGB have experienced little to no change in water levels, while other areas have fluctuated more. They also found that groundwater in the BVGB is generally of excellent quality. The details of their findings are available in BVGB GSP **Chapter 5. Groundwater Conditions** (which has been temporarily "set aside" by the BVAC). Chapter 5 also includes other data required by the GSP regulations including changes in groundwater storage, water quality, land subsidence, and interconnected surface water. None of these indicators have shown undesirable results. **Figure 4** shows the estimated direction of groundwater flow in the BVGB.

An important tool to monitor groundwater sustainability is a water budget. BVGB GSP **Chapter 6. Water Budget** ("set aside") has estimates of the volume of water flowing into and out of the basin – from causes such as rain, rivers, and evaporation. Comparing the volumes of water entering and exiting the basin indicates if the basin is in balance, is in overdraft, or has surplus water. **Figure 5** shows the draft historical water budget (1984 to 2018).

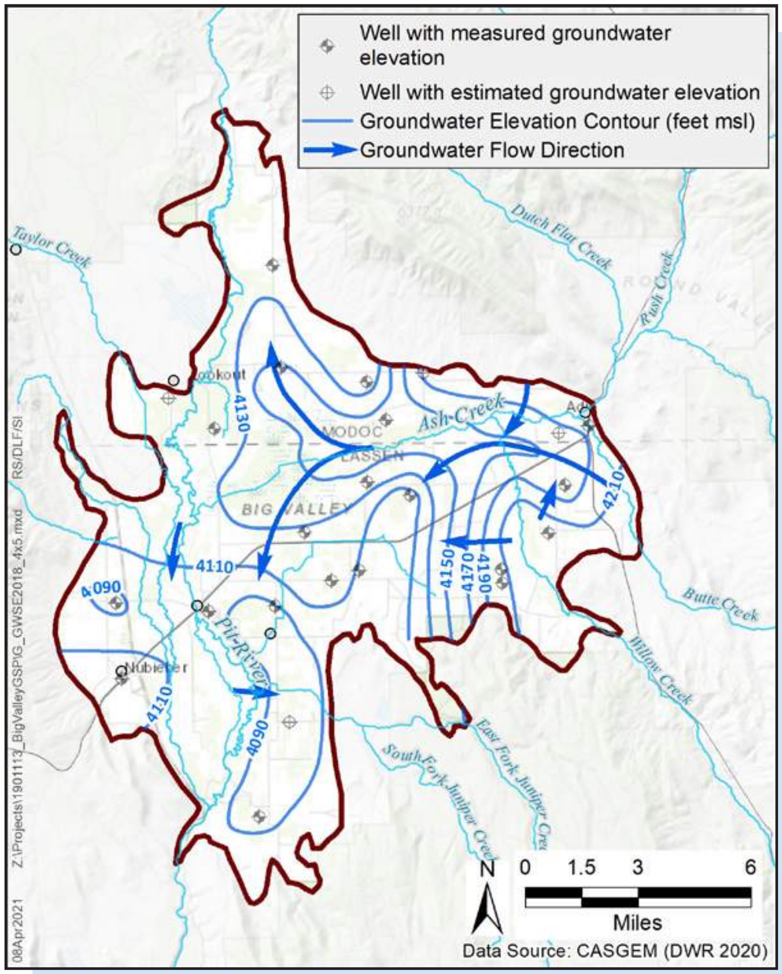

FIGURE 4: BIG VALLEY GROUNDWATER BASIN GROUNDWATER CONTOURS AND ESTIMATED FLOW DIRECTION

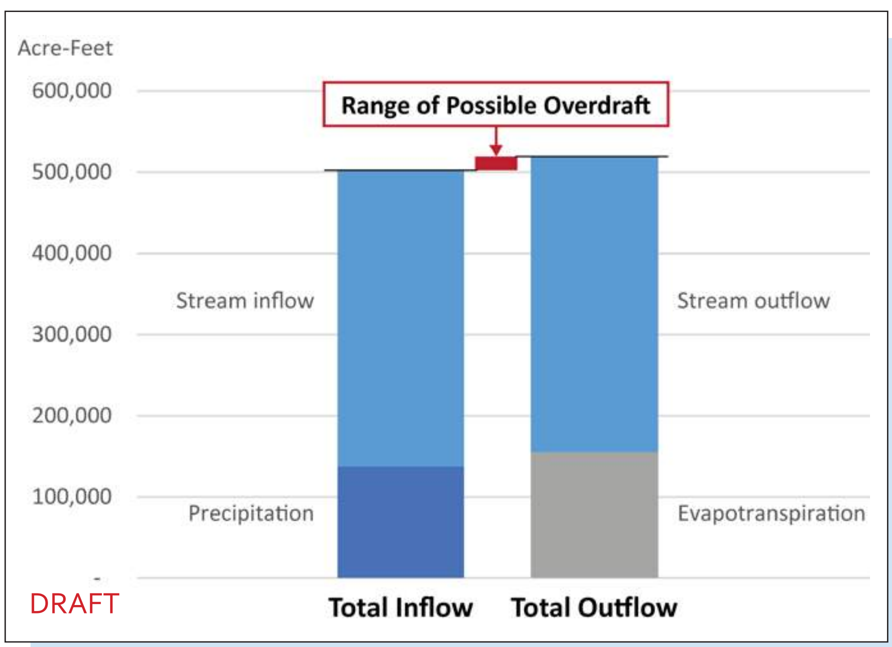

FIGURE 5: DRAFT AVERAGE ANNUAL WATER BUDGET (1984–2018)

Figure 6 shows the change in groundwater storage and indicates that most of the deficit is due to the 2000-2018 time frame being drier than it had been historically. Conversely, the extended wet periods that occurred in the late 1990s caused groundwater levels to recover.

FIGURE 6: CUMULATIVE CHANGE IN STORAGE (1982-2018)

Up Next: Projects and Actions

The next steps in the GSP process are to set measurable criteria to track progress toward sustainability and to define projects and actions to help move the basin toward sustainable groundwater management. The BVAC and GSAs are currently developing these items, and **you are invited** to participate.

How to Participate

- Register as an interested party on our website: https://bigvalleygsp.org.
- Attend BVAC meetings, which are advertised to interested parties and viewable on the online calendar: https://bigvalleygsp.org/calendar.
- View draft GSP documents and offer your comments using the online form: https://bigvalleygsp.org/comment/new.

Thank you for your interest in the Big Valley GSP.

Appendix 11D Comment Matrix

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
Public Draft Chapters 1 and 2	Section 1.2, line 23	Prove description of Lassen County Basin. DWR boundary definitions and the GSP need to be more specific.	3/4/2020	The boundaries of the basin are established by DWR in their Bulletin 118 for SGMA. A basin boundary modification process is allowed under SGMA and can be investigated, but is outside the scope of writing the GSP. A background section has been added to Chap 1 that describes the County's request for basin boundary modification that was denied by DWR.
Public Draft Chapters 1 and 2	Section 1.3	DWR prioritization criteria are subjective. Groundwater irrigated acres need to be differentiated from surface water irrigation. DWR doesn't respond to questions.	3/4/2020	A section was added describing the basin prioritization process and the interaction between the counties and DWR regarding the ranking. DWR's dataset that they used to determine irrigated acres is documented on their website. The acreage irrigated by groundwater will be evaluated in Chapter 6: Water Budget. The extent of lowering groundwater levels in the basin will be evaluated in Chapter 5: Groundwater Conditions. DWR's lack of responsiveness to questions is noted.
Public Draft Chapters 1 and 2	Chap 2 Line 61	Add that GSA was established because we have to, it is not voluntary	3/4/2020	A Background section was added describing the basin prioritization, basin boundary modification request, and correspondence between the counties and DWR. The overarching message of this new text is to document that the counties did not start this process willingly. Wording was changed in Chap 2 to add the word "mandate" when referring to SGMA to emphasize that compliance with this law is not voluntary.
Public Draft Chapters 1 and 2	Page #: 1.1, Line #: 6,7,&8	1.1 Lines 6,7,&8 Should state in the body with verbiage of the fact that the Stake Holders" contested DWR findings and protested the priority ranking.1.3 Line 54 graphWhat is it? Where do these numbers come from?I also think that we should refer to the land owners with wells effected by the basin should be referred to as "Stake Holders"	3/5/2020	A background section has been added to Chap 1 that describes the prioritization and the Counties' responses. DWR provides some of the data it used for prioritization on its website, at the URL shown on Line 53. Use of the term "stakeholders" will be defined and used in future chapters.

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
Public Draft Chapters 1 and 2	Page #: 1-2, Line #: 42	I would like to recommend that the description of the boundary of the Big Valley Basin be amended to include the water delivery sources which feed into the water table of the valley. These water sources are varied and include a number of perennial and ephemeral drainages, springs and reservoirs. For example:North: Halls Canyon Creek, Howell Canyon Creek, Fox Draw, Hayes Canyon and seventeen (17) Unnamed ephemeral drainages along Barber and Ryan Ridges.East: Ash Creek, Butte Creek and seven (7) Unnamed Ephemeral drainages.South: Willow Creek, Juniper Creek, Juniper Creek Ã¢Â€Â“ South Fork, Hot Springs Slough, Gobel Slough, Big Valley Canal and twenty (20) Unnamed ephemeral drainages.West: Taylor Reservoir, Kramer Reservoir, Lower Roberts Reservoir, Taylor Creek, Widow Valley Creek, Bull Run Slough, Egg Lake Slough and fifteen (15) Unnamed ephemeral drainages.My reasoning for this recommendation to include these delivery systems is due to the topographic gradients that assist in the recharging of the Big Valley Basin groundwater. The Pit River itself offers limited influence on recharging groundwater levels to the West and southwest areas of the basin. It offers very little to no influence to the north, east and southern areas. The elevation gradient in the basin varies approximately from 4450 feet in the east to 4160 feet in the westÃ¢Â€Â¦ a drop of a few hundred feet. These areas are vital to not only modeling the water budget for the Basin, but provide potential areas for remediation projects. It will make it easier for project planning in the future since we will not have to go through amending the original boundaries at a later date.Although DWR Bulletin 118 determines the boundary based on alluvial deposits, the basin does not exist in an environmental vacuum and is dependent upon all of its water delivery systems.	3/8/2020	A background section has been added to Chap 1 that, in part, describes Lassen County's request for a basin boundary modification that was denied by DWR in 2016. DWR will again accept requests for basin boundary modifications in 2023. The current GSP will need to honor the currently established basin boundary. With that said, the GSP will acknowledge the importance of areas outside the basin on recharge. Projects and management actions described in the Plan are not restricted to being inside the groundwater basin.
Public Draft Chapter 3	Section 3.1 lines 23-34	Says that Round Valley is separated from the basin by a 1/2 mile gap. What is the proof of that?	5/6/2020	This text describes how the basin boundaries were drawn by DWR. The text has been updated to reflect this. Connectivity to the Round Valley groundwater basin may be investigated at a later time.
Public Draft Chapter 3	Section 3.4.2	Concern expressed that domestic well is being combined with agricultural use.	5/6/2020	Text has been updated and domestic categorized as a separate use from agriculture
Public Draft Chapter 3	Section 3.4.1	Disagree with USGS being represented as a public supply well.	5/6/2020	There are specific definitions used by the SWRCB with regard to a public water supply system, and the text reflects this categorization. Text has been modified to emphasize that the USFS station does not serve a resident population.
Public Draft Chapter 3	Section 3.5	The addition of monitoring wells into the well inventory increases the well density per square mile. This is not right. There is some confusion on the public supply wells, with 6 on the maps, but only 2 public water supply systems.	5/6/2020	The figures in this section only show wells that are designated by drillers on their well completion reports as production, domestic, and public supply. Some of the public supply wells on the map are inactive. The map has been updated to indicate inactive public supply wells.
Public Draft Chapter 3	Section 3.6.1	Information on wells monitored by LMFCWCD says information is not readily available. This information should be public.	5/6/2020	The information has not yet been obtained
Public Draft Chapter 3	3.6.6	Should say that the Lassen County ordinance prohibits extraction of groundwater for use outside the County.	5/6/2020	Noted, text will be updated to reflect this

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
Public Draft Chapter 3	Fig. 3-2 Jurisdictions	There may be some areas indicated as BLM, that are not BLM. It's possible that this is the same for some Tribal lands.	7/1/2020	Checking with BLM.
Public Draft Chapter 3		There is significant new irrigated acreage in the basin since 2014.	7/1/2020	David: can you see if there are numbers available from 2015 or 2016?
Public Draft Chapter 3	Table 3-1 Crop Use	The crop of rice should say wild rice - this should be changed wherever referenced	7/1/2020	Change made
Public Draft Chapter 3		Do USFS mangagement plans need to be included in the section on Land Use plans? (Are there USFS lands within the Basin?)	7/1/2020	Being discussed.
Public Draft Chapter 3		Regarding response to question about whether surface water supplies are adequate for irrigation, the answer is "YES." There is significant acreage irrigated with surface water supplies.	7/1/2020	
Public Draft Chapter 3		Ash Creek Wildlife Area: This is a "potentially" managed area.	7/1/2020	New text clarifies that the wildlife area is minimally improved.
Public Draft Chapter 3		In response to the question of: "How should Wildlife Area and riparian be represented?" - Show riparian areas along creeks and Pit River, where wetlands make it too wet to farm. Use the footprint of the Wildlife Area in all maps and add riparian lines along the river. For example; "x" number of feet along Pit River, other creeks. Either map it or put it into text - explaining number of river miles and estimating width of riparian corridor. (e.g. 363 acres for Pit River)	7/1/2020	The category of "riparian areas" is removed from the maps, per discussion at the July 1, 2020 BVAC meeting in Adin. Table 3-1, Land Use Summary, has been revised to show 12,407 acres of riparian areas (including Ash Creek Wildlife Management area and corridors along waterways.
Public Draft Chapter 3		The document reports the Wildlife Area and/or riparian area as 12,000 acres v. 14,000. There is a discrepancy in the numbers.	7/1/2020	See previous reponse.
Public Draft Chapter 3		Much of the area of Ash Creek Wildlife Area is not riparian. Some areas along Ash Creek are not riparian. Water supplies for the Wildlife Area include a mix of surface water and groundwater supplies.	7/1/2020	See previous reponse.
Public Draft Chapter 3		Water bodies should be on the map, including lower Roberts Reservoir.	7/1/2020	Water bodies are shown on Map
Public Draft Chapter 3		How is mixed source shown on the map? There are areas represented as groundwater only, where landowners also irrigate with surface water.	7/1/2020	Looking at water rights information from the Modoc County watermaster and Water Boards. If information cannot resolve the question, it may need to be listed as a data gap.
Public Draft Chapter 3	line 91	Remove language on LMFLWCD.	7/1/2020	Deleted.
Public Draft Chapter 3		Beneficial uses: reassess categories of municpal, domestic, recreation (both contact and non-contact).	7/1/2020	First paragraph on surface water regulation reivsed (section 3.5.6) and added new section 3.3.3, Beneficial Uses of Groundwater
Public Draft Chapter 3		There are questions about the accuracy of information (data gaps). Be clear about degrees of uncertainty. How will the GSP deal with data gaps - where is it so wrong that additional survey or study must be done? The GSP needs to note inaccuracies. 70% - 80% accuracy is not good enough.	7/1/2020	Be cautious about identifying data gaps - where DWR may require addressing data gaps without providing funding to do so.
Public Draft Chapter 3		It's not the level of importance about certain points of data. The fact is, that it's not right that we have to make decisions based on inaccuracies. That's an imposition. Having to accept inaccuracies is not reasonable. Where there are questions, Big Valley can make estimate and assumptions to our benefit.	7/1/2020	A paragraph of draft text discusses data uncertainties and decision-making. This will be presented at the next BVAC meeting. Currently place in Chapter 4, page 4-1.
Public Draft Chapter 3		It's not clear what's important. The better information that is collected now, perhaps the basin prioritization will be lowered in the futre.	7/1/2020	Other data sets may help increase accuracy - those will need to be looked at.

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
Ch. 3 Plan Area		The term managed wetlands should be changed to state wildlife habitat	9/24/2020	Change made in text
Ch.3 Plan Area	page 173, line 399	In reference to Diversions: There are claimants on the river that do their own measurments and recordings separate from Water Master @ 2:30:00-2:35:00 Set aside with the condition that the language is revised.	9/24/2020	Changes made in text
Ch 3 Plan Area	Line 404	Ash Creek divergence is not measure past Modoc county line by water master @ 2:31:00-2:35:00	9/24/2020	Changes made in text
Revised Draft Chapters 1-2 v2	Page #:, Line #:	Currently BV Groundwater District mapping has defined groundwater zones within its boundaries.Â Will the district consider Â groundwater use similar to surface water use (CA riparian doctrine) in that beneficial use and waste or unreasonable use is firstÂ Â appliedÂ within zones to helpÂ alleviate projectedÂ over draft of groundwater reserves withinÂ zones?Â Does the SWRCB have guidance regarding this subject under the current groundwater lawÂ ?Â HasÂ this been applied in other groundwaterÂ management plans in California?Â Â	2/17/2021	
BigValleyGSP_Ch3_RevisedDraft_2020_08_19.pdf	Page #: 3-15, Line #: 323	The estimate of 18 well in the town of Adin is too low. I would guestimate the number of wells to match the number of parcels and homes in town which would come close to 60+ Each home has its own well, and some parcels have two. Many of these wells were put in place long before well drillers appeared in the community. The town sits a the edge of a very large artesian system and many of the homes have wells less than 100 feet deep. For example, my home was built in 1868 with a hand dug well system that reaches down 80 feet	3/15/2021	
BigValleyGSP_Ch3_RevisedDraft_2020_08_19.pdf	Page #: 3-21, Line #: 403	There is a great deal of precipiatation monitoring performed by the US Forest Service Big Valley Ranger Station. they collect both monthly and annual estimates. As a matter of fact, this will be their 78th year of providing this data to NOAA (they received a plaque from NOAA a couple of years ago celebrating their 75th year in providing weather information). Please call Lennie Edgerton who has this information in spreadsheet form at the Forest Service: (530) 299-8444Â	3/15/2021	
BigValleyGSP_Ch3_RevisedDraft_2020_08_19.pdf	Page #: 3-21, Line #: 407	Using CIMIS data from McArthur CA is incongruous at best. The nearest CIMIS Station that best represents the weather attributes of the Big Valley area is located in Alturas, CA (CIMIS #90).Although located 40 miles to the east, both Alturas and the Big Valley area are located within the Modoc Plateau Physiographic Province, NOT the Fall River Valley. Being over 1000 feet higher in elevation can drive significant differences in precipitation levels and evapotranspiration rates as well as significant differences in soil types. Please reconsider your "source data" ... Even NOAA uses weather information from the Alturas Airport to estimate changes in weather for this area.	3/15/2021	
BigValleyGSP_Ch3_RevisedDraft_2020_08_19.pdf	Page #: 3-21, Line #: 407	Continuation of limited climate information for the Big Valley Basin.There is a Remote Access Weather Station (RAWS) that is located just north of Round Valley on a west facing slope. It has been collecting local weather information for decades. You can find its weather data here:https://raws.dri.edu/cgi-bin/rawMAIN.pl?caCRUSIt is named "Rush Creek RAWS"	3/15/2021	

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
Big Valley GSP All Chapters Public Draft 8/26/21	Chapt 1	Comment was made that the Ash Creek Wildlife Area is a "disaster". Before it was taken on by the state, the local land owner was farming the property and the area was teeming with wildlife. Since taking over, the state has left the property unmanaged and it does not support the wildlife that it used to	9/9/2021	Text was added to Section 1.1 describing this mismanagement.
Big Valley GSP All Chapters Public Draft 8/26/21	Chapt 1	Comment was made that many Big Valley residents participated in a program with the State Board where they put in stockwatering wells off-stream to keep cattle out of the riparian areas to improve water quality. Now those extra wells drilled are being used against the residents due to the prioritization including the number of wells as one of the prioritization criteria	9/9/2021	Text was added to Section 1.1 regarding residents participating in this program to protect water quality. Text added to section 1.3 describing how the inventory of wells has been used against the landowners.
Big Valley GSP All Chapters Public Draft 8/26/21	Line 132	Don't like sentence. Change to Currently there is no evidence to suggest that…	9/9/2021	Sentence changed
Big Valley GSP All Chapters Public Draft 8/26/21	Line 164	Change may to will.. Capitalize Board of Supervisors	9/9/2021	Text changed
Big Valley GSP All Chapters Public Draft 8/26/21	Line 234	Strike contend	9/9/2021	Word stricken
Big Valley GSP All Chapters Public Draft 8/26/21	Line 809	The Goose Lake Basin statement needs further clarification such as "The Goose Lake Basin, with similar land use practices"	9/9/2021	Text changed
BigValleyGSP _Ch1_2_RevisedDraft_2021_03_21_setaside.pdf	Page #:, Line #:	Letter to BVAC.Â General comments on chapters 1-6.: https://bigvalleygsp.org/service/document/download/281	9/13/2021	Comment will be reviewed by GSAs and responded in the final GSP
BigValleyGSP _Ch1_2_RevisedDraft_2021_03_21_setaside.pdf	Page #: 1-90, Line #:	BigValley GSP Chapters 1-3,Â Comments are both editorial and content.Â See attached memo.Â Â https://bigvalleygsp.org/service/document/download/280	9/13/2021	Comment will be reviewed by GSAs and responded in the final GSP

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
BigValleyGSP_Ch3_RevisedDraft_2021_03_21_setaside.pdf	Page #:, Line #:	comments are editorial and content and are marked as such.Â Doreen SmithPower ParalegalÂ https://bigvalleygsp.org/service/document/download/283	9/13/2021	Comment will be reviewed by GSAs and responded in the final GSP
BigValleyGSP_Ch3_RevisedDraft_2021_03_21_setaside.pdf	Page #: 1-90, Line #:	Not sure if the last e-mail actually went through.Â The comments are editorial and content.Â There is also a separate letter attached.Â Doreen SmithPower - ParalegalÂ https://bigvalleygsp.org/service/document/download/282	9/13/2021	Comment will be reviewed by GSAs and responded in the final GSP
Big Valley GSP All Chapters Public Draft 8/26/21	Line 230	Add text "of this unfunded mandate"	9/9/2021	Text added
Big Valley GSP All Chapters Public Draft 8/26/21	Lines 243-245	There are local conservation groups such as the FSA that have helped	9/9/2021	Text modified to include NGOs
Big Valley GSP All Chapters Public Draft 8/26/21	Line 251	Wildlife grazes on ag lands and also rear their young and seek protection from predators	9/9/2021	Text modified. Quote from Stadtler (2007), former land owner, added.
Big Valley GSP All Chapters Public Draft 8/26/21	Chapter 1	We installed off-stream stockwatering wells to improve water quality. Now this increase in well inventory is coming back to bite us.	9/9/2021	Text added regarding participation in the EQUIP program. Text added to Table 1-1. Text added to section 3.4.1
Big Valley GSP All Chapters Public Draft 8/26/21	Line 299	BVAC members were appointed, not elected	9/9/2021	Text changed
Big Valley GSP All Chapters Public Draft 8/26/21	Line 302	BVAC and county staff have devoted their hours without compensation	9/9/2021	Text added, stating that time was largely uncompensated.

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
Big Valley GSP All Chapters Public Draft 8/26/21	Line 318	DWR needs the better understanding of the Basin	9/9/2021	Text added.
Big Valley GSP All Chapters Public Draft 8/26/21	Line 390	County staff didn't "feel" misled, they "were" misled	9/9/2021	Text changed.
Big Valley GSP All Chapters Public Draft 8/26/21	Line 428-434	Please point out the inadequacy of using a 60 year old map to draw basin boundries	9/9/2021	Text changed.
Big Valley GSP All Chapters Public Draft 8/26/21	Lines 531-532	Last sentence regarding right to pump water should be bold	9/9/2021	Text bolded
Big Valley GSP All Chapters Public Draft 8/26/21	Section 3.2	The Superior Court has jurisdiction over water rights.	9/9/2021	Section added regarding court role. Text will be added
Big Valley GSP All Chapters Public Draft 8/26/21	Section 3.2	Don't like saying that federal and state agencies "own" land.	9/9/2021	Text changed to "has jurisdiction over".
Big Valley GSP All Chapters Public Draft 8/26/21	Line 647	Change "Habitat" to "Area"	9/9/2021	Text changed.
Big Valley GSP All Chapters Public Draft 8/26/21	Figure 3-5	Don't like this map it is grossly inaccurate	9/9/2021	Map replaced with the one used in Chapter 6

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
Big Valley GSP All Chapters Public Draft 8/26/21	Lines 685-686	Pumping on ACWA is for growing feed stock, not for creating wetlands	9/9/2021	Text changed to be more general "habitat".
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 25	Reference to Conner 2021 should be for multiple years	10/6/2021	Reference changed to 2020-2021
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 26	Ag was not supplemented by timber. Both were equally important	10/6/2021	Text changed from "supplemented" to "complemented"
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 36-37	Doesn't the designation of "disadvantaged" comes from the state, not DWR in particular?	10/6/2021	For the purposes of SGMA and grant funding, DWR has performed and analysis of the status of communities throughout the state and designates areas that are "disadvantaged" and "severely disadvantaged". The information is available on their map viewer: https://gis.water.ca.gov/app/dacs/
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Lines 93, 254, 310	Change "SGMA mandate" to "SGMA unfunded mandate"	10/6/2021	Text changed
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 97	Add text "and prosecute" with respect to the illegal marijuana grows	10/6/2021	Text added
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 107	Change "habitat" to "ecosystem"	10/6/2021	Text changed

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Lines 107-108	This sentence about diversification of the economy is unclear	10/6/2021	Sentence modified for clarity.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Lines 115-116	Add "prove that the Basin is low priority" to the list of reasons why the GSP is being developed	10/6/2021	Sentence modified
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 127	Add "and maintain" sustainability	10/6/2021	Text added
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 151	Don't understand why "understanding upland recharge" and "improved estimate of crop water usage" are listed here.	10/6/2021	Sentence shortened to remove those elements
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 163	Change "should" to "will"	10/6/2021	Text changed
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 166	Add "and should be re-ranked as low priority"	10/6/2021	Text added
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 191	Add "inaccurate" basin boundary	10/6/2021	Text added

Big Valley GSP Comment Matrix Chapters 1-3

Document	Page & Line Number	Comment	Date	Response
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Lines 232-240	Pont out that DWR's denial was based on a lack of scientific justification, yet they used inaccurate, unscientific information in their ranking process.	10/6/2021	Sentence added.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 262	Add "inaccurate" basin boundary	10/6/2021	Text added
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 345	It states "about 144 square miles" here, yet elsewhere it says "approximately" or just states "144 square miles". Which is it?	10/6/2021	Text changed in the document to consistently be "about 144 square miles"
Changes made between 9/22 & 10/5/21 introduced at 10/6/21 BVAC	Lines 4573-4577	SGMA cannot alter existing water rights	10/6/2021	Text changed to state that SGMA does not alter existing water rights.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 498	The Forest Service is also an agency with jurisdiction over illegal cannibis operations	10/6/2021	Text modified to add USFS to list of agencies
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Lines 638-643	The language regarding the BVWUA measurement and reporting of diversions may be inaccurate	10/6/2021	Text changed and verified with BVWUA and Modoc Watermaster.

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Document	Page & Line Number	Comment	Date	Response
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 666	The historic gages on the map are hard to see	10/6/2021	Map updated with color of historic gages changed
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 668	Table 3-12 needs to be explained better	10/6/2021	Additional explanation added to section 3.5.1.3
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 774	Groundwater export ordinances aren't requirements as much as they are limitations	10/6/2021	Text changed from "requirements" to "limitations".
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 905	Sentence ends in a preposition	10/6/2021	Sentence modified as requested.
Changes made between 9/22 & 10/5/21 introduced at 10/6/21 BVAC	Line 4703	Many CRP and WRP contracts do not end after 10-15 years	10/6/2021	Text modified to remove the time and just state until end of contract.
Changes made between 9/22 & 10/5/21 introduced at 10/6/21 BVAC	Line 4696	Sometimes reserve lands are kept in agricultural production to enhance habitat	10/6/2021	Text changed to simply state that the land owner agrees to promote plant species that will improve environmental health and quality.

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Document	Page & Line Number	Comment	Date	Response
Changes made between 9/22 & 10/5/21 introduced at 10/6/21 BVAC	Line 5516	Misspelling	10/6/2021	Corrected.
Changes made between 9/22 & 10/5/21 introduced at 10/6/21 BVAC	Line 4628	Private parties also report diversions	10/6/2021	Text added.
Changes made between 9/22 & 10/5/21 introduced at 10/6/21 BVAC	Lines 65-77	It's not clear who this quote is from.	10/6/2021	Reference moved to after the quote.

Big Valley GSP Comment Matrix Chapter 4

Document	Page & Line Number	Comment (NOTE: break from 02:19:30-02:28:00	Date	Response
Public Draft Chapter 4		How much UC Davis information is included in Chapter 4? Is preliminary information available from that Study.		Being looked at
Public Draft Chapter 4		DWR identifies options for defining a basin bottom: bedrock, water quality that precludes use (using resistivity) It's not clear where bedrock occurs, or where water quality decreases. Are using 1,200' as a definable bottom, to capture existing wells.		See conceptual language at the bottom of page 4-10 and at the top of page 4-13.
Public Draft Chapter 4		Data gaps include: basin boundary, confining conditions, definable bottom, faults as barriers to flow, soil permeability, recharge		See conceptual language on page 4-1
Public Draft Chapter 4	Page 1 line 13	Dimensions of basins do not match with Chapter 3.		Being looked at
Public Draft Chapter 4	Page 1 Line 21	Add in 363.63 acres of riparian area (30 miles of Pit River, 50' on each side)		Riparian area is captured in Table 3-1
Public Draft Chapter 4	Sec. 4.4.1	Single principal aquifer is most appropriate for managing groundwater. This should be removed. The BVAC is not interested in managing groundwater. What is the basis for the determination of a single aquifer? To define multiple aquifers, there would need to be evidence of hydrologic separation (such as clay layers). Pumps that have different levels of production could be connected - the differences resulting from the fact that aquifers are not consistent throughout. Also, there is a stream between the upper basin and lower basin. Laura: If there was a bathtub filled with sand, everyone would have the same pumping. However, the bathtub is filled with sand, gravel, clay and silt. There are also layers of lava, faults and streams. Additionally, the basin is thinner at the edges. Better pumping occurs in sand, less production is found where drilling occurred where there is more clay or silt. Wells were drilled to see what the layers of materials are in areas where there aren't many wells. Tiffany: These wells supllement the CASGEM wells. Also: the Wildlife Area looked at adding a monitoring well. However, it is not likely that that the well would have been permitted in time to inform the GSP. (Note:Check into whether this is proceeding?)		Language for section 4.4.1 is that: "a single principal aquifer will be used for this GSP." (will not say "for managing groundwater") Explain that there are potential differences across the basin. There are 21 CASGEM wells. Ranging in depteh from 800' to 50'-100'. It's hard to pin down details and distnintions with 21 wells with a wide range in depth. There are three wells in Lookout (or south of Bieber) that provide a clue that something might be different. Somewhere in the report, say that the GSAs are being asked to make decisions with incomplete information and uncertainties.
Public Draft Chapter 4		Regardless of the complexity and cost of monitoring, it is important to accurately describe the aquifer. If there is variation across the basin, that should be described.		
Public Draft Chapter 4	page 26 Line 423	Shows many small towns and reservoirs. There are also small ponds and reservoirs within the basin. Ranchers have to pay dam fees for reservoirs and water rights fees for stock ponds. These are surface supplies. These should be shown on the maps or described in text.		There will be an opportunity to mark up maps and revise presentation of waterbodies. (Map -14)

Big Valley GSP Comment Matrix Chapter 4

Document	Page & Line Number	Comment (NOTE: break from 02:19:30-02:28:00	Date	Response
Public Draft Chapter 4	page 26 Line 425	Importing surface water into the basin: Roberts Reservoir and Silver Reservoir has water rights used in this basin, that is stored outside the basin boundaries. Clarify language on imported water. Explain that some water sources used in the basin is stored outside the basin boundaries. Ensure that all incoming supplies are accounted for in water balances.		Imported water refers to surface water supplies that originate from outside the watershed where the supplies are used. This is clarified.
Public Draft Chapter 4	page 27	The issue of definable bottom: What value works to the favor, in the interests of, Big Valley residents? Say that the definable bottom has not been established, there is much variability, and that a bottom is set at "x" for the pursposes of the plan. Helpful to know when things are, or are not, in our interest - and to explain why that is so. If the definable bottom needs to be in the plan, say so. Then heavily caveat the number. Any uncertainties should be evaluated in favor of the Basin.		Annual reports require calculations on change in storage for the basin. Those calculations are multiplied by the number of aquifers. Then definable bottoms must be determined for each aquifer. The change in storage is what is important, not the overall storage. The key is to understand the conditions and the best options for optimizing and using the resource to make sure there are not dire consequences in the future. NOTE: GEI provides a list of required elements for each chapter.
Public Draft Chapter 4	Page 23 Line 360	Replace the word "poorer." Perhaps lesser - keep looking… The quality of water that is naturally occuring will not be affected by management decisions. Clarify that this is not about good water quality being degraded.		See suggested alternative language
Public Draft Chapter 4		Explain that there is a lot of complexity across the basin, including termperature and water quality. Show the variety in where water levels are maintaining or going down. Want to focus on the goals, for example - wells not drying up, supporting agriculture, springs going dry. Management will focus on the goals rather than absolute numbers.		This will be the central discussion for creating Sustainable Management Criteria - this suggestion will be included when discussions are underway for developing the criteria
Public Draft Chapter 4		How can the GSP use remedial soils, outside of basin boundaries, to help support recharge to the basin?		This suggestion will be carreid forward for discussions on developing "Projects and Management Actions."
BigValleyGSP_Ch4_RevisedDraft_2020_08_19.pdf	Page #: 4-16, Line #: 270	Figure 4.5.1 Taxonomic Soil Orders identified for the Basin are oversimplified and are too "Coarse Grain" to be used effectively for any management implications. It certainly simplifies the landscape analysis process, but does not adequately describe in enough detail as to the attributes of soil classification that supports the poor infiltration and problems with groundwater recharge found in throughout this area. Please include more extensive soil classification descriptions. NRCS soil maps provide a more comprehensive backdrop to the soils out here	3/19/2021	

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Document	Page & Line Number	Comment (NOTE: break from 02:19:30-02:28:00	Date	Response
BigValleyGSP_Ch4_RevisedDraft_2020_08_19.pdf	Page #: 4-18, Line #: 303	Table 4.5.2 Hydrologic soil descriptions .... Again, the Hydrologic Soil DescriptionsÂ identified for the Basin are oversimplified and are too "Coarse Grain" to be used effectively for any management implications. They do not adequately describe in enough detail as to the attributes of different hydrologic soil classifications that support this area. Please include more extensive hydrologic soil descriptions. These hydrologic soil descriptions are important for protection of rare habitat types found within the Valley which include northern basalt vernal pools.	3/19/2021	
BigValleyGSP_Ch4_RevisedDraft_2020_08_19.pdf	Page #: 4-23, Line #: 400	Figure 4-12 NCCAG Wetland delineation.I am challenging the use of the NCCAG dataset at the principal data source for the delineation of wetland systems in the Big Valley Basin. It appears that wetland acreages are under represented in their data set due to the fact that it is based upon "natural community types", i.e; vegetation.Â The USGS National Wetlands Inventory Wetland Mapper utilizes multiple variables including soil type, soil profile, oxidation within the soil profile, depth to water, vegetation, hydrologic factors and more when delineating and describing wetland types in their mapping data. I would recommend that the information provided by the USGS National Wetland Inventory be compared with the NCCAG dataset. The history of land use in the Valley by ranching and agricultural activity has has a direct effect on the "vegetation community types" one can identify on an aerial photograph. These activities however, do not necessarily change the underlying attributes of wetland characteristics within the soil.Â Â You can access this information via the USGS website:Â https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/	3/19/2021	
BigValleyGSP_Ch4_RevisedDraft_2020_08_19.pdf	Page #: 4-26, Line #: 454	Figure 4-14 Recharge, discharge and major surface water bodies.The legend that is presented with this Figure has an item listed as "Lake". As mentioned on page 4-27, line 466, this figure represents the streams, ponds and surface waters within and adjacent to the Basin.Â There are little "lake" effects in the Valley.Â The surface waters present in the Basin are over-represented in this Figure. We have no reservoirs within the Valley basin. We DO have stock ponds, small impoundments and freshwater ponds located on the Ash Creek Wildlife Refuge. More current aerial photographs of the Basin clearly show extant, smaller and more depleted surface waters than what is presented in this Figure. Please review this data.	3/19/2021	
BigValleyGSP_Ch4_RevisedDraft_2021_03_21_setaside.pdf	Page #: 1-90, Line #:	comments on 1-3 both editorial and content.Â Doreen SmithPower ParalegalÂ https://bigvalleygsp.org/service/document/download/285	9/13/2021	
BigValleyGSP_Ch4_RevisedDraft_2021_03_21_setaside.pdf	Page #: 1-90, Line #:	editorial and content.Â See attached document.Â Â Doreen SmithPower ParalegalÂ https://bigvalleygsp.org/service/document/download/284	9/13/2021	

Big Valley GSP Comment Matrix Chapter 4

Document	Page & Line Number	Comment (NOTE: break from 02:19:30-02:28:00	Date	Response
Big Valley GSP All Chapters Public Draft 8/26/21	Section 4.2.1	Add more language regarding the inaccuracies in the Basin Boundary, particularly the finger that includes E. Fork Juniper Creek	9/9/2021	Text modified.
Big Valley GSP All Chapters Public Draft 8/26/21	Lines 1274-1275	Delete last sentence	9/9/2021	Sentence deleted
Big Valley GSP All Chapters Public Draft 8/26/21	Section 4.6, Environmental Uses	Don't like map and discussion of NCCAG	9/9/2021	Map and discussion removed.
Big Valley GSP All Chapters Public Draft 8/26/21	Line 1515	Does young water mean we are not in overdraft?	9/9/2021	Young water indicates that the water is being flushed through the system.
Big Valley GSP All Chapters Public Draft 8/26/21	Lines 1555-1558	Flood irrigation doesn't occur just on lower portions of Pit River	9/9/2021	Text changed to state flood irrigation occurs in the Basin generally.
Big Valley GSP All Chapters Public Draft 8/26/21	Figures 4-9 through 4-11	Expand these maps so they include areas outside the Basin	9/9/2021	This will be done bfore the final GSP is submitted.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1017	With regard to the basin boundary modification, change "may be necessary" to "is necessary"	9/9/2021	Text modified.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1020	Change "may be inaccurate" to "is inaccurate"	9/9/2021	Text modified.

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Document	Page & Line Number	Comment (NOTE: break from 02:19:30-02:28:00	Date	Response
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1043	Change "suggested that these mountains serve as recharge" to "stated that…"	10/6/2021	Text modified.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1106	Big Valley doesn't have brackish or saline water. Why is this term in here?	10/6/2021	This reference to brackish or saline water does not indicate that it exists in the Basin, it is a reference to what DWR defines as an "effective bottom"
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1050	What is the dashed line on the map?	10/6/2021	Map changed and dashed line added to legend.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Lines 1163-1188	The data that was used to determine the aquifer characteristics came from the new monitoring wells which are small diameter and were pumped at a very low rate (8 gpm). Is this sufficient to determine the aquifer characteristics	10/6/2021	The text does acknowledge that larger wells pumped at higher rates would give higher values for the aquifer characteristics. This has been added as a data gap.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1338	Change "underflow could enter the basin" to "underflow does enter the basin"	10/6/2021	Text changed
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1344	Don't like the blanket statement that precipitation that doesn't infiltrate runs off or is consumed through evapotranspiration	10/6/2021	Conceptually, precipitation that hits the ground must go in one of three places: deep infiltration, runoff, or remains in the soil and is eventually evapotranspirated. Text changed to remove the word "consumed".
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Lines 937 to 938	Add "assumed" physical characteristics and "estimates" the principal aquifer	10/6/2021	These terms diminish and degrade the quality of the work put into the HCM. The changes are not necessary and the statement as written in complete and accurate. The statement ends by qualifying the HCM as being based on best available information. This is the appropriate language for introducing the chapter.

Big Valley GSP Comment Matrix Chapter 4

Document	Page & Line Number	Comment (NOTE: break from 02:19:30-02:28:00	Date	Response
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 949	Add "estimated" before HCM	10/6/2021	See response above.

Big Valley GSP Comment Matrix Chapter 5

Document	Page & Line Number	Comment	Date	Notes and Responses
Public Draft Chapter 5	Subsidence, Section 5.5, pages 5-22 to 5-24	**How do the measurements account for agricultural practices that affect ground level? That should be discussed. Subsidence may not be due to changes in groundwater levels. It could be compaction, grazing land converted to row crops - with soils used to enhance levees. Or earthwork done at Caltrans. Or erosion. There may be other actions affecting ground levels, such as new ground disturbance.** **• Consider a footnote on land use, saying that additional on-ground monitoring is needed. Explain that these measurements show where ground is lower or higher.**	9/24/2020	Subsidence associated with groundwater dynamics and pumping generally result in "bulls-eye" patterns of subsidence. Some of the subsidence in Big Valley is likely due to oxidation of organic materials. There are other options for monitoring subsidence, including the survey markers embedded in the new well monitoring foundations. A key consideration is where groundlevel changes are due to groundwater pumping are undesirable.
Public Draft Chapter 5	Water Quality Section 5.4, pages 5-9 to 5-22.	There are concerns that providing quantifative measurements on water quality will encourage micro-analysis by the state.	9/24/2020	Elevated constituents are naturally occurring (iron, manganese, arsenic). Also good to watch specific conductants. The GSP is required to report on contamination sites (such as gas stations and landfills). The graphs do show that there is better water quality (graphs 5-8, 5-9 and 5-10). It can support a baseline groundwater quality monitoring in the GSP. Additional data on water quality can show that conditions are even better than what was seen with Bieber samples.
Public Draft Chapter 5	Groundwater Levels (and surface water interactions)	Don't groundwater levels necessarily need to be the same across the basin? Explain how it's determined that a stream is gaining or losing. It is not understandable.	9/24/2020	Two reaons way surface water depletions are a critical element: surface water rights and groundwater dependent ecosystems. (Response: as long as the wells are in the same geologic formation, the levels should be very close. If a pump is located in a different formation, the response times may be different - and affect the levels) (Response: Pit River and Ash Creek have different water signatures. Additional monitoring and samples will better inform the patterns of gaining and losing.
Public Draft Chapter 5	GDEs, Sec. 5.7, pages 5-26 to 5-31	• The acreage for amount of willows in the basin is overstated. There is not 4,700 acres of willows in the basin. • Ash Creek Refuge uses surface water supplies. There was discussion about groundwater levels in that specific area, which are closer to the surface and contribute to surface water supplies. <u>Table 5.5, page</u> **• Alfalfa is listed as a native species – change this** • Is aspen found in the basin? • Is elderberry found in the basin? **• Change "salix" to "willow"**	9/24/2020	Ash Creek Refuge does also use groundwater pumping to irrigate at Ash Creek. This area is known as an ecological preserve and land uses are not likely to change. The consultants were careful to clearly delineate what truly qualifies as a GDE. This current text is about describing likely or potential GDE. The big question is about managing for GDEs, w.hich comes later Species listings are obtained from the Native CalFlora website. The Nature Conservancy website was also reviewed and many of the species listed were deleted for the Big Valley GSP
Public Draft Chapter 5	GDEs	Do not say that Ash Crrek is "managed" Descriptions of GDEs should be verified by those who are working on the land	9/24/2020	Chapter 5 does not contain the word "managed" or "managed wetlands" - the area is referred to as Ash Creek Wildlife Area
Public Draft Chapter 5	River reaches: Page 5-25 b and c	**• Reaches 6 and 9 are both labled Upper Pit River** • Reach 3 is Willow Creek: water rights and diversions mean that Willow Creek does not exist after a certain point during the summer (Sup. Albaugh spoke to David Fairman about the issue, briefly, before the meeting) -	9/24/2020	Figure updated
Public Draft Chapter 5		Referring to the Elements checklist guide, there was a question about which items are required.	9/24/2020	Clarification was provided during the presentation.

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Document	Page & Line Number	Comment	Date	Notes and Responses
BigValleyGSP_Ch5_RevisedDraft_2020_10_22.pdf	Page #: 5-29, Line #: 361	Regarding key "Vegetation Areas" ... "Willow" is described as the second largest habitat comprising 41% of the area.Wrong. If anything, we lack willow as a component within or adjacent to creeks, ditches and ponds in this area. We have no habitat for the Willow Flycatcher here. There are scant distributions of willow species among the Ash trees along the full length of Ash Creek, along the edges of freshwater ponds and water compounds on ranches and within the wildlife refuge as well as along Willow Creek. There is a dearth of willow in the basin... especially enough to cover 41% of your vegetative composition. Please review this classification as a vegetation area. Something is in error here	3/19/2021	
BigValleyGSP_Ch5_RevisedDraft_2020_10_22.pdf	Page #: 5-30, Line #: 365	Figure 5-19 NCCAG Wetlands lacks the locations of "riverine" and "seep or spring" on the map ...	3/19/2021	
BigValleyGSP_Ch5_RevisedDraft_2020_10_22.pdf	Page #: 5-31, Line #: 368	Figure 5-20 NCCAG Vegetation. The "willow" component in this figure is in error. The vegetation composition along Ash Creek is not willow at all but Oregon Ash (Fraxinus latifolia). There are a few individual willow shrubs on the ACWR along with a few Black Cottonwoon (Populous trichocarpa ssp. trichocarpa) as well as a few other Ash trees distributed here or there. No grand distribution of willow...Has your environmental staff been on the ground here to support your vegetation suppositions? This entire "Willow" vegetation type needs to be reassessed ...	3/19/2021	
BigValleyGSP_Ch5_RevisedDraft_2020_10_22.pdf	Page #: 5-32, Line #: 389	Table 5-5 "Big Valley Common Plant Species"Three out of the six plant species listed in this table do not occur in Big Valley. Carex sp., Alfalfa sp.,and Salix sp. are the only ones that occur here. Aspen sp., Sambucus sp. (Elderberry) and Distichlis sp. (saltgrass) do not occur very often if at all in the local landscape. i is recommended that Oregon Ash (Fraxinus latifolia) or Black Cottonwood (Populus trichocarpa)Â be used for tree species that occur in these areas. There is rooting depth data available for both of these species.Â Wild rose (Rosa woodsii)Â is commonly found along Ash Creek and within the ACWR. We KNOW that Idaho fescueÂ (Festuca idahoensis) and Tufted hair grass (Deschampsia cespitosa) are commonly found within wet meadow types, adjacent to ponds and along creekbanks in this area. Develop a more localized species list to use for rooting depth estimates.Â Â	3/19/2021	
Big Valley GSP All Chapters Public Draft 8/26/21	Line 1929	"It is unknown if the subsidence in these areas has been induced by groundwater extraction." We argue earlier that we don't have any and this is opening the door to saying we do.	9/9/2021	
Big Valley GSP All Chapters Public Draft 8/26/21	Lines 1685-1586	Do we need the sentence describing the declines in water levels	9/9/2021	This is a factual statement and is important to putting changes in water levels in context.
Big Valley GSP All Chapters Public Draft 8/26/21	Line 1874	Delete "including groundwater pumping.	9/9/2021	Text removed.

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Document	Page & Line Number	Comment	Date	Notes and Responses
Big Valley GSP All Chapters Public Draft 8/26/21	Section 5.5	Subsidence is not happening in the Basin, yet we use the word subsidence many times	9/9/2021	Text changed to talk about "lowering of ground" where appropriate.
Big Valley GSP All Chapters Public Draft 8/26/21	Section 5.7	We don't like this section, don't like the maps. This data is inaccurate	9/9/2021	Two maps removed, text changed to emphasize need to field verify GDEs.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1486	Why is the word "regression" used here? Not all the lines are going down.	10/6/2021	Regression refers to the mathematical method used to detemine the line. Wording changed to "line of best fit".
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1728 Figure 5-17	Don't like this figure. Change the scaling so that each color is 3 inches	10/6/2021	The current scaling of 1.5" per color is appropriate given that the published accuracy of the data. Figure modified to show that white areas don't have data and that the lowest gradation goes from -3 to -3.2 rather than < -3. Also added the published accuracy of 0.7"
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1779	What does areal mean?	10/6/2021	Areal means how much space it takes up. Wording edited.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1735	What is the definition of a perrennial stream? Why use perennial streams?	10/6/2021	A stream that flows year-round or nearly year-round indicates that it is not completely depleted. Using perennial streams is not a requirement of SGMA. Identification of interconnected surface water is a requirement. The word perennial was removed and the streams analyzed are seen to be the "major", defined as streams that are named in the National Hydrologic Dataset from USGS.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1736 and 1794	Why use 20 feet. Isn't 15 feet more realistiz?	10/6/2021	Text and figures have been changed to 15 feet, and justification for that depth has been added to the text.

Big Valley GSP Comment Matrix Chapter 6

Document	Page & Line Number	Comment	Date	Notes and Responses
Public Draft Ch 6, Historic Wtr Budget	Figure 6-2, page 6-2	Why is the atmospheric system not incorporated into the water budget	Nov. 4	Inputs from the atmospheric system appear as precipitation, which is about 12' - 15" per year. The water budget accounts for precipitation as either falling onto land or onto water bodies.
Public Draft Ch 6, Historic Wtr Budget	Figure 6-4, page 6-4	If inflow were to equal outflow, that would represent a balanced system. There are some streams that have crazy flows during periods of high precipitation.	Nov. 4	Yes, which is why it's important to recharge groundwater during high flows - so that stored groundwater can be used during dry periods.
Public Draft Ch 6, Historic Wtr Budget	Section 6.2, page 6-4 and elsewhere	**There are no naturally occuring lakes in the basin. Any standing bodies of water are reservoirs.**	Nov. 4	**Change terms in text to "lakes/reservoirs" including bar charts and figures.**
Public Draft Ch 6, Historic Wtr Budget	Footnote 1, page 6-6	**What is the definition of long-term (e.g. long-term sustainability)?**	Nov. 4	By 2042, mechanisms should be in place to manage water from year to year. When it comes to setting thresholds, those levels should provide room so as to stay in compliance during periods of variation or fluctuation. It may be that, during the next 20 years, conditions might get worse before it gets better.
Public Draft Ch 6, Historic Wtr Budget	Figure 6-8, page 6-6; and PPT slide #15	**Double-check the lines calculated by excel.**	Nov. 4	The results where checked to see if they were reasonable.
Public Draft Ch 6, Historic Wtr Budget	Appendix 6-A, Land System, Line 1	**How are inflows from areas outside the basin boundaries represented? [Note: This is paraphrased from a question by Aaron asking if calcualtions can be provided to support future requests for boundary modifications.]**	Nov. 4	[David: Is this stream inflow to the basin?]
Public Draft Ch 6, Historic Wtr Budget	Page 6-3, Line 49	**Has the data from the CIMIS station in McArthur been adjusted for Bieber?**	Nov. 4	That is being adjusted for. Also, Steve Orloff has a paper on percent application of water, in terms of ET, for alfalfa in Scott Valley - which may be a helpful estimate.
Public Draft Ch 6, Historic Wtr Budget	Appendix 6-B, (multiple locations)	**Why is Managed Aquifer Recharge set at zero?**	Nov. 4	Managed Aquifer Recharge refers to actions where the primary objective is recharge (e.g., as opposed to reservois, where surface water storage is the primary objective, with recharge is a secondary result). Projects such as flooding for habitat might quantify as Managed Aquifer Recharge. It would be necessary to state that groundwater recharge is an intended benefit from the flooding.
Public Draft Ch 6, Historic Wtr Budget	Figure 6-4, page 6-4	**Question from the public: ou mentioned approximately 100K error in stream outflow out of the basin. Also, you said that we know that more water actually flows into the basin than out. (Fig 6-4) Does this explain the approximately 80K difference between the estimated and actual groundwater budget? (not sure of slide #)**	Nov. 4	
Public Draft Ch 6, Historic Wtr Budget	Appendix 6A Land System, line 2, assumptions	**Ag is not the only user of surface water: surface water is also used by loggers, fire-fighters, Caltrans, illegal marijuana grows, wildlife, etc.**	Nov. 4	There is no quantification of other surface water uses.
Public Draft Ch 6, Historic Wtr Budget	Appendix 6A Land System, line 2, data needs	**Ash Creek Wildlife Area and Groundwater Pumping: (someone) retired and had maintained a lot of data on groundwater pumping.**	Nov. 4	Laura can work to coordinate data transfer.

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Public Draft Ch 6, Historic Wtr Budget	Appendix 6A Land System, line 3, data source	**Population source shows Bieber - there are other communities as well.**	Nov. 4	Bieber has a munical system, which is different from domestic extractions. Adin will be added in as a public water supply which is a non-municipal use.
Public Draft Ch 6, Historic Wtr Budget	Appendix 6C Land System chart	**Do inflows on the Land System bar chart include surface water sources from outside the basin what provide water for irrigation uses within the basin? (e.g., Roberts Reservoir, Silva Flat, etc.)**	Nov. 4	Those reservoirs outside the basin are not per se considered here. The flows out of the reservoir are included in the category of the watershed that are ungaged. While flow out of the reservoir is measured, there is not access to a long-term record of that. It is shown as an inflow coming in as stream flow. The diversion of the stream flow to application to the field or ditch is represented as a surface water delivery. (40% of applied water is from surface water.)
Public Draft Ch 6, Historic Wtr Budget	6-4 and 6-5, Section 6.2	How is it possible that inflow exceeds outflow?	Oct. 30	While inflow and outflow may be more equal during certain seasons, outflow may exceed inflow during other seasons. This data represents the total annual inflow and outflow. ***Figure 6-4 through 6-7 will be changed to read "Total Annual Water Budget" for clarity.**
Public Draft Ch 6, Historic Wtr Budget	pg. 6-5, Figures 6-5, 6- 6, 6-7	A better explanation of "Between Systems" is needed.	Oct. 30	Flow between systems is depicted in Figure 6-2 (pg. 6-2) and will be further explained during 11/4/20 BVAC meeting. ***Figure 6-2 can be referenced on page 6-5**
Public Draft Ch 6, Historic Wtr Budget	Appendix 6A, Land System, items 2 & 3	Need clarification on where assumption of 40% surface water and 60% groundwater used for irrigation comes from.	Oct. 30	Studies will be completed by December 2021 and information can be incorporated.
Public Draft Ch 6, Historic Wtr Budget	Appendix 6A, Land System, items 7 & 8	Need clarification on percentages under "Assumptions" column; change "grounwater" to "groundwater".	Oct. 30	***Explanation about the 85% irrigation efficiency and the 15% inefficiency, resulting in 7.5% return flow and 7.5% recharge, will be included for clarification; typo will be corrected.**
Public Draft Ch 6, Historic Wtr Budget	Appendix 6A, GW System item 27	Is it true that no subsurface inflow occurs in the basin?	Oct. 30	Until it can be shown otherwise, it will be assumed that there are no inflows and no connection to Round Valley.
Public Draft Ch 6, Historic Wtr Budget	Appendix 6C, Total Basin bar chart	Stream inflow and outflow are even during some parts of the year but not others; It would be helpful to see exact number of acre-feet on Appendix 6C bar charts	Oct. 30	***Text will be added to read something like "Stream flow varies throughout the year."; Actual number of acre-feet will be added to some of the years on Appendix 6C bar charts**
Public Draft Ch 6, Historic Wtr Budget	Appendix 6C, Surface Water bar chart	Explanation is needed for Surface Water Delivery as an outflow. If a percentage used for irrigation goes to the plants, is the percentage that goes back to the groundwater captured in one of the categories on the inflow side of the chart?	Oct. 30	
Public Draft Ch 6, Historic Wtr Budget	Appendix 6C, Groundwater bar chart	Because the colors are similar, it appears that there is a small amount of subsurface inflow on the bar	Oct. 30	***Subsurface Inflow will be removed from the bar chart key**

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Public Draft Ch 6, Current Wtr Budget		**The Tables in Chapter 6 should say "ESTIMATED" or "ASSUMED" for Inflow, Outflow.**	Dec. 2	Data is used where it's available, rough estimates are made in other areas, and assumptions based on best professional judgement in still other areas. The water budget is balanced by adjusting the estimates and assumptions within generally acceptable ranges until the budget is balanced. As such, the water budget is not necessarily a unique solution, but represents the best professional estimate. Water budget estimates of this type are considered order of magnitude estimates and can be refined as new data becomes available
Public Draft Ch 6, Current Wtr Budget		**Some areas are shown on the map as irrigated, when they are actually dry farmed. These areas have only been irrigated on a select few occasions.**	Dec. 2	In order to reflect these farming practices, the GSP development team needs data to substantiate it. Input was requested on water source throughout the Basin in previous BVAC meetings. Similar input will be solicited at upcoming meetings and the new information can be incorporated into the Water Budget in future revisions.
Public Draft Ch 6, Current Wtr Budget		**Concern that the 14,000 acres of the wetland don't show irrigation. Ash Creek Refuge is white on the map, rather than blue.**	Dec. 2	The focus was on calculating irrigated acreage. Wetlands are a water use in the water budget - the assumption is that 98% of the water supply on the refuge is from surface water, and 2% groundwater. **The wetlands in the Ash Creek Wildlife area have been added to Figure 6-5.**
Public Draft Ch 6, Current Wtr Budget		**How were the percentages of 98% surface water and 2% groundwater derived for the wetlands?**	Dec. 2	Starting with the area of the wetlands, the evapatranspiration values (more specific to the conditions in Big Valley) are combined with crop co-efficients. A coefficient was used for crops similar to the vegetation of the wetland. The yields an estimate of evapotranspiration associated with the plants in the wetland. If the refuge did not run any groundwater pumps, then the refuge would be supplied 100% by surface water. Because there are three pumps that are occasionally run, there is some source from groundwater. The 2% was estimated based on professional judgement due to knowledge of the locations of the wells, the areas that they irrigate and conversations from the CDFW about how often they use them (typically for a month or two in the fall to bridge the driest part of the year). Consultant staff has reached out to the CDFW to obtain pumping data, but they have indicated that the data does not exist. As such, 2% is currently the best estimate. **Text was added to the chapter to document this estimate.**
Public Draft Ch 6, Current Wtr Budget		What are the options for determining runoff? Which way is best?		Modeling or calculations using the "Curve Number Method" (CNM) are the two widely accepted options to determine runoff. In the opinion of the consultants, modeling runoff would not produce significantly improved estimates from CNM, but would take additional time and budget.
Public Draft Ch 6, Current Wtr Budget		Is there a way to get a larger map, or better electronic version, to take a closer look at the basin boundary?	Dec. 2	**A KMZ file (viewable in Google Earth) of the Basin Boundary has been posted on the website. An email notification was sent to the interested parties notifying them of the file and how to use it.**
Public Draft Ch 6, Current Wtr Budget		Using the numbers on this chart, does this mean that a 7-8% reduction in pumping is needed?	Dec. 2	What this means is that there needs to be about 5,000 AF per year on average in compensation to reduce overdraft. It might involve managed aquifer recharge, reduced pumping or combination of the two. Reducing overdraft can be achieved in various ways.

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Public Draft Ch 6, Future Wtr Budget		Is it required to use 50 years of data? Does it specify which years of data need to be used?	Dec. 2	At least 50 years of historical data are required as per the GSP Regulations. Going back further would include data from a time period with higher uncertainty and lower accuracy.
Public Draft Ch 6, Future Wtr Budget		How does an overdraft of about 5-10% compare with other basins? It's surprising that the number is so small, but it would still impact a lot of people.	Dec. 2	Not sure, but there are certainly a lot other basins that are much worse off.
Public Draft Ch 6, Future Wtr Budget		**Land System Water Budget Chart, item 2 (inflow between systems): This uses surface water. Ash Creek Wildlife Refuge is here. The assumption is that ag is the only sector that uses surface water. There are other uses and users of surface water.**	Dec. 2	The wetlands are alos a surface water user and text has been added to describe that. There are also illegal uses, fire uses. There is not a way to measure or quantify those uses. If some reasonable and defensible data or assumptions were provided to the GSP development team, then those uses could be incorporated into the budget.
Public Draft Ch 6, Future Wtr Budget		**Land System Water Budget Chart, item 3 (population): This only uses the population from the census of Bieber, there's Adin, New Bieber and Lookout. Those need to be added in.**	Dec. 2	The water budget considers the entire population of Big Valley published by DWR. A distinction is made between Bieber and the rest of Big Valley, because Bieber is served by a public water supply system while the rest of domestic use in Big Valley is from individual wells. This is a distinction between "municipal" and "domestic" uses, which SGMA categorizes differently. However, all household use is considered and accounted for in the water budget.
Public Draft Ch 6, Future Wtr Budget		**There's a piece of ground that's not on the map that needs to be included (Jimmy Nunn).**	Dec. 2	This information can be incorporated once the land is clearly identified. Such information will be solicited at future BVAC and/or public outreach meetings.
Public Draft Ch 6, Future Wtr Budget	Line 38	~~Ideally~~ **In concept**,each component could be quantified precisely and accurately, and the budget ~~would~~ **could**	Jan. 22	Changes will be made to next iteration of chapter.
Public Draft Ch 6, Future Wtr Budget	Line 39	come out balanced. In practice, ~~many~~ **most** of the components can only be roughly estimated, and in	Jan. 22	Changes will be made to next iteration of chapter.
Public Draft Ch 6, Future Wtr Budget	Line 40	~~some~~ **many** cases not at all. Therefore, much of the work to balancethe water budget is adjusting ~~some~~ **many**	Jan. 22	Changes will be made to next iteration of chapter.
Public Draft Ch 6, Future Wtr Budget	Line 44	components estimated through the use of the water budget are order of magnitude. Estimation of **Suggested wording change to "order of magnitude" comments were that the content needs to be made clearer to the reader**	Jan. 22	Wording will be adjusted in the next iteration to make the concept of "order of magnitude" estimates more clear.
Public Draft Ch 6, Future Wtr Budget	Line 56	because it represents an average set of climatic conditions and adequate water level, land use, **"adequate water level" What is adequate? Define adequate water levels**	Jan. 22	This refers to the fact that many of the wells with water level measurements started in 1983, so the amount of data was "adequate". We can remove the word "adequate"
Public Draft Ch 6, Future Wtr Budget	Line 73	**Add a footnote to Figure 6-4 regarding DWR using inaccurate data. Including in the footnote there should be a mention of better data needed for the waterbudget and that observational and public input has been received regarding the inaccuary of the map from DWR. (crop and wetland acreages)**	Jan. 22	The land use data used for the water budget is different from the data used for basin prioritization. This part of the GSP is not addressing prioritization. We discuss data gaps in previous chapters, but can re-emphasize here.
Public Draft Ch 6, Future Wtr Budget	Line 87	also has three wells that extract groundwater from the **deeper aquifers** and is applied in portions	Jan. 22	Not sure what the comment is here. Deeper aquifers emphasizes that the ACWA wells are around 800 feet deep and are not pulling solely from shallow (wetland) portion of the aquifer. In other words, the wells are simply re-distributing groundwater from deep portions of the aquifer to shallow (wetland) portions.

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Public Draft Ch 6, Future Wtr Budget	Line 110-111	~~Overdraft occurs when the groundwater system change in storage is negative over a long period~~. **(Remove this sentence)**	Jan. 22	Change will be made to next iteration of chapter.
Public Draft Ch 6, Future Wtr Budget	Line 115-116	The current water budget is demonstrated by looking at water year 2018, which is the most recent year with reliable data. **(Is 2018 the only year with reliable data? Who states what is reliable?)**	Jan. 22	We (GEI) have determined that 2018 is more reliable than 2019 because there were several wells without measurements. We can remove the "~~which is the most recent year with reliable data~~." in the next iteration of the Chapter.
Public Draft Ch 6, Future Wtr Budget	Footnote	long-term undesirable results Who determines this? **Suggested to add a note to the chapter where information which covers the details of DWR guidelines for estabilishing long-term undesirable results.**	Jan. 22	Undesirable results are locally defined. This will be discussed in Chapter 7
Revised Draft Chapter 6		This chapter is full of estimates and assumptions. It's not fair to have to make decisions based no such inaccurate and incomplete data	2/3/2021	The water budget uses the best, readily available data to develop the estimates. Improvements to the water budget can and should be made over time as more data is gathered and estimates and assumptions are refined with objective information.
Revised Draft Chapter 6		Figure 6-5: Primary Applied Water Sources is inaccurate.	2/3/2021	Some input from local stakeholders has been used in the map. More field-by-field information will continue to be solicited and incorporated as it becomes available. Text was added to the chapter emphasizing the inaccurate nature of the map.
BigValleyGSP_Ch6_RevisedDraft_2021_01_14.pdf	Page #: 6-3, Line #: 62	Please update your precipitation estimates using local precipitation data from the US Forest Service in Adin and local RAWS (Remote Access Weather Station) on Rush Creek. Weather is significantly different between the Fall River Valley out of McArthur and what we experience here in Big Valley. Part of that is due to the orographic effect of Big Valley Mountain...	3/20/2021	
BigValleyGSP_Ch6_RevisedDraft_2021_01_14.pdf	Page #: 6-8, Line #: 132	Land use patterns are changing significantly right now. I have lived in the Valley for 30 years, and have never observed the number of acres under vegetation type conversion and we are seeing now. Hundreds of acres this year alone are being converted from native sagebrush steppe into alfalfa (which demands so much more water). It looks like most of these acreages are being watered using agricultural wells. Land use patterns are not static here ... this variable is currently experiencing a change in what has been known to occur in the past.	3/20/2021	
BigValleyGSP_Ch6_RevisedDraft_2021_01_14.pdf	Page #: 6-9, Line #: 149	I challenge the results of your predictive modeling regarding Climate Change for this area. For the last 30+ years Big Valley has been experiencing a contracted drying spell. Winter precipitation in both the form of snow and rain has significantly reduced over that period of time. I do not believe that the choice of your Climate Change predictive model adequately addresses the reality of what is actually happening in this Basin. What many of the locals have observed here are warming temps, drying climate, higher ET rates and less recharge to surface waters.Â I am challenging you on your "baseline" weather data utilized in all of your hydrologic and climatic models. Consider this a "fatal flaw" that is consistent in the underpinning of a lot of your generated analyses. Your models are only as good as the original data allows, and you utilize data that IS NOT specific to our area ...Â	3/20/2021	

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BigValleyGSP_Ch6_RevisedDraft_2021_03_21_setaside.pdf	Page #: 6-9, Line #: 150	Projection with Climate Change.I challenge your projection of the effects of climate change on soil water use and availability in the Big Valley basin. "Wetter and warmer" climate prediction may apply to central California up toÂ its northern boundary at Santa Rosa... but not here.Although the Big Valley area is located within California its floristic, hydrologic and geologic attributes are more similiar to the "Great Basin" province of the Intermountain West. The boundaries of the northeastern reach of the Great Basin province are located less than 50 miles east from Big Valley. Future effects of climate change in this area will definitely be seen as reductions in winter snow levels with precipitation coming in the form of rain. Summer temperatures are anticipated to increase as well as the number of days of warm/hot weather. The summer season will become longer and the night time temperatures warmer.Climatic predictions for both Nevada and California were identified in November 2020 in an article presented by the Desert Research Institute. Climate change and a Ã¢Â€Âœthirsty atmosphereÃ¢Â€Â will bring more extreme wildfire danger and multi-year droughts to Nevada and California by the end of this century, according to new research from the Desert Research Institute (DRI), the Scripps Institution of Oceanography at the University of California, San Diego, and the University of California, Merced.Â According to their results, climate change projections show consistent future increases in atmospheric evaporative demand (or the Ã¢Â€Âœatmospheric thirstÃ¢Â€Â) over California and Nevada. These changes are largely driven by warmer temperatures, and would likely lead to significant on-the-ground environmental impacts. "Higher evaporative demand during summer and autumn means ... faster drying of soil moisture and vegetation" ... explains lead author Dan McEvoy, Ph.D.,Â Assistant Research Professor of Climatology at DRI.With very little recharge coming off of the surrounding mountains due to lack of snow cover, both surface and subsurface water will be affected ... especially with changes in land use patterns. Land use patterns are not static here in Big Valley, and it is unwise to use this variable as a constant for future water use predictions. Vegetation type conversion is changing right now as I write this comment. Hundreds of acres are currently being converted from natural vegetation community types into alfalfa	3/24/2021	
Chap 10 Public Draft 5/26/21	10-3, 91-92	Groundwater extractions should also include water used for fire, wildlife, logging, and construction.	6/2/2021	
Big Valley GSP All Chapters Public Draft 8/26/21	Chapter 6 figures	This budget has many assumptions. The numbers in the tables give the impression that it is highly accurate	9/9/2021	"Estimated" added to all figures. Figures rounded to indicate less accuracy.
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Lines 1882-1883	Remove "that may be interconnected with Ash Creek"	10/6/2021	Text removed
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 1886	Don't like the term "groundwater-enhanced habitat"	10/6/2021	Text changed

Big Valley GSP Comment Matrix Chapter 7

Document	Page & Line Number	Comment	Date	Notes and Responses
Public Draft Chap 7 (4/1/2021)	5, 113	Deep freezes can occur from September to May	4/7/2021	Text changed
Public Draft Chap 7 (4/1/2021)	6, 125	Environmental regulations include SGMA	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	6, 133	Change "may" to "will"	4/7/2021	Text changed
Public Draft Chap 7 (4/1/2021)	6, 135	Change "may" to "is likely to"	4/7/2021	Text changed
Public Draft Chap 7 (4/1/2021)	6,144-146	Ash creek wildlife area is 14,000 acres of unmanaged land	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	7, 197-199	The Basin needs the support of Federal management	4/7/2021	Text changed
Public Draft Chap 7 (4/1/2021)	8, 215	Monitoring also helps DWR	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	8, 224	Remove slightly	4/7/2021	Text changed
Public Draft Chap 7 (4/1/2021)	9, 261	If there is no Ag there is no community.	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	11, 314-321	Paragraph needs clarification, table or example	4/7/2021	Section was re-worded for clarity
Public Draft Chap 7 (4/1/2021)	11, 327	Add "and breeding grounds"	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	11, 328	Add "develop" a new water source	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	11, 350	Add text clarifying that storage estimates are based on an assumed aquifer depth of 1200 feet	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	15, 479	NCWA is a regulatory program	4/7/2021	Text added. Detail on the nature of the program, regulations and fees needed
Public Draft Chap 7 (4/1/2021)	5, 95-98	Add spring-fed streams verbiage	4/7/2021	Text added

Big Valley GSP Comment Matrix Chapter 7

Document	Page & Line Number	Comment	Date	Notes and Responses
Public Draft Chap 7 (4/1/2021)	6, 127	Add "and roads"	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	6, 127	Add "reduction of timber yield tax"	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	6, 135	Include effect of low land values, the ongoing cost of monitoring and updates, lower property tax base	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	8, 217	Remove "chronic"	4/7/2021	Text removed
Public Draft Chap 7 (4/1/2021)	11, 321	1/3 of representative wells	4/7/2021	Text altered
Public Draft Chap 7 (4/1/2021)	12, 353	decline was less than 16.5 feet in fall, 19.77 in spring	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	15, 480	Water quality sample required when home is sold or foster chlid is placed	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)	16, 508-510	Remove "Continued… flood risk" sentence	4/7/2021	Text removed
Public Draft Chap 7 (4/1/2021)	16, 519 and 522	Add spring-fed streams verbiage	4/7/2021	Text added
Public Draft Chap 7 (4/1/2021)		Cost of drilling deeper wells needs to be considered	4/7/2021	Right now the GSP only addresses costs of pumping.
Public Draft Chap 7 (4/1/2021)		There is need for domestic users to be considered and need for some domestic users to have to drop their domestic wells and install filters. Calcium is up. Some wells are 20-foot hand-dug wells. Fingers are not being pointed at ag. There are other people coming to the basin for recreation, fishing, and hunting.	4/7/2021	
Public Draft Chap 7 (4/1/2021)		Need better definition of threshold, number of wells by type. How do ditches and canals factor in? Water quality is important.	4/7/2021	The threshold has been defined as 140 feet below the fall 2015 baseline (or lowest water level if there was no 2015 measurement). Chapter 8 details the representative wells, their depths, screen intervals and types. Undesireable results have been defined as when 1/3 of the representative wells are below their MT for 5 years. Recharge from ditches and canals is estimated in the water budget. The guidance from the BVAC has been to not set thresholds for water quality, but to assess at the 5-year updates.
Public Draft Chap 7 (4/1/2021)		What about habitat? Special status? How are we monitoring?	4/7/2021	A set of shallow monitoring wells has been established and will be assessed further at the 5-year update.

Big Valley GSP Comment Matrix Chapter 7

Document	Page & Line Number	Comment	Date	Notes and Responses
Public Draft Chap 7 (4/1/2021)		Of the GDEs, how much of it is springs?	4/7/2021	A map of GDE's can be found in Chapter 5 (Figure 5-20). A map of springs can be found in Chapter 4 (Figure 4-14).
Public Draft Chap 7 (4/1/2021)	6, 119	This helps to justify reasoning to get boundary modification	4/7/2021	The basin boundary and its limitations are discussed in Chapter 4. SGMA applies to areas within the basin boundary, but projects that benefit the basin can be outside the basin boundary.
Public Draft Chap 7 (4/1/2021)	16, 508-510	We don't know that subsidence will continue	4/7/2021	
Public Draft Chap 7 (4/1/2021)	16	DWR induced additional walls because they required off-stream watering sources to have grazing away from streams due to water quality concerns	4/7/2021	This program is independent of the GSP
Public Draft Chap 7 (4/1/2021)		Are we writing off that the Bieber mill site will be revived for novel wood products uses that require significant water?	4/7/2021	The GSP and water budget consider known uses. The future projection of the water budget assumes negligible industrial groundwater use.
Public Draft Chap 7 (4/1/2021)		Can we calculate and add in the cost per foot of deepening wells?	4/7/2021	Right now the GSP only addresses costs of pumping.
Public Draft Chap 7 (4/1/2021)		Any ideas on how to use monitoring data in innovative ways to solve some of Big Valley's specific data aps and questions that have arisen… beyond the reasons that DWR wants the data collected.	4/7/2021	The detailed water level data from the new monitoring wells is being evaluated and may provide insights into recharge areas, interconnection of streams, and other questions.
Public Draft Chap 7 (4/22/2021)	7-5, 178	Add "California" Department of Fish and Wildlife	5/4/2021	Added and moved to Chapter 1
Public Draft Chap 7 (4/22/2021)	7-5, 187	Add further clarification: appropriately advertised, not much interest in being on BVAC	5/4/2021	Text added and moved to Chapter 1
Public Draft Chap 7 (4/22/2021)	7-6, 246	Insert "…enacting various projects to improve management during the drought periods and wet periods experienced in the Basin…"	5/4/2021	Text added
Public Draft Chap 7 (4/22/2021)	7-6, 263	Insert "In summary, there have not been wide-spread reports of issues or concerns regarding groundwater levels from the residents of the Basin (whether agriculture producers or domestic users or others). Instead the concern was raised by DWR based on isolated wells that experienced limited decline during a drought."	5/4/2021	Text changed
Public Draft Chap 7 (4/22/2021)	7-8, 295	re: word "diminished, work on wording (perhaps that it would be a ghost town or similar	5/4/2021	Text added "and the ability of people to live and work in the basin would be largely absent."
Public Draft Chap 7 (4/22/2021)	7-12, 402-406	All of these should be activated when 1/3 of the wells meet the action level.	5/4/2021	Text changed.
Public Draft Chap 7 (4/22/2021)	Appendix: Monitoring Well Construction Report, Page 6	Would like to see more GEI accountability, and that the public and BVAC wanted the wells re-drilled	5/4/2021	Text changed in the well construction report. Report text removed from the appendix. Appendix now only contains the as-built drawings of the wells.
Public Draft Chap 7 (4/22/2021)	7-16, 550	LAMP needs to be added as a water quality regulatory program	5/21/2021	Text added.

Big Valley GSP Comment Matrix Chapter 7

Document	Page & Line Number	Comment	Date	Notes and Responses
Big Valley GSP All Chapters Public Draft 8/26/21	Line 2516	"For all interested parties, there is need for a greater understanding of interconnected surface water that may be present in the Basin" Still opening the door. Recommend scratching the first part of the sentence	9/9/2021	Sentence modified
Big Valley GSP All Chapters Public Draft 8/26/21	Line 2531	"conclusive evidence of stream interconnection is not available." Recommend changing to "there is currently no evidence to support interconnected surface water."	9/9/2021	Text changed.
Big Valley GSP All Chapters Public Draft 8/26/21	Section 7.3	Add "medium ranking" as undesirable result	9/9/2021	Undesirable result is a term defined in SGMA and the ranking is unralated to undesirable results as defined.
Big Valley GSP All Chapters Public Draft 8/26/21	Lines 2348-2351	Remove last paragraph	9/9/2021	Paragraph removed.
Big Valley GSP All Chapters Public Draft 8/26/21	Section 7.3.6	We need better tracking of surface water allocations	9/9/2021	Text discusses data gap of surface water tracking.
Big Valley GSP All Chapters Public Draft 8/26/21	Section 7.3.6	There is a lot of unpredictability of weather patterns	9/9/2021	Text added
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 2052	Add the word "unscientific"	10/6/2021	Word added
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 2059	Remove the words "assumed to be"	10/6/2021	Words deleted

Big Valley GSP Comment Matrix Chapter 8

Document	Page & Line Number	Comment	Date	Notes and Responses
Chapter 8 Public Draft	Appendix 8B	Don't like the inclusion of well logs	4/27/2021	Well logs removed from appendix and well log number added to Appendix 8A.
Chapter 8 Public Draft	1, 67	Add "The assumed" groundwater contours…	5/24/2021	Text added
Chapter 8 Public Draft	1, 68	Shallow groundwater monitoring to "help" define the potential interconnection of groundwater aquifers with surface water bodies	5/24/2021	Text added
Chapter 8 Public Draft	Table 8-1	Revise table to adjust to 140 feet below 2015 baseline	5/24/2021	Table replaced.
Chapter 8 Public Draft	Figure 8-1	During the summer, Willow Creek is 100% allocated. There is no water. If you were going to argue that there is a surface water/groundwater connection, what is it connected to if there is no water? Same for Ash Creek west of Adin.	5/24/2021	This comment should be addressed in Chapter 5, when it is updated and compiled into the entire draft of the GSP.
Chapter 8 Public Draft	4, 89:97	It is noted that many of the DWR wells are domestic which have pumps all the time. How is this accounted for?	5/24/2021	The end of the paragraph addresses this, where staff that monitor the wells should be noting when the well or a nearby well is pumping.
Chapter 8 Public Draft	4, footnote 2	Moniutoring needs to be late october. Needs to be communicated and coordinated with DWR who collects level measurements.	5/24/2021	Text changed to "late-October"
Chapter 8 Public Draft	5, 116	It needs to be noted that the BVAC has done a great job making sure the wells are spatially distributed.	5/24/2021	The factual statement that the wells are distributed throughout the basin should suffice. DWR or other readers can make their own judgment on this.
Chapter 8 Public Draft	5, 8.2.1.2	We would like to understand the contour mapping requirements better. Doesn't make sense.	5/24/2021	Groundwater contours are presented in Chapters 4 and 5
Chapter 8 Public Draft	5, 136:143	Modify text: Chapter 5 discusses <u>the lack of</u> interconnected surface water and describes the perennial streams in the BVGB which may be interconnected to the groundwater aquifer. As described in Chapter 7 there is currently no conclusive evidence for interconnection of perennial streams with the groundwater aquifer, ~~and the volume of depletions (if any) is unknown.~~ Therefore, measurable objectives, minimum thresholds, and a representative monitoring network ~~for depletion~~ of interconnected surface water have not	5/24/2021	Text modified.
Chapter 8 Public Draft	Table 8-2	DWR, 2016a : What is this?	5/24/2021	This is a reference (documented in the references list) to a best management practices paper published by DWR. This is used as guidance on monitoring standards so that data gaps can be assessed.

Big Valley GSP Comment Matrix Chapter 8

Document	Page & Line Number	Comment	Date	Notes and Responses
Chapter 8 Public Draft	Table 8-2	"Data must be sufficient for mapping groundwater depressions, recharge areas, and along margins of basins where groundwater flow is known to enter or leave a basin" Comment: There is no data.	5/24/2021	This table identifies the data gaps
Chapter 8 Revised Draft 5/24/21	8-1, 60	If monitoring from outside agencies change their monitoring, it shouldn't be up to the counties (GSAs) to pick up the slack.	6/2/2021	Text added: "The monitoring networks will generally be adjusted to the availability of data collected and provided by the outside agencies."
Chapter 8 Revised Draft 5/24/21	8-1, 65	What is the "groundwater storage" sustainability indicator?	6/2/2021	Text regarding groundwater storage removed.
Chapter 8 Revised Draft 5/24/21	8-4, 93-94	Measurements need to be taken March 15 or before beginning of pumping season in spring, and taken after Oct 15 in the fall	6/2/2021	This statement refers to historic data. Footnote (3) clarifies when measurements should be taken in the future.
Chapter 8 Revised Draft 5/24/21	8-5, 116	Need to point out that the the distribution of representative wells is excellent and based on a thoughtful, comprehensive review of the wells	6/2/2021	Text changed and added: "Extensive discussion and consideration was performed by the GSAs and local stakeholders to determine an appropriate water level monitoring monitoring network. Based on the comprehensive review of the wells, the network was selected based on:"
Chapter 8 Revised Draft 5/24/21	8-5, 136	Note that water in the basin is 100% allocated.	6/2/2021	Text added: "and all summer flows are 100% allocated based on existing surface water rights."
Chapter 8 Revised Draft 5/24/21	8-5, 137	Delete "which may be interconnected to the groundwater aquifer"	6/2/2021	Text removed
Chapter 8 Revised Draft 5/24/21	8-7, 181	second row, last column. Owner of well 06C1 is very unlikely to agree to monitoring again	6/2/2021	Comment noted. The table states that the absence of that well is a data gap.
Chapter 8 Revised Draft 5/24/21	8-8, 183	Please define "anomalous", perhaps in a footnote	6/2/2021	Footnote added.
Chapter 8 Revised Draft 5/24/21	8-11, 231	We don't want to have the land use data collection fall on the GSAs	6/2/2021	The text is written in a way that states the GSAs will rely on DWR for land use data.
Big Valley GSP All Chapters Public Draft 8/26/21	Section 8.2.3	Subsidence is not happening	9/9/2021	Text changed to emphasize micro-subsidence in section 7.3.5
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 2486	The land use data provided by DWR is inaccurate	10/6/2021	Footnote added.

Big Valley GSP Comment Matrix Chapter 9

Document	Page & Line Number	Comment	Date	Notes and Responses
Chapter 9 Public Draft 5/24/21	1, 21	change "returning to" to "remaining"	6/2/2021	
Chapter 9 Public Draft 5/24/21	4, 95	What is meant by a "water storage basin"	6/2/2021	
Chapter 9 Public Draft 5/24/21	6, 120-121 7, 180-181	Change "towards sustainability" to "remain sustainable"	6/2/2021	
Chapter 9 Public Draft 5/24/21	7, 160-161	Regarding sentence "Development of additional wells strictly for monitoring is also of interest as they provide unobstructed measurements year round". It's not necessarily desirable. Remove or change wording.	6/2/2021	
Chapter 9 Public Draft 5/24/21	8, 195-196	change "achieve sustainability" to "maintain sustainability"	6/2/2021	
Chapter 9 Public Draft 5/24/21	8, 198	Insert "several" to discussion of reservoirs. Multiple reservoirs could be expanded.	6/2/2021	
Chapter 9 Public Draft 5/24/21	9, 228-235	In discussion of Allen Camp Dam, strengthen language regarding the need for the reservoir	6/2/2021	
Chapter 9 Public Draft 5/24/21	9, 240 et seq	Add controlled burns to potential actions	6/2/2021	
Chapter 9 Public Draft 5/24/21	12, 329	add "as compared to SGMA". to end of sentence	6/2/2021	
Chapter 9 Public Draft 5/24/21	14, 375	Add text about illegal marijuana grows	6/2/2021	
Big Valley GSP All Chapters Public Draft 8/26/21	Line 2776	Table 9-3 - 9.1 and 9.2 "projects will be communicated through the Big Valley Groundwater Advisory Committee." Have we determined if the Advisory Committee will continue to exist after plan adoption?	9/9/2021	Text changed to reflect communication from GSAs rather than BVAC.
Big Valley GSP All Chapters Public Draft 8/26/21	Line 2755	Add "and economically disadvantaged.	9/9/2021	Text added
Big Valley GSP All Chapters Public Draft 8/26/21	Line 3184	Add "and economically disadvantaged.	9/9/2021	Text added

Big Valley GSP Comment Matrix Chapter 10

Document	Page & Line Number	Comment	Date	Notes and Responses
Chap 10 Public Draft 5/26/21	10-2, 45-56	Why do we have to download, repackage, and send data back to state	6/2/2021	The GSP Regulations require this to be done as per §356 et. seq. Unlike most other basins in California, all Big VAlley data is being collected by outside agencies, including DWR taking water level measurements in the Basin. Therefore, the GSAs are downloading the data from the collecting agencies (e.g. DWR) to include in the annual report. The GSAs and their consultants are working to ensure that the data and figures that need to be submitted in the annual reports are able to be generated and submitted as easily as possible with little effort from GSA staff and/or consultants. Text has been added to point out the fact that the GSAs are regurgitating data.
Chap 10 Public Draft 5/26/21	10-3, 91-92	Groundwater extractions should also include water used for fire, wildlife, logging, and construction.	6/2/2021	A note has been made for future updates to Chapter 6 (Water Budget) to include these items. For water budgeting purposes these will fit under the umbrella of industrial uses. A footnote was added to this portion of Chapter 10 referring to these uses
Chap 10 Public Draft 5/26/21	10-3, 93-94	Surface water supply is 100% allocated	6/2/2021	A footnote was added to emphasize this point.
Chap 10 Public Draft 5/26/21	10-3, 95-96	Add industrial uses	6/2/2021	Industrial was added, with a footnote detailing the various users.
Chap 10 Public Draft 5/26/21	10-3, 101	"Progress toward achieving measurable objectives". Change wording to reflect that already sustainable.	6/2/2021	Wording changed
Chap 10 Public Draft 5/26/21	10-7, 138	Why do we need to manage water quality when it is already good.	6/2/2021	The discussion and approach to water quality data was changed to reflect that the GSAs will rely on the SWRCB to store and provide water quality data via their GAMA Groundwater Information System.
Chap 10 Public Draft 5/26/21	10-2, 40	The water year is difficult to apply to Big Valley	6/2/2021	Sentence added, pointing this out. "While the WY as defined by DWR isn't ideal for use in Big Valley, the GSAs will assemble data based on DWR's definition as per SGMA statute and regulationsThe discussion and approach to water quality data was changed to reflect that the GSAs will rely on the SWRCB to store and provide water quality data via their GAMA Groundwater Information System.
Chap 10 Public Draft 5/26/21	10-13, 234	Poor wording	6/2/2021	Wording changed
Chap 10 Public Draft 5/26/21	10-15, 270	Poor wording. Rewrite to emphasize that basin is economically disadvantaged and residents can't afford new taxes or fees	6/2/2021	Wording changed
Chap 10 Public Draft 5/26/21	Appendix 10A	Don't like grant funding	6/2/2021	Wording changed
9/22/21 Draft GSP as introduced at 10/6/2021 BVAC meeting	Line 3115	Change requirement of SGMA to mandates of SGMA	10/6/2021	Text changed.

Big Valley GSP Comment Matrix Chapter 11

Document	Page & Line Number	Comment	Date	Notes and Responses
Big Valley GSP All Chapters Public Draft 8/26/21	Line 2776	Lassen and Modoc County Boards of Supervisors sent letters. Supervisor Byrne testified before both the Senate and Assembly committees in support of this bill citing the constraints of inadequate broadband in the community for meaningful public participation.	9/9/2021	Text added
9/22/21 Draft GSP as introduced at	Lines 3326 to 3345	Grammatical tenses are inconsistent	10/6/2021	Section edited for tense agreement.
9/22/21 Draft GSP as introduced at	Line 3378	Isn't the purpose of the BVAC to provide a product that the Boards of Supervisors can approve?	10/6/2021	The MOU states that the BVAC is to provide a recommendation.

Big Valley GSP Comment Matrix Chapter 12

Document	Page & Line Number	Comment	Date	Notes and Responses

Big Valley GSP Comment Matrix General Comments

Document	Page & Line Number	Comment	Date	Notes and Responses
General Comment	Page #:, Line #:	See attached letter.https://bigvalleygsp.org/service/document/download/279	9/11/2021	
General Comment	Page #:, Line #:	See the attachment.Â My comments refer to the document as a whole.Â I appreciate the committees time and efforts.Â I hope my comments are utilized.Â https://bigvalleygsp.org/service/document/download/299	10/5/2021	
General Comment	Page #:, Line #:	My lady and I attended the meeting yesterday (Oct. 6, 2021) in Bieber mostly to learn what's going on regarding water rights in Big Valley, and if offered the opportunity, to ask questions and/or comment. We ended up leaving when a brief break was called because it was obvious that just more of the nitpicking over spelling, grammar, and semantics was going to drag on. This sort of very boring off-topic obsession over irrelevant minutia might be somewhat humorous at some level, but all of that needs to be done prior to a public meeting so that the meat of the issue(s) can be addressed and discussed. We ended up over at the Roundup and sat next to another couple that also bailed out of the meeting for the same reason I state above. Public meetings are supposed to be for the PUBLIC, not for inane grade school lessons regarding how to properly compose sentences. I have a degree in geology (though I never worked as a geologist) and a degree in civil engineering (which I worked in professionally for a couple of years in the 1970s). I independently study climate dynamics and I have a solid base of knowledge regarding paleo climate in our greater geographical region. We'd love to be involved in what looms on the horizon regarding the State's possible future water-snatching efforts, but if every "public" meeting is going to involve the nitpicking over how something has been structurally written then we will be loathe to be involved.Â Â	10/7/2021	

Big Valley Groundwater Sustainability Plan

Public Review Draft
October 2021

No. 5-004 Big Valley Groundwater Basin

Prepared by:

Big Valley Groundwater Sustainability Plan

Revised Draft October 18, 2021

Prepared by:

Lassen County
Groundwater Sustainability Agency

Modoc County
Groundwater Sustainability Agency

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- Chris Gallagher, Vice-Chair
- Gary Bridges
- Jeff Hemphill
- Tom Hammond

Modoc County:
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- Gary Bridges, Alt. Board Representative
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The Basin Setting (Chapters 4-6) was developed under the direction of Professional Geologists:

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Acronyms and Abbreviations

ACWA	Ash Creek Wildlife Area
AF	acre-feet
AFY	acre-feet per year
AgMAR	Agriculture Managed Aquifer Recharge
ASR	Aquifer Storage and Recovery
Basin	Big Valley Groundwater Basin
Basin Plan	Water Quality Control Plan
bgs	below ground surface
BIA	U.S. Bureau of Indian Affairs
Big Valley	Big Valley Groundwater Basin
BLM	U.S. Bureau of Land Management
BMO	Basin Management Objective
BMP	Best Management Practices
BVGB	Big Valley Groundwater Basin
BVAC	Big Valley Groundwater Basin Advisory Committee
BVWUA	Big Valley Water Users Association
C&E	communication and engagement
CAL FIRE	California Department of Forestry and Fire Protection
CASGEM	California Statewide Groundwater Elevation Monitoring
CDEC	California Data Exchange Center
CDFA	California Dept of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFCC	California Financing Coordinating Committee
CGPS	continuous global positioning system
CIMIS	California Irrigation Management Information System
CRP	conservation reserve program
CWA	Clean Water Act
CWC	California Water Code

DDW	State Water Resources Control Board's Division of Drinking Water
District	Lassen-Modoc County Flood Control and Water Conservation District
DMS	Data Management System
DOI	Department of the Interior
DTW	depth to water
DWR	California Department of Water Resources
EC	electrical conductivity
EQIP	Environmental Quality Incentives Program
ET	evapotranspiration
ETo	reference evapotranspiration
°F	degrees Fahrenheit
Forest Service	U.S. Forest Service
ft/yr	foot or feet per year
GAMA	Groundwater Ambient Monitoring and Assessment Program
GAMA GIS	GAMA Groundwater Information System
GDE	groundwater dependent ecosystem
General Order	Statewide ASR General Order
GIS	geographic information system
GP	General Plan
gpm	gallons per minute
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	hydrogeologic conceptual model
HSG	Hydrologic Soils Group
IC	institutional controls
ILRP	Irrigated Lands Regulatory Program
IM	Interim Milestone
in/hr	inches per hour
InSAR	Interferometric Synthetic Aperture Radar, a technology used to detect subsidence
IRWMP	Upper Pit Integrated Regional Water Management Plan
IWFM	Integrated Water Flow Model

LCGMP	Lassen County Groundwater Management Plan
LCWD #1	Lassen County Waterworks District #1
LNAPL	Light non-aqueous phase liquid (found in petroleum hydrocarbons)
LUST	Leaking underground storage tank
M	million
MCL	Maximum Contaminant Level
Mn	manganese
MO	Measurable Objective
MOU	Memorandum of Understanding
msl	mean sea level
MT	Minimum Threshold
MTBE	Methyl tert-butyl ether
NCCAG	Natural Communities Commonly Associated with Groundwater
North Cal-Neva	North Cal-Neva Resource Conservation and Development Council
NCWA	Northern California Water Association
NECWA	Northeastern California Water Association
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NR	Natural Resources
NRCS	Natural Resources Conservation Service
NSP	Nonpoint Source Program
OS	Open Space
OWTS	Onsite Water Treatment System
PFAS	per/polyfluoroalkyl substances
PG&E	Pacific Gas and Electric
Plan	Groundwater Sustainability Plan
Reclamation	United States Bureau of Reclamation
RWMG	Regional Water Management Group
RWQCB	Regional Water Quality Control Board
RWQCB-R5	Regional Water Quality Control Board Region 5

SAGBI	Soil Agricultural Groundwater Banking Index
SB	Senate Bill
SC	specific conductance
SGMA	Sustainable Groundwater Management Act of 2014
SMC	Sustainable Management Criteria
SRI	Sacramento River Index of water year types
SSURGO	Soil Survey Geographic Database
State Water Board	California State Water Resources Control Board
SVE	Surprise Valley Electric
SVWQC	Sacramento Valley Water Quality Coalition
SWEEP	State Water Efficiency and Enhancement Program
SY	specific yield
TBA	tert-Butyl alcohol
TDS	total dissolved solids
TMDL	Total Maximum Daily Load Program
TNC	The Nature Conservancy
UCCE	University of California Cooperative Extension
U.S.	United States
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	United States Geologic Survey
UST	Underground Storage Tank
WAA	Water Availability Analysis
WCR	well completion report
WDR	Waste Discharge Requirement
WRP	wetland reserve project
WY	Water Year (October 1 – September 30)

Executive Summary

ES.1. Introduction & Plan Area (Chapters 1 – 3)

The Big Valley Groundwater Basin (BVGB, Basin, or Big Valley) lies on the border of Modoc and Lassen counties in one of the most remote and untouched areas of California. The sparsely populated Big Valley has a rich biodiversity of wildlife and native species who live, feed and raise young ~~primarily~~ on the irrigated lands throughout the Basin. The snow-fed high desert streams entering the Basin have seasonal hydrographs with natural periods of reduced flows or complete cessation of flows late in the summer season. The Pit River is the largest stream and is so named because of the practice, employed by the Achumawi and other Native American bands that are now part of the Pit River Tribe, of digging pits ~~to~~in the river channel when it went dry to expose water and trap game that came to water at the river. Farming and ranching in Big Valley date back to the late 19th and early 20th centuries when families immigrated to Big Valley and made use of the existing water resources. A large amount of the land in the Basin is still owned and farmed by the families that homesteaded here.

Historically, agriculture was ~~supplemented~~complemented by a robust timber industry ~~which was~~as a key component of the economy for Big Valley which ~~also~~ supported four lumber mills. Due to regulations and policies imposed by state and federal governments, the timber industry has been diminished over time and subsequently caused a great economic hardship to the Big Valley communities. Stakeholders realize that the Sustainable Groundwater Management Act of 2014 (SGMA) will unfortunately cause a similar decline to agriculture. The change in land management has transformed once thriving communities in the Basin to "disadvantaged" and "severely disadvantaged" communities. Viable agriculture is of paramount importance to the residents of Big Valley because it supports the local economy and unique character of the community. As required by SGMA, stakeholders have developed a sustainability goal:

> The sustainability goal for the Big Valley Groundwater Basin is to maintain a locally governed, economically feasible, sustainable groundwater basin and surrounding watershed for existing and future legal beneficial uses with a concentration on agriculture. Sustainable management will be conducted in context with the unique culture of the basin, character of the community, quality of life of the Big Valley residents and the vested right of agricultural pursuits through the continued use of groundwater and surface water.

Lassen and Modoc counties are fulfilling their unfunded, mandated roles as Groundwater Sustainability Agencies (GSAs) to develop this Groundwater Sustainability Plan (GSP) after exhausting its administrative challenges to the California Department of Water Resources' (DWR's) determination that Big Valley qualifies as a medium-priority basin. Both counties are disadvantaged, have declining populations and have no ability to cover the costs of GSP development and implementation.

The Basin, shown on **Figure ES-1**, encompasses an area of about 144 square miles (92,057 acres) with Modoc County representing 28 percent and Lassen County comprising 72 percent of the Basin by area. The Basin includes the towns of Adin and Lookout in Modoc County and the towns of Bieber and

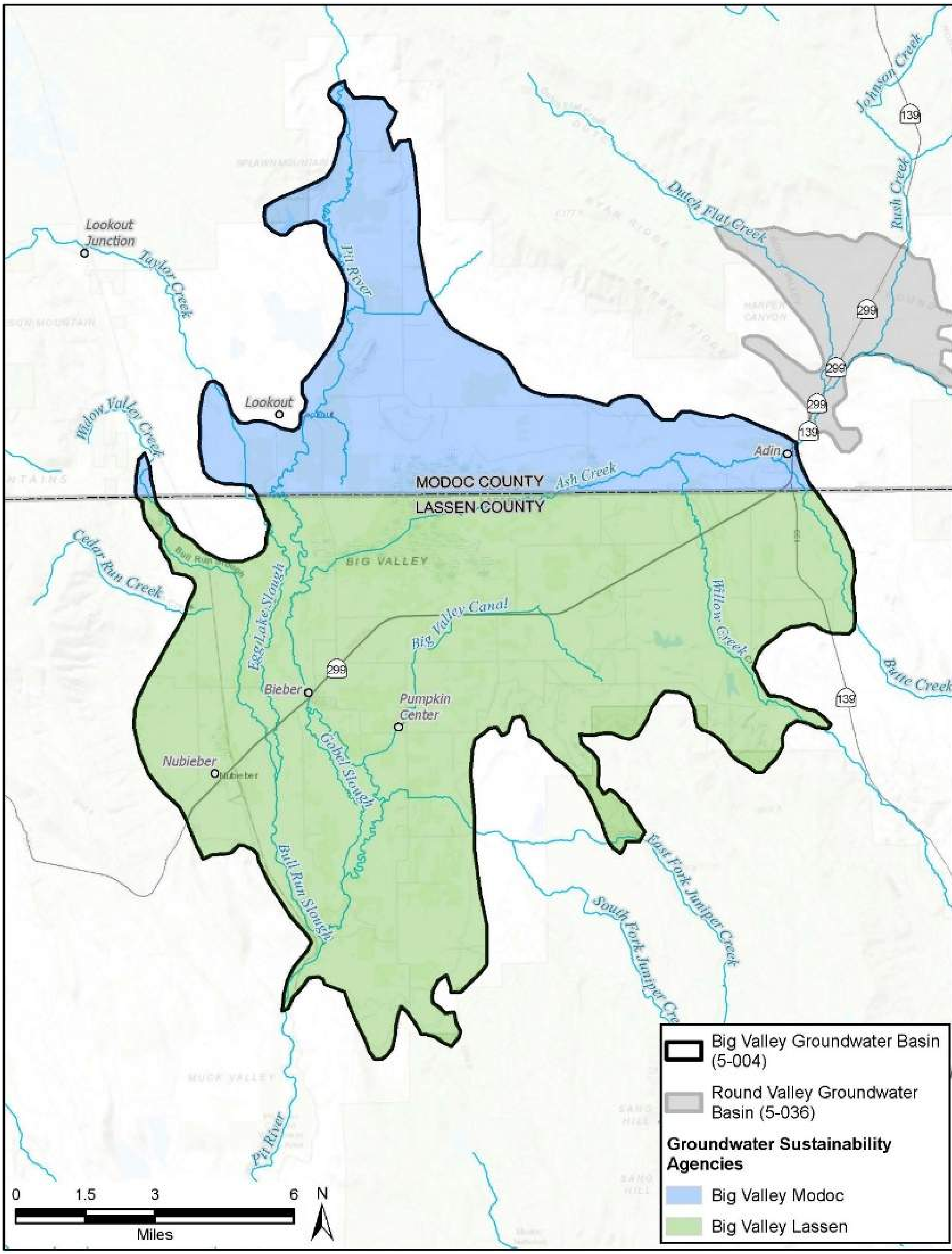


Figure ES-1 Groundwater Sustainability Agencies in Big Valley Groundwater Basin.
Source: DWR 2018d

Nubieber in Lassen County. The Ash Creek State Wildlife Area straddles both counties occupying 22.5 square miles in the center of the Basin in the marshy/swampy areas along Ash Creek. Land use in the BVGB is detailed in **Table ES-1**.

Table ES-1 2016 Land Use Summary by Water Use Sector

Water Use Sector	Acres	Percent of Total
Community[a]	250	<1%
Industrial	196	<1%
Agricultural	22,246	24%
State Wildlife Area[b]	14,583	16%
Managed Recharge	-	0%
Native Vegetation and Rural Domestic[c]	54,782	60%
Total	**92,057**	**100%**

Notes:
[a] Includes the use in the communities of Bieber, Nubieber and Adin
[b] Made up of a combination of wetlands and non-irrigated upland areas
[c] Includes the large areas of land in the Valley which have domestic wells interspersed
Source: See Chapter 6 – Water Budget for explanation of approach

ES.2. Basin Setting (Chapters 4 – 6)

Hydrogeologic Setting

The topography of BVGB is relatively flat ~~within~~in the central area with increasing elevations along the perimeter, particularly in the eastern portions where Willow and Ash creeks enter the Basin. This low relief in the Basin results in a meandering river morphology and widespread flooding during large storm events. The Basin is underlain by a thick sequence of sediment derived from the surrounding mountains of volcanic rocks and is interbedded with lava flows and water-lain tuffs. The volcanic material is variable in composition and is Miocene to Holocene age (23 million to several hundred years ago). The compositions of the lava flows are primarily basalt[1] and basaltic andesite[2], while pyroclastic[3] ash deposits are rhyolitic[4] composition. In general, the Basin boundary drawn by DWR ~~can be described as~~was intended to define the contact between the valley alluvial deposits and the surrounding mountains of volcanic rocks. During development of this GSP, the Basin boundary has been found to be grossly inaccurate in many areas and is not clearly isolated from areas outside the valley floor. The mountains outside of the groundwater Basin capture and accumulate precipitation, which produces runoff that flows into BVGB. Moreover, DWR (1963) suggested that these mountains serve as "upland recharge areas" and provide subsurface recharge to BVGB *via* fractures in the rock and water bearing formations that ~~may~~ underlie the volcanics.

[1] Basalt is an extrusive (volcanic) rock with relatively low silica content and high iron and magnesium content.
[2] Andesite is an extrusive rock with intermediate silica content and intermediate iron and magnesium content.
[3] Pyroclastic rocks are formed during volcanic eruptions, typically not from lava flows, but from material (clasts) ejected from the eruption such as ash, blocks, or "bombs."
[4] Rhyolitic rocks are extrusive with relatively high silica content and low iron and magnesium. Rhyolites are the volcanic equivalent of granite.

The Pliocene-Pleistocene age (5.3 million to 12 thousand years ago) Bieber Formation (TQb), shown in **Figure ES-2**, is the main formation of aquifer material defined within the BVGB, ~~extending~~and DWR (1963) estimates that it ranges in thickness from a thin veneer to ~~depths of~~over 1,000 feet~~ or more~~. The formation was deposited in a lacustrine (lake) environment and is comprised of unconsolidated to semi-consolidated layers of interbedded clay, silt, sand, gravel and diatomite. The coarse-grained deposits (gravel and sand) are aquifer material[5] and are part of the Big Valley principal aquifer. The "physical bottom" has not been clearly encountered or defined but may extend 4,000 to 7,000 feet or deeper. The "practical bottom" of the aquifer is 1,200 feet because that depth encompasses the known production wells and water quality may be poorer below that depth. As required by SGMA, 1,200 feet is used as the "definable bottom" for this GSP. A single principal aquifer is used for this GSP because distinct, widespread confining beds ~~were~~have not been identified in the subsurface, which, if present, would create multiple aquifers.

The Natural Resources Conservation Service (NRCS) Hydrologic Soils Group (HSG) classifications provide an indication of soil infiltration potential and ability to transmit water under saturated conditions~~,~~ based on hydraulic conductivities of shallow, surficial soils. Characterizing these soils is important because water must first penetrate the shallow subsurface to provide any chance of groundwater recharge. According to the HSG dataset, the Basin is composed of only soils with "slow" or "very slow" infiltration rates. While the soils are not highly permeable, some research has found that water can penetrate through these soils~~ which means~~, indicating that managed aquifer recharge projects such as on-farm recharge may be viable.

Groundwater Conditions

Historic groundwater elevations are available from a total of 22 wells in Big Valley that are part of the CASGEM[6] monitoring network, six located in Modoc County and 16 in Lassen County**.** In addition to these 22 wells, five well clusters were constructed in late 2019 and early 2020 to support the GSP. Groundwater level hydrographs from the historic wells show that most areas of the Basin have remained stable, and a few areas have seen some decline averaging ~~only~~ 0.53 feet per year of groundwater level decline in the last 38 years.[7]

To determine the annual and seasonal change in groundwater storage, groundwater elevation surfaces[8] were developed for spring and fall for each year between 1983 and 2018. **Figure ES-3** shows this information graphically, along with the annual precipitation. This graph shows that groundwater storage generally declines during dry years and stays stable or increases during normal or wet years. During the period from 1983 to 2000, groundwater levels dipped in the late 1980's and early 1990's, then recovered during the wet period of the late 1990's. After 2000, while most wells are still stable, a few wells have

[5] Meaning the sediments contain porous material with recoverable water.
[6] California Statewide Groundwater Elevation Monitoring Program
[7] Average slope of the trend lines in Appendix 5A.
[8] Groundwater elevation surfaces are developed from the known groundwater elevations at wells throughout the Basin and then estimating/interpolating elevations at intermediate locations *via* a mathematical method known as kriging. The kriging elevation surface is based on a grid covering the entire basin that has interpolated groundwater elevation values for each node of the grid.

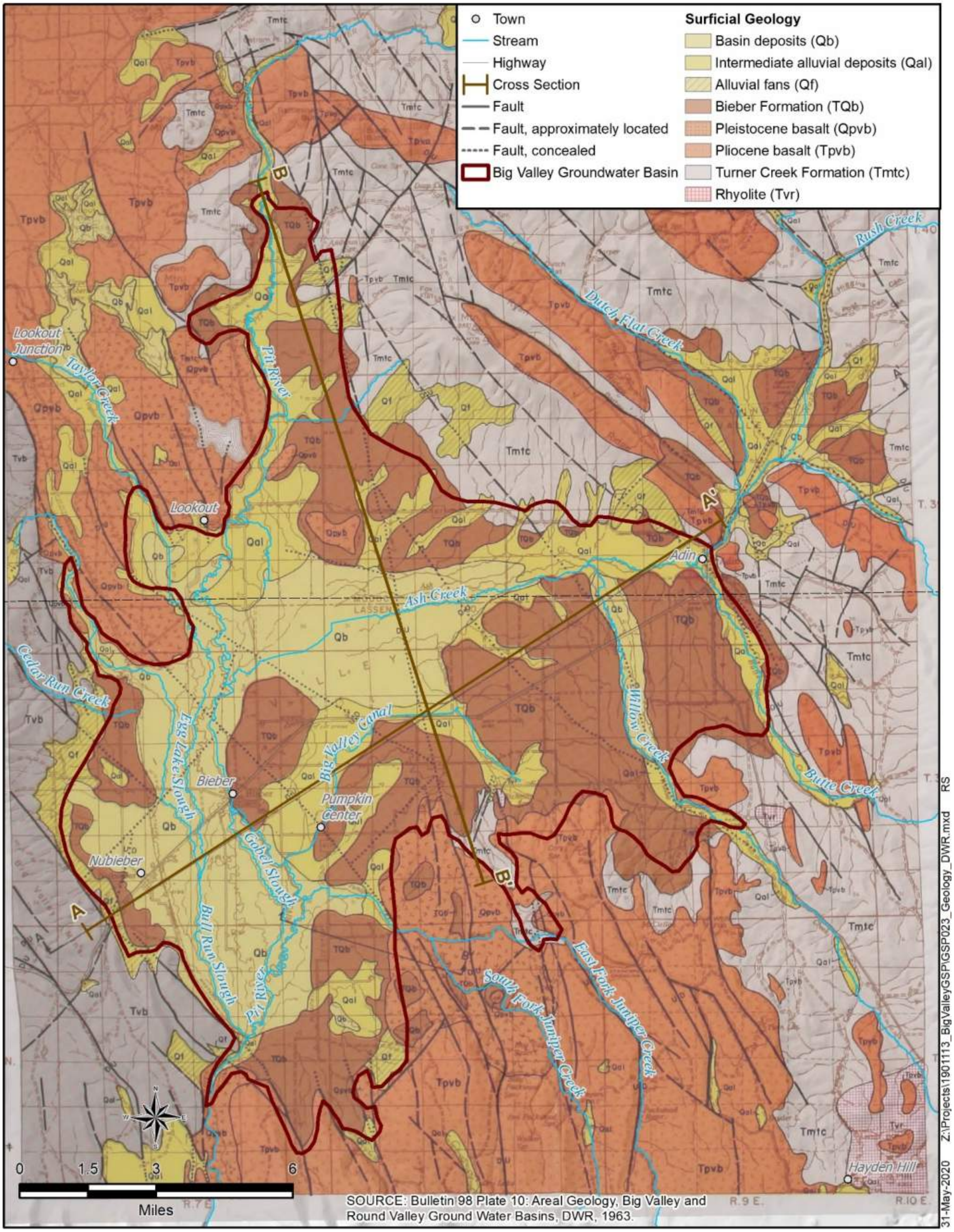


Figure ES-2 DWR 1963 Local Geologic Map.

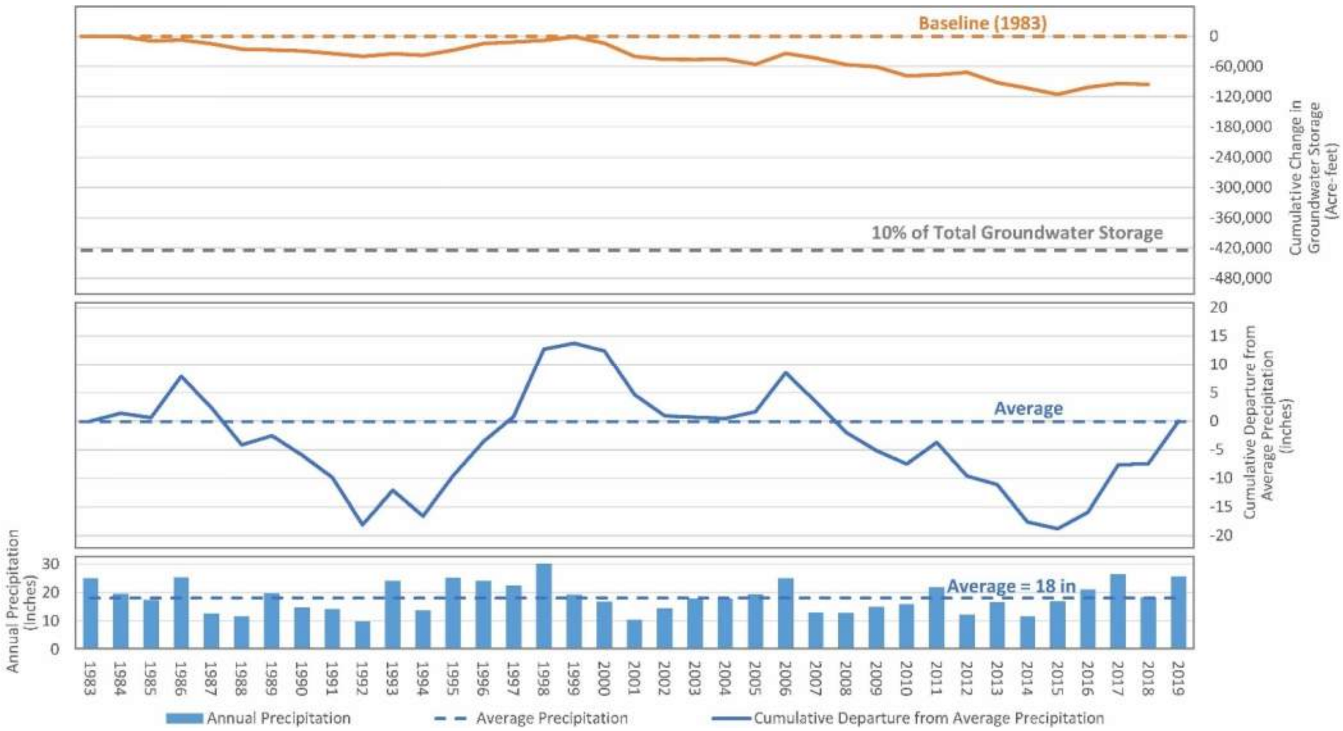


Figure ES-3 Cumulative Change in Groundwater Storage and Precipitation

generally declined resulting in a reduction in overall groundwater storage. The amount of decline represents a reduction in storage of less than 2 percent of groundwater storage.[9]

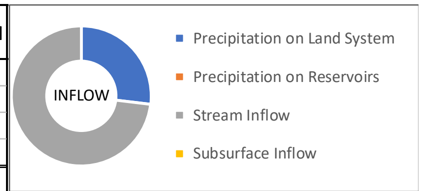
Groundwater in the BVGB is generally of good to excellent quality. (DWR 1963, United States Bureau of Reclamation [Reclamation] 1979) An analysis of available historic water quality indicates that some naturally occurring constituents associated with volcanic formations and thermal waters are slightly elevated. These elevated concentrations are extremely isolated and primarily not above thresholds that are a risk to human health~~.~~ nor does the water quality affect beneficial uses. There are no contamination plumes or cleanup sites that are likely to affect groundwater quality for beneficial use.

Water Budget

A historic water budget was developed for the 1983-2018 timeframe, shown in **Figure ES-4.** From this water budget analysis, a rough estimate for the sustainable yield is about 39,~~400~~300 acre-feet per year (AFY) and a rough estimate of average annual overdraft is 5,~~200~~000 AFY.

[9] Based on assessment in Section 5.2, indicating storage has been reduced by about 96,000 AF since 1983 and using a total storage of about 5.2 million AF (92,057 acre basin area * 1,200 feet to definable bottom * 5% specific yield)

Item	Flow Type	Origin/ Destination	Component	Estimated
	TOTAL BASIN WATER BUDGET			Acre-Feet
(1)	Inflow	Into Basin	Precipitation on Land System	136,800
(14)	Inflow	Into Basin	Precipitation on Reservoirs	500
(13)	Inflow	Into Basin	Stream Inflow	371,100
(27)	Inflow	Into Basin	Subsurface Inflow	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*508,400*
(5)	Outflow	Out of Basin	Evapotranspiration	154,000
(24)	Outflow	Out of Basin	Stream Evaporation	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	700
(19)	Outflow	Out of Basin	Conveyance Evaporation	-
(18)	Outflow	Out of Basin	Stream Outflow	358,500
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*513,600*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(5,000)



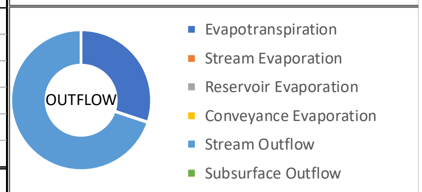


Figure ES-4 Average Total Basin Water Budget 1984-2018

ES.3. Sustainable Management (Chapters 7 – 9)

Sustainable Management Criteria

Sustainable Management Criteria (SMC) define the conditions that constitute sustainable groundwater management. The following is a description of the SMC for each of the six sustainability indicators:

- **Groundwater Levels:** Do not allow groundwater levels to decline to a level where the energy cost to lift groundwater exceeds the economic value of the water for agriculture. A depth of 140 feet below fall 2015 groundwater level for each well in the monitoring network was determined to be the depth at which groundwater pumping becomes uneconomical for agricultural use.
- **Groundwater Storage:** Groundwater levels are used as a proxy for this sustainability indicator because change in storage is directly correlated to changes in groundwater levels.
- **Seawater Intrusion:** This sustainability indicator does not apply to Big Valley
- **Water Quality:** Due to the existence of excellent water quality in the Basin, significant amount of existing water quality monitoring, generally low impact land uses and a robust effort to conduct conservation efforts by agricultural and domestic users, per §354.26(d), SMCs were not established for water quality because undesirable results are not present and not likely to occur. At the 5-year update of this GSP, data from various existing programs will be assessed to determine if degradation trends are occurring in the principal aquifer.
- **Land Subsidence:** Based on evaluation of subsidence data from a continuous GPS station and Interferometric Synthetic Aperture Radar (InSAR) provided by DWR, no significant subsidence has occurred. Therefore, per §354.26(d), SMCs were not established for subsidence because undesirable results are not present and not likely to occur. At the 5-year update of this GSP, subsidence data will be assessed for any trends that can be correlated with groundwater pumping.
- **Interconnected Surface Water:** Data for this sustainability indicator is limited. Currently there is no evidence to suggest that undesirable results have occurred or are likely to occur. At the 5-year update, water level and streamflow data from newly constructed wells and proposed stream

gages will be assessed. Thresholds will be considered if trends indicate that undesirable results have occurred or are likely to occur in the subsequent 5 years.

Monitoring Network

Monitoring networks are developed to promote the collection of data of sufficient quality, frequency and distribution to characterize groundwater and related surface water conditions in the Basin and to evaluate changing conditions that occur as the Plan is implemented. The GSAs developed monitoring networks for the parameters listed below. **Figure ES-5** shows the water level monitoring networks.

- Groundwater levels
- Groundwater storage *via* groundwater levels as proxy
- Shallow groundwater for interconnection of groundwater and surface water
- Groundwater quality
- Land subsidence
- Streamflow and climate
- Land use

Projects and Management Actions

Through an extensive planning and public outreach process, the GSAs have identified an array of projects and management measures that may be implemented to meet sustainability objectives in the BVGB. Some of the projects can be implemented immediately while others will take significantly more time for necessary planning and environmental review, navigation of regulatory processes and implementation. The various projects and estimated timeline can be found in **Table ES-2**.

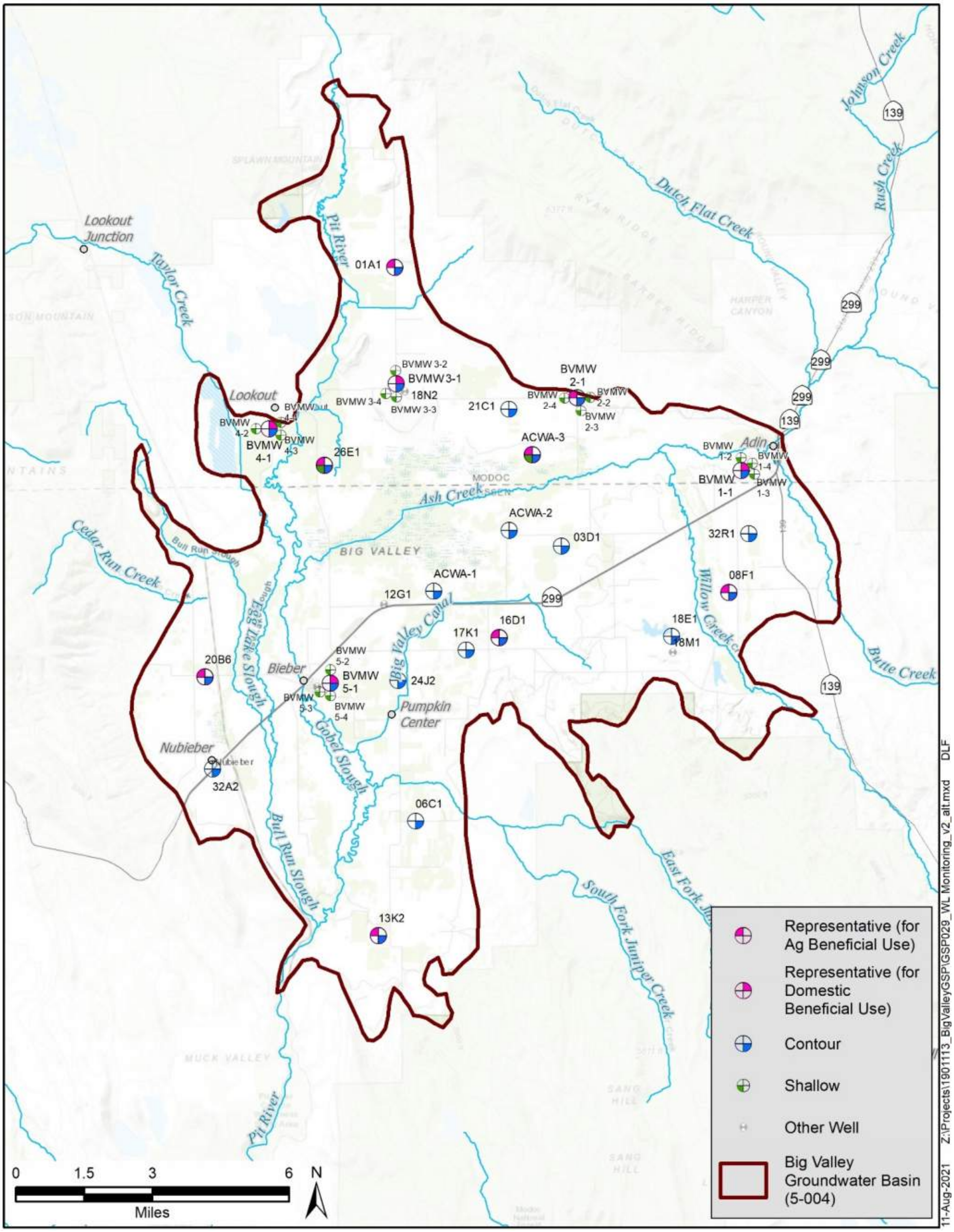


Figure ES-5 Groundwater Level Monitoring Networks

Table ES-2 Projects and Potential Implementation Timeline

No.	Category	Description	Estimated Time for Potential Implementation (years)		
			0-2	2-8	>8
1	9.1 Recharge Projects	AgMAR	X	X	X
2		Drainage and Basin Recharge	X	X	X
3		Ag Injection Wells			X
4	9.2 Research and Data Development	Stream Gages	X		
5		Refined Water Budget	X	X	
6		Agro-Climate Station	X		
7		Voluntary Installation of Well Meters	X	X	
8		Adaptive Management	X	X	X
9		Mapping and Land Use	X	X	
10	9.3 Increased Storage Capacity	Expanding Existing Reservoirs		X	
11		Allan Camp Dam			X
12	9.4 Improved Hydrologic Function	Forest Thinning and Management	X	X	X
13		Juniper Removal	X	X	X
14		Stream and Meadow Restoration	X	X	X
15	9.5 Water Conservation	Irrigation Efficiency	X	X	
16		Landscaping and Domestic Water Conservation	X	X	
17		Conservation Projects	X	X	
18	9.6 Education and Outreach	Public Communication	X		
19		Information and Data Sharing	X	X	
20		Fostering Relationships	X		
21		Compiling Efforts	X	X	
22		Educational Workshops	X		
22		Educational Workshops	X		

Note: AgMAR = Agricultural Managed Aquifer Recharge

ES.4. Plan Implementation (Chapters 10 – 11)

The GSP lays out a roadmap for addressing ~~all of~~ the activities needed for GSP implementation. Implementing this GSP requires the following activities:

- **GSA Administration and Public Outreach:** The fundamental activities that will need to be performed by the GSAs are public outreach and coordination of GSP activities. Public outreach will entail updates at County Board of Supervisors' meetings and/or public outreach meetings. At a minimum the GSAs will receive and respond to public input on the Plan and inform the public about progress implementing the Plan as required by §354.10(d)(4) of the Regulations. Coordination activities would include ensuring monitoring is performed, annual reports to DWR, 5-year GSP updates and coordinating projects and management actions.

- **Monitoring and Data Management:** Data collection and management will be required for both annual reporting and 5-year updates. Monitoring data that will be collected and stored in the data management system (DMS) for reporting will include water levels, precipitation, evapotranspiration, streamflow, water quality, land use and subsidence.

- **Annual Reporting:** According to §356.2 of the Regulations, the Big Valley GSAs are required to provide an annual report to DWR by April 1 of each year following the adoption of the GSP. The first annual report will be provided to DWR by April 1, 2022 and will include data for the prior Water Year (WY), which will be WY 2021 (October 1, 2020 to September 30, 2021), despite DWR's definition of a WY being inconsistent with what works for Big Valley. The Annual Report will establish the current conditions of groundwater within the BVGB, the status of the GSP implementation and the trend towards maintaining sustainability.
- **Plan Evaluation (5-Year Update)**: Updates and amendments to the GSP can be performed at any time, but at a minimum the GSAs must submit ~~and~~an update and evaluation of the plan every 5 years (§356.4). While much of the content of the GSP will likely remain unchanged for these 5-year updates, the Regulations require that most chapters of the plan be updated and supplemented with any new information obtained in the preceding 5 years.

Cost of Implementation

Cost is a fundamental concern to the GSAs and stakeholders in the BVGB, as the Basin is disadvantaged and there is ~~little to~~ no revenue generated in the counties to fund the state-mandated requirements of SGMA. Therefore, the GSAs will rely on outside funding to implement this unfunded, mandated Plan.

1. Introduction § 354.2-4

1.1 Introduction

The Big Valley Groundwater Basin (BVGB, Basin, or Big Valley) is located in one of the most remote and untouched areas of California. The sparsely populated Big Valley has a rich biodiversity of wildlife and native species who feed, live and raise young primarily on the irrigated lands throughout the Basin. The Basin has multiple streams which enter from the North, East and West. The Pit River is the only surface water outflow and exits at the southern tip of the Basin. The streams that enter the Basin are some of the most remote, least improved and most pristine surface waters in all of California. The snow-fed high desert streams entering the Basin have seasonal hydrographs with natural periods of reduced flows or complete cessation of flows late in the summer season. The Pit River is the largest stream and is so named because of the practice, employed by the Achumawi and other Native American bands that are now part of the Pit River Tribe, of digging pits ~~to~~in the river channel when it went dry to expose water and trap game that came to water at the river. In addition to the Pit River, the Basin is also fed by Ash Creek year-round, along with Willow Creek and many seasonal streams and springs.

Farming and ranching in Big Valley date back to the late 19^{th} and early 20^{th} centuries when families immigrated to Big Valley and made use of the existing water resources. A large amount of the land in the Basin is still owned and farmed by the families that homesteaded here. The ~~sur names~~surnames on the tombstones at any of the three cemeteries are the same names that can be overheard during a visit to the Bieber Market or the Adin Supply store, local institutions and gathering places for the residents of this tight-~~nit~~knit community. These stores are remaining evidence of a much more vibrant time in Big Valley.

Following World War II, with the advent and widespread use of vertical turbine pumps, farmers and ranchers began using groundwater to irrigate the land, supplementing their surface water supplies to make a living in ~~the~~ Big Valley. The local driller, Conner's Well Drilling, has drilled the majority of wells in Big Valley and the third-generation driller, Duane Conner has been on the advisory committee during the development of this Groundwater Sustainability Plan (GSP or Plan). (Conner 2020-2021)

Historically, agriculture was ~~supplemented~~complemented by a robust timber industry, a key component of the economy for Big Valley, which supported four lumber mills. Due to regulations and policies imposed by state and federal government, the timber industry has been diminished over time which has caused a great economic hardship to the Big Valley communities. Stakeholders realize that the Sustainable Groundwater Management Act of 2014 (SGMA) will unfortunately cause a similar decline to agriculture. The loss of jobs due to the closure of all four lumber mills and the reduction of timber yield tax, which had provided financial support to the small rural schools and roads, is evident in the many vacant buildings which once had thriving businesses. In addition to the loss of jobs, the reduced student enrollment in local schools has caused an economic hardship to the school district which is struggling to remain viable. The change in land management has transformed once thriving communities in the Basin to "disadvantaged" and "severely disadvantaged" communities as defined by the California Department of Water Resources (DWR). The addition of SGMA will increase the severity of the disadvantaged and severely disadvantaged status in the Basin due to increased regulatory costs and potential actions that must be taken to comply with SGMA and is likely to intensify rural decline in this area. With the increased cost of this unfunded mandate for monitoring, annual reports and GSP updates, land values will likely decline and lower the property tax base.

The two counties that overlie the BVGB are fulfilling their unfunded, mandated role as the Groundwater Sustainability Agencies (GSAs) since there are no other viable entities that can serve as GSAs. Both counties have severe financial struggles as their populations and tax base are continually declining. The counties not only lack the tax revenue generated out of Big Valley to implement SGMA, but they have no buffer from revenue generated county-wide to cover such costs. As such, the GSAs are depending almost solely on outside funding sources for development and implementation of this Plan.

With the demise of ~~a~~the timber industry, agriculture has been the only viable industry remaining to support residents living and working in the Basin, with many of the families who ranch and farm today having cultivated the land for over a century. These families are fighting to maintain the viability and productivity of their land so that their children and grandchildren can continue to pursue the rural lifestyle that their forebearers established.

The ranchers and farmers have developed strategies to enhance the land with not only farming and ranching in mind, but also partnerships with state and federal agencies as well as local non-governmental agencies (NGOs). The purpose of these partnerships is to maintain and improve the condition of privately-owned land for the enhancement of plant and animal populations while addressing invasive plant and pest concerns.

The Ash Creek Wildlife Area (ACWA) is an example of a local rancher who provided land for conservation efforts with an understanding that managed lands promote wildlife enhancement for the enjoyment of all. The California Department of Fish and Wildlife (CDFW) has largely left the property unmanaged. (Albaugh 2021) While the ACWA does offer some refuge, most species graze and rear their young on the private lands around the Basin which are actively being cultivated because those lands offer better forage and protection from predators. Below is an account from the former land owner of how the ACWA property has fared since being sold to the government.

> The government bought the ranch as a refuge for birds and wildlife. When I was running cattle on that ranch it was alive with waterfowl. They fed around and amongst the cattle. It was a natural refuge. The cattle kept the feed down so the birds didn't have to worry about predators, and they could feed on the new growth grass. After the government got their hands on it all the fences were removed, at taxpayer expense. In the years since, the meadows have turned into a jungle -- old dead feed and tules. The birds are gone, moved to other ranches where they get protection from skunks and coyotes and other predators that work on waterfowl and wildlife. Under the management of the U.S. Fish and Wildlife the value of the land has been completely destroyed. All those acres of wonderful grass and the irrigation

> system that for generations have produced food for the people of this country now *produce nothing*. (Stadtler 2007)

Recently the CDFW has attempted to manage the property by constructing a ¾-mile pipeline to replace an unlined portion of the Big Valley canal and convey water to a 65-acre constructed wetland on a corner of the ACWA property. CDFW allows water to continue past ACWA to water rights holders down-canal, then uses any excess to support the wetland. The abandoned portion of the unlined canal travels through a private land-owner's property. Although there are no documented water rights holders on the abandoned portion of the unlined canal, it has dried that portion of the land-owner's property and reduced groundwater recharge there. (CDFW 2021)

Activities such as this from state agencies exacerbates the negative sentiments from local stakeholders toward state government and make them extremely wary of unintended consequences of government programs. This, coupled with the burden imposed on locals through regulations such as SGMA, are some of the fundamental reasons why residents of this area generally consider themselves distinct from the rest of the state. Furthermore, local political leaders have pointed out that the state is behind on tax payments to the disadvantaged counties. (Albaugh 2021)

The BVGB not only differs ~~from many of~~ politically, but also differs physically from California's other groundwater basins because the climate sees extreme cold. On average there are fewer warm temperature days, making the growing season considerably shorter than in other parts of the state. Ground elevations in the Basin range from about 4,100 to over 5,000 feet and along with its northerly latitude in the state, creates conditions where snow can fall in any month of the year. According to the Farmer's Almanac, the average growing season for the Big Valley Basin is about 101 days. The typical crops for the Big Valley Basin are low land use intensity and low value crops such as native pasture, grass hay, alfalfa hay and rangeland.

The vast majority of the farmed land utilizes low impact farming, employing no-till methods to grow nitrogen-fixing crops which require little to no fertilizer or pesticide application. While this climate and range of viable crops is a challenge to farmers and ranchers, it helps maintain the pristine nature of surface water and groundwater. As an example of how local landowners have been good stewards of their water resources, they have participated in the Natural Resources Conservation Service's (NRCS's) Environmental Quality Incentives Program (EQIP), drilling wells away from streams to encourage watering of cattle outside of riparian corridors. Now these additional wells have increased the inventory of wells in the Basin, one of the criteria used by DWR to categorize Big Valley as medium priority and subject to the SGMA unfunded mandate of developing a GSP. (Albaugh 2020-2021)

The GSAs are also aware of poor stewardship, such as illegal water uses (i.e., unlicensed marijuana growers). These operations may utilize groundwater, are known to have illegal diversions of surface water and have a negative impact on water quality. However, the counties have not received the state and federal support needed to identify ~~and~~, eliminate, and prosecute these operations.

The Big Valley Basin has a population of 1,046 residents and a projected slow growth of 1,086 by 2030. (DWR 2021a). The largest town (unincorporated community) within the Basin is Adin, California which had a population of 272 residents according to the 2010 Census. (USCB 2021). Located in Modoc

County, Adin had a 2.43 percent decline in population from 2017 to 2018. Both Modoc and Lassen are experiencing a decline in population county-wide. (USCB 2021)

As detailed in this GSP, there are three major beneficial uses of groundwater: agriculture, ~~municipal~~community/domestic and environmental. However, the importance of agriculture to Big Valley cannot be overstated, as it is the economic base upon which ~~municipal~~community/domestic users rely and provides the habitat for many species important to healthy wildlife and biodiversity. Both groundwater and surface water are important to maintaining this ~~habitat. Other plans, policies and ordinances unrelated to this GSP attempt~~ecosystem. There are efforts being made to diversify the economic base of the community. ~~Economic~~While economic diversity of Big Valley is not the purview of this GSP,~~ but~~ it is acknowledged that at present and for the foreseeable future, the Big Valley communities rely almost solely on farming and ranching to support ~~its~~their residents. The financial and regulatory impact of implementing SGMA will affect this disadvantaged community. Therefore, minimizing the GSP's impact to agriculture while complying with SGMA and working to enhance water supply in Big Valley is the thrust of this GSP.

1.2 Sustainability Goal

The GSAs are developing this GSP to comply with SGMA unfunded mandates, maintain local control and preclude intervention by the State Water Resources Control Board (State Water Board~~).~~), and prove that the Basin is sustainable and should be ranked as low priority. Satisfying the requirements of SGMA generally requires four activities:

1. Formation of at least one GSA to fully cover ~~a~~the basin. Multiple GSAs are acceptable and Big Valley has two GSAs
2. Development of ~~a~~this GSP that fully covers the basin
3. Implementation of ~~the~~this GSP and management to achieve quantifiable objectives
4. Regular reporting to DWR

~~The two~~Two GSAs were established in the Basin; County of Modoc GSA and County of Lassen GSA; each ~~cover~~covering the portion of the Basin in their respective jurisdictions. This document is a single GSP, developed jointly by both GSAs for the entire Basin. This GSP describes the BVGB, develops quantifiable management criteria that accounts for the interests of the Basin's legal beneficial groundwater uses and users, and identifies projects and management actions to ensure and maintain sustainability.

The Lassen and Modoc GSAs developed a Memorandum of Understanding (MOU) which detail~~e~~s~~d~~ the coordination between the two GSAs. The MOU state~~s~~~~d~~ a Big Valley Advisory Committee (BVAC) ~~was~~ is to be established to provide local input and direction on the development of a GSP. The counties solicited applicants to be members of the BVAC through public noticing ~~channels~~protocols. Big Valley landowners and residents submitted applications to the County Boards of Supervisors, who then appointed the members of the BVAC. The BVAC is comprised of one county board member from each county, one alternate board member from each county and two public applicants from each county. The BVAC and county staff have dedicated countless hours to reviewing the data and content of the GSP, largely uncompensated. After careful consideration of the available data and community input from the BVAC and interested parties, the GSAs have developed the following sustainability goal:

> The sustainability goal for the Big Valley Groundwater Basin is to maintain a locally governed, economically feasible, sustainable groundwater basin and surrounding watershed for existing and future legal beneficial uses with a concentration on agriculture. Sustainable management will be conducted in context with the unique culture of the basin, character of the community, quality of life of the Big Valley residents and the vested right of agricultural pursuits through the continued use of groundwater and surface water.

The BVGB sustainability goal will be culminated through DWR's better understanding of the surface water and groundwater conditions over time and the implementation of projects and management actions described in this GSP. Several areas of identified data gaps have been established and while an estimated future water budget has been completed, its accuracy is uncertain since many assumptions had to be made due to the lack of available data. The monitoring network established under this Plan includes new and existing monitoring wells, inflow/outflow measurement of surface water, groundwater quality~~, land subsidence, understanding upland recharge and an improved estimate of crop water use. This monitoring will provide the GSAs and DWR a better understanding of the Basin water budget and timely information regarding any changes or trends~~ and land subsidence.

The implementation of projects such as winter recharge studies currently in progress will help establish the feasibility of immediate actions the GSAs can take to improve Basin conditions. A detailed off-season water ~~budget~~availability analysis has not been conducted on the Upper Pit River watershed and this has been identified as a data gap within the Basin. The GSAs are working to locate funds to conduct an off-season and storage capacity water accounting which will provide the amount of available surface water for potential winter recharge in the Basin. Additional research will be conducted on the available use of non-active surface water rights for storage. An additional stream gage is being installed where the Pit River enters the Basin and will provide a more accurate accounting of the amount of surface water entering the Big Valley Basin from the Pit River. While better accounting is needed, it should be noted that SGMA and this GSP ~~should~~will not affect existing water rights in the Basin.

The understanding that has been gained by the GSAs is that with proper management and coordination with and support from federal landowner partners, the Big Valley Basin, which is not currently at risk of overdraft, will remain sustainable for the benefit of all interested parties and should be re-ranked as low priority.

1.3 Background of Basin Prioritization

The Big Valley GSAs are being forced to develop this GSP after exhausting its challenges to the California Department of Water Resources' (DWR's) determination that Big Valley qualifies as a medium-priority basin. DWR first prioritized the state's basins in 2014, at which time Big Valley was the lowest-ranked medium priority basin that had to develop a GSP. In 2019, DWR changed their prioritization process and criteria and issued draft and final prioritizations. In the end, Big Valley is still the lowest-ranked medium priority basin.

From the draft to final re-prioritization, the Big Valley GSAs recognize the scoring revisions made by DWR for Component 8.b, "Other Information Deemed Relevant by the Department." However, the GSAs continue to firmly believe that the all-or-nothing scoring for Component 7.a, regarding documented declining groundwater levels, is inconsistent with the premise of SGMA: that prioritization levels recognize different levels of impact and conditions across the basins of the state. DWR's adherence to treating all declines the same, assigning a fixed 7.5 points for any amount of documented groundwater level decline, renders meaningless the degrees of groundwater decline and penalizes those basins experiencing minor levels of decline, including Big Valley which has only experienced approximately 0.53 feet per year of groundwater level decline on average in the last 38 years.

Additionally, the GSAs recognize the adjustments made to Component 7.d, overall total water quality degradation. Noting that degradation implies a lowering from human-caused conditions, the Big Valley GSAs urge DWR to further refine the groundwater quality scoring process for Secondary Maximum Contamination Levels (MCLs) - which are not tied to public health concerns, but rather aesthetic issues such as taste and odor. Secondary MCLs which are due to naturally occurring minerals should not be factored into the scoring process. Here, the water quality conditions reflect the natural baseline and are not indicative of human-caused degradation and cannot be substantially improved through better groundwater management.

The inaccurate Basin boundary was drawn with a 63-year old regional scale map (CGS 1958~~)~~), and ~~was not drawn with as much precision as~~ subsequent geologic maps with more precision and detail are available. Additionally, the "upland" areas outside the Basin boundary are postulated to be recharge areas interconnected to the Basin, which is contrary to DWR's definition of a lateral basin boundary as being, "…features that significantly impede groundwater flow" (DWR 2016c). The GSAs submitted a request to DWR for basin boundary modification, to integrate planning at the watershed level and leverage a wider array of multi-benefit water management options and strategies within the Basin and larger watershed. DWR's denial of the boundary modification request greatly hampers jurisdictional opportunities to protect groundwater recharge areas in higher elevations. The final boundary significantly curtails management options to increase supply through upland recharge, requiring that groundwater levels be addressed primarily through demand restrictions. *See* **Appendix 1A** for communications with DWR regarding Basin prioritization ranking and boundary modification. The GSAs may consider future submittal of a Basin boundary modification ~~requests~~request to DWR.

Development of this GSP by the GSAs, in partnership with the BVAC and members of the community, does not constitute agreement with DWR's classification as a medium-priority basin – nor does it preclude the possibility of other actions by the GSAs or by individuals within the Basin seeking regulatory relief.

1.3.1 Timeline

In September 2014, the state of California enacted SGMA. This law requires medium- and high-priority groundwater basins in California to take actions to ensure they are managed sustainably. DWR is tasked with prioritizing all 515 defined groundwater basins in the state as high, medium, low and very low priority. Prioritization establishes which basins need to go through the process of developing a GSP. When SGMA was passed, basins had already been prioritized under the California Statewide

Groundwater Elevation Monitoring (CASGEM) program, and that existing ranking process was used as the initial priority baseline for SGMA.

DWR was required to develop its rankings for SGMA based on the first seven criteria listed in **Table 1-1**. For the final SGMA scoring process (DWR, 2019), groundwater basins with a score of 14 or greater (up to a score of 21) were ranked as medium priority basins. Big Valley scored 13.5 and DWR chose to round the score up to put it in the medium priority category as the lowest ranked Basin in the state required to develop a GSP. Lassen County reviewed the 2014 ranking process and criteria that were used and found ~~some potentially~~ erroneous data. The county made a request to DWR for the raw data that was used, which were eventually provided, and verified the error that would have put the BVGB into the low priority category. However, because the comment period for these rankings had already expired in 2014 (prior to the passage of SGMA), DWR would not revise their ranking. County staff were mis-led because when the rankings were first publicized, SGMA had not yet existed, and county staff were told that being ranked as a medium priority basin was insignificant and would actually be a benefit to the counties.

Table 1-1 Big Valley Groundwater Basin Prioritization

Criteria	2014	2018	2019	Comments
2010 Population	1	1	1	
Population Growth	0	0	0	
Public Supply Wells	1	1	1	
Total # of Wells	1.5	2	2	Existing information inaccurate, and includes all types of wells, including newly constructed stockwatering wells under EQIP
Irrigated Acreage	4	3	3	
Groundwater Reliance	3	3.5	3.5	
Impacts	3	3	2	Declining water levels, water quality
Other Information	0	7	2	Streamflow, habitat and "other information determined to be relevant"
Total Score	**13.5**	**20.5**	**14.5**	**Medium priority each year**

Source: DWR 2019

Once SGMA was passed and the onerous repercussions of being ranked as medium priority were better understood (and the counties identified erroneous data), DWR did not offer any recourse, simply saying the Big Valley Basin would remain ranked as medium priority and that the basins would soon be re-prioritized anyway.

In 2016, Lassen County submitted a request for a basin boundary modification as allowed under SGMA. The request was to extend the boundaries of the BVGB to the boundary of the watershed. The purpose of the proposed modification was to enhance management by including the volcanic areas surrounding the valley sediments, including federally managed timberlands and rangelands, that have an impact on groundwater recharge. The modification was proposed on a scientific basis but was denied by DWR because the request, "…did not include sufficient detail and/or required components necessary and evidence was not provided to substantiate the connection [of volcanic rock] to the porous permeable alluvial basin, nor were conditions presented that could potentially support radial groundwater flow as observed in alluvial basins." DWR therefore justifies denial based on inadequate scientific evidence, yet as stated above they used inaccurate, unscientific information to rank the Basin as medium priority in the first place.

In 2018, DWR released an updated draft basin prioritization based on the eight components shown in **Table 1-1** using slightly different data and methodology than previously used. For this prioritization, Big Valley's score increased from 13.5 to 20.5, primarily because of an addition of 5 ranking points awarded under the category of "other information determined to be relevant" by DWR. DWR's justification for the five points was poorly substantiated as "Headwaters for Pit River/Central Valley Project – Lake Shasta." Lassen and Modoc counties sent a joint comment letter questioning DWR's justification and inconsistent assessment of these five points as well as their methodology for awarding the same number of points for water level and water quality impacts to basins throughout the state regardless of the severity of the impacts.

In 2019, DWR released their final prioritization with the BVGB score reduced to 14.5, but still ranked as medium priority and subject to the development of a GSP. DWR's documentation of the 2019 prioritization can be viewed on their website (DWR 2019).

Meanwhile, throughout this time, Lassen and Modoc counties began moving forward to comply with SGMA unfunded mandates through a public process that established them as the GSAs in 2017. The establishing resolutions forming the GSAs adopted findings that it was in the public interest of both counties to maintain local control by declaring themselves the GSA for the respective portion of the Basin. The Water Resources Control Board would become the regulating agency if the counties did not agree to be the GSAs since there were no other local agencies in a position or qualified to assume GSA responsibility. The counties obtained state grant funding to develop the GSP in 2018 and began the GSP development process and associated public outreach in 2019.

1.4 Description of Big Valley Groundwater Basin

The BVGB is identified by DWR in Bulletin 118 as Basin No. 5-004 (DWR, 2016a). The inaccurate Basin boundary was drawn by DWR using a 1:250,000 scale geologic map produced by the California Geological Survey (CGS 1958) along the boundary between formations labeled as volcanic and those labeled as alluvial. The Basin boundary was not drawn with as much precision as subsequent geologic maps, and because of this the "uplands" areas outside the Basin boundary are postulated to be recharge areas interconnected to the Basin. The ~~60~~63-year old map being used to define the Basin boundary is inadequate and contrary to DWR's definition of a lateral basin boundary as being "features that significantly impede groundwater flow" (DWR 2016c).

The Basin is one of many small, isolated basins in the ~~north-eastern~~northeastern region of California, an area with widespread volcanic formations, many of which produce large quantities of groundwater and are not included within the defined groundwater basin due to their classification as "volcanic" rather than "alluvial".

The boundary between Lassen and Modoc counties runs west-east across the Basin. Each county formed a GSA for its respective portion of the Basin and the counties are working together to manage the Basin under a single GSP. The Basin, shown on **Figure 1-1**, encompasses an area of ~~approximately~~about 144 square miles

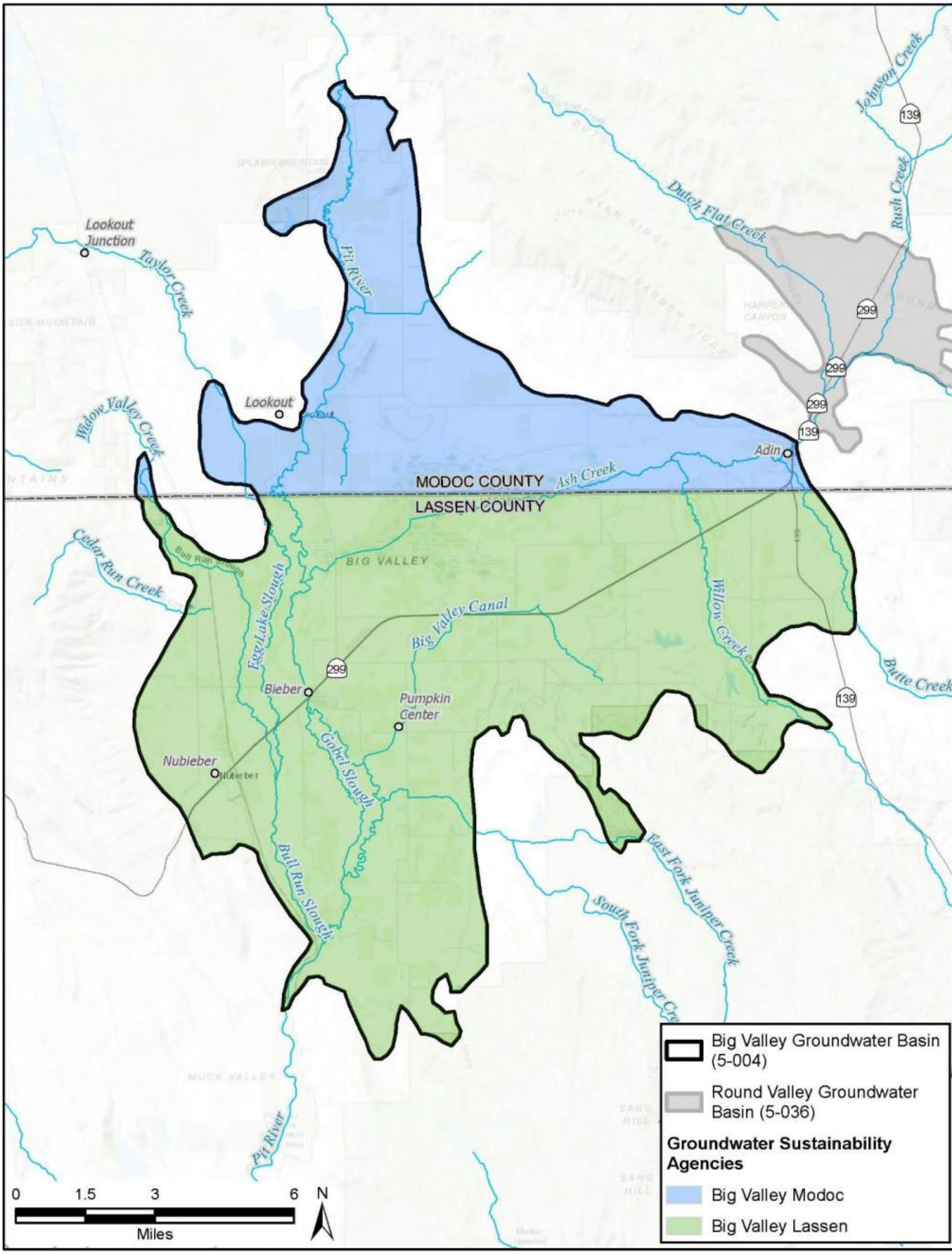


Figure 1-1 Big Valley Groundwater Basin, Surrounding Basins and GSAs
Source: DWR 2018d

with Modoc County comprising 40 square miles (28%) on the north and Lassen County comprising 104 square miles (72%) on the south. The Basin includes the towns of Adin and Lookout in Modoc County and the towns of Bieber and Nubieber in Lassen County. The ACWA is located along the boundary of both counties, occupying 22.5 square miles in the center of the Basin ~~in~~encompassing the marshy/swampy areas along Ash Creek.

The BVGB, as drawn by DWR, is isolated and does not share a boundary with another groundwater basin. However, Ash Creek flows into Big Valley from the Round Valley Groundwater Basin at the town of Adin. Despite the half-mile gap of alluvium which may provide subsurface flow between the two basins, DWR doesn't consider them interconnected due to the ~~manner in which~~way the basin boundary was defined.

The surface expression of the Basin boundary is defined as the contact of the valley sedimentary deposits with the surrounding volcanic rocks. The sediments in the Basin are comprised of mostly Plio-Pleistocene alluvial deposits and Quaternary lake deposits eroded from the volcanic highlands and some volcanic layers interbedded within the alluvial and lake deposits. The Basin is surrounded by Tertiary- and Miocene-age volcanic rocks of andesitic, basaltic and pyroclastic composition. These volcanic deposits may be underlain by alluvial deposits in these upland areas. The boundary between the BVGB and the surrounding volcanic rocks generally correlates with change in topography along the margin of the valley.

~~However, t~~Throughout the development of this GSP, the inaccuracies of the Basin boundary have become clear and revisions to the boundary are needed. The hydrogeology of Big Valley is complex~~,~~ and requiring an all or nothing (inside or outside Basin Boundary), one size fits all approach to the Basin under SGMA does not sit well with stakeholders and will be difficult to implement by the GSAs.

2. Agency Information § 354.6

The two Big Valley GSAs were established for the entire BVGB to jointly develop, adopt and implement a single mandated GSP for the BVGB pursuant to SGMA and other applicable provisions of law.

2.1 Agency Names and Mailing Addresses

The following contact information is provided for each GSA pursuant to California Water Code (CWC) §10723.8.

Modoc County
204 S. Court Street
Alturas, CA 96101
(530) 233-6201
tiffanymartinez@co.modoc.ca.us

Lassen County
Department of Planning and Building Services
707 Nevada Street, Suite 5
Susanville, CA 96130
(530) 251-8269
landuse@co.lassen.ca.us

2.2 Agency Organization and Management Structure

The two GSAs, Lassen and Modoc counties, were established in 2017 as required by the unfunded SGMA, -mandated legislation. **Appendix 2A** contains the resolutions forming the two agencies. Each GSA is governed by a five-member Board of Supervisors. In 2019, the two GSAs established the BVAC through a MOU, included as **Appendix 2B**. The membership of the BVAC is comprised of:

- One member of the Lassen County Board of Supervisors selected by said Board
- One alternate member of the Lassen County Board of Supervisors selected by said Board
- One member of the Modoc County Board of Supervisors selected by said Board
- One alternate member of the Modoc County Board of Supervisors selected by said Board
- Two public members selected by the Lassen County Board of Supervisors. Said members must either reside or own property within the Lassen County portion of the BVGB
- Two public members selected by the Modoc County Board of Supervisors. Said members must either reside or own property within the Modoc County portion of the BVGB

The decisions made by the BVAC are not binding, but the committee serves the important role of providing formalized, local stakeholder input and guidance to the GSA governing bodies, GSA staff and consultants in developing and implementing the GSP.

2.3 Contact Information for Plan Manager

The plan manager is from Lassen County and can be contacted at:

Gaylon Norwood
Assistant Director
Lassen County Department of Planning and Building Services
707 Nevada Street, Suite 5
Susanville, CA 96130
(530) 251-8269
gnorwood@co.lassen.ca.us

2.4 Authority of Agencies

The GSAs were formed in accordance with the requirements of CWC §10723 et seq. Both GSAs are local public agencies organized as general law counties under the State Constitution and have land use responsibility for their respective portions of the Basin. The resolutions of formation for the GSAs are included in **Appendix 2B**.

2.4.1 Memorandum of Understanding

In addition to the MOU establishing the BVAC, the two GSAs may enter into an agreement to jointly implement the GSP for the Basin. However, this agreement is not a SGMA requirement.

3. Plan Area § 354.8

3.1 Area of the Plan

This GSP covers the BVGB, which is located within Modoc and Lassen counties and is ~~approximately 92,057 acres (~~about 144 square miles (92,057 acres). The Basin is a broad, flat plain extending about 13 miles north to south and 15 miles east to west and consists of depressed fault blocks surrounded by tilted fault-block ridges. The BVGB is designated as basin number 5-004 by the DWR and was most recently described in the 2003 update of Bulletin 118 (DWR 2003):

> The basin is bounded to the north and south by Pleistocene and Pliocene basalt and Tertiary pyroclastic rocks of the Turner Creek Formation, to the west by Tertiary rocks of the Big Valley Mountain volcanic series and to the east by the Turner Creek Formation.
>
> The Pit River enters the Basin from the north and exits at the southernmost tip of the valley through a narrow canyon gorge. Ash Creek flows into the valley from Round Valley and disperse into Big Swamp. Near its confluence with the Pit River, Ash Creek reforms as a tributary at the western edge of Big Swamp. Annual precipitation ranges from 13 to 17 inches.

Communities in the Basin are Nubieber, Bieber, Lookout and Adin which are categorized as census-designated places. Highway 299 is the most significant east to west highway in the Basin, with Highway 139 at the eastern border of the Basin. **Figure 3-1** shows the extent of the GSP area (the BVGB) as well as the significant water bodies, communities and highways.

Lassen and Modoc counties were established as the exclusive GSAs for their respective portions of the Basin in 2017. **Figure 3-1** shows the two GSAs within the Basin. Round Valley Basin (5-036) is a very low-priority basin to the northeast; DWR does not consider it to be connected to Big Valley Basin, but there is a half-mile-wide gap of alluvium between the basins. The ACWA occupies 22.5 square miles (14,~~583~~400 acres) in the center of Big Valley.

No other GSAs are associated with the Basin, nor are there any areas of the Basin that are adjudicated or covered by an alternative to a GSP. **Landowners have the right to extract and use groundwater beneath their property.**

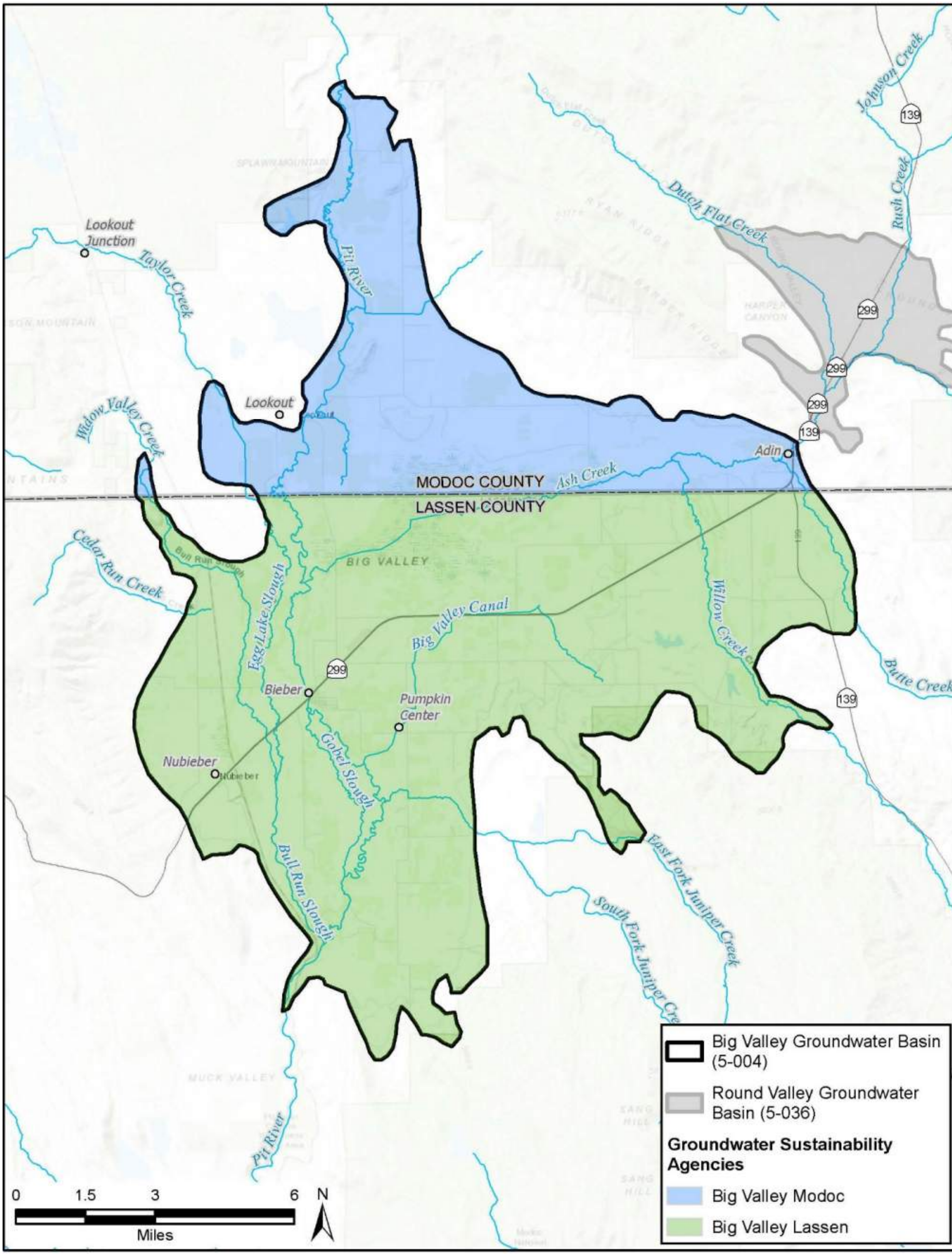


Figure 3-1 Area Covered by the GSP

Source: DWR 2018d

3.2 Jurisdictional Areas

In addition to the GSAs, other entities have water management authority or planning responsibilities in the Basin, as discussed below. A map of the jurisdictional areas within the Basin is shown on **Figure 3-2**.

3.2.1 Superior Courts

SGMA does not alter existing water rights. Therefore, water use in the Basin exists within the confines of state water law and existing water rights. These rights are ultimately governed by court decisions. In Big Valley, two decrees govern much of the surface water rights allocations: Decree 3670 (1947) for Ash Creek and Decree 6395 (1959) for the Pit River. Any changes to these and any other judgments relevant to Big Valley would have to go through the superior courts.

3.2.2 Federal Jurisdictions

The U.S. Bureau of Land Management (BLM) and the U.S. Forest Service (USFS or Forest Service) have jurisdiction over land within the Basin including portions of the Modoc National Forest, shown on **Figure 3-2**. Information on their Land and Resource Management Plan is described in Section 3.8. The Forest Service Ranger Station in Adin is a non-community public water supplier with a groundwater well, identified as Water System No. CA2500547. (SWRCB 2021)

3.2.3 Tribal Jurisdictions

The U.S. Bureau of Indian Affairs (BIA) Land Area Representations database identifies one tribal property in the BVGB (BIA 2020a). Lookout Rancheria, shown on **Figure 3-2**, is associated with the Pit River Tribe. There are other "public domain allotments" or lands held in trust for the exclusive use of individual tribal members within the Basin not shown. (BIA 2020b)

3.2.4 State Jurisdictions

The CDFW has jurisdiction over the ACWA, as shown on **Figure 3-2**.

3.2.5 County Jurisdictions

The County of Modoc and the County of Lassen have jurisdiction over the land within the Basin in their respective counties as shown on **Figure 3-1** and **Figure 3-2**. Information on their respective General Plans is provided in Section 3.~~8 – Management Areas.~~7 – Land Use Plans. Within the Basin, Modoc County includes the census-designated community of Adin and part of the community of Lookout. ~~Within the Basin,~~ Lassen County contains the census-designated communities of Bieber and Nubieber.

3.2.6 Agencies with Water Management Responsibilities

Upper Pit Integrated Regional Water Management Plan

Big Valley lies within the area of the Upper Pit Integrated Regional Water Management Plan (IRWMP), which was developed by the Regional Water Management Group (RWMG). The IRWMP is managed by the North Cal-Neva Resource Conservation and Development Council (North Cal-Neva), a member of the RWMG along with 27 other stakeholders. Other stakeholders include community organizations,

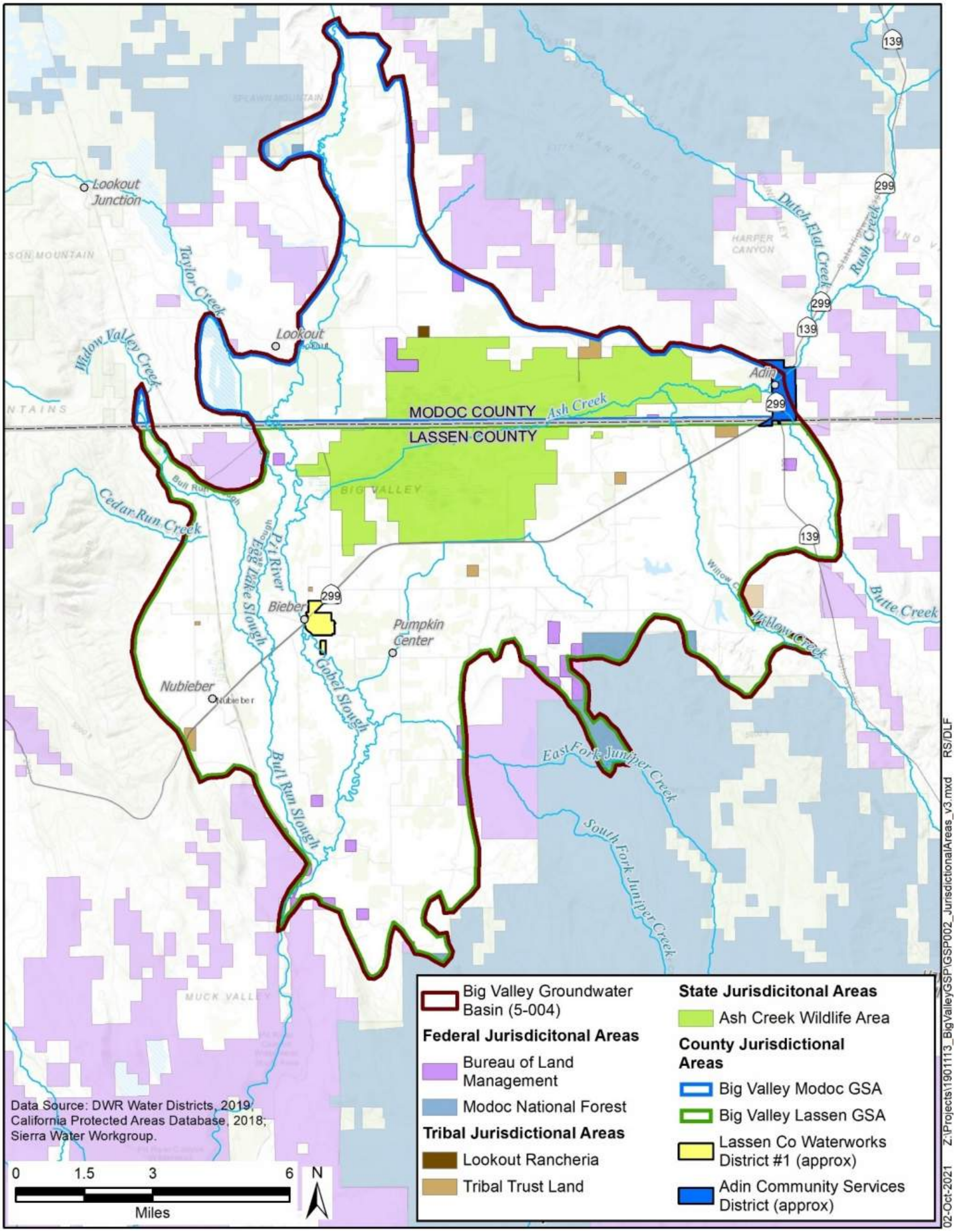


Figure 3-2 Jurisdictional Areas

environmental stewards, water purveyors, numerous local, county, state and federal agencies, industry, the University of California, and the Pit River Tribe. The IRWMP addresses a 3-million-acre watershed across four counties in northeastern California. **Figure 3-3** shows the Upper Pit IRWMP boundary and the BVGB's location in the center of the IRWMP area. **Figure 3-3** also shows the complete watershed that flows into the BVGB and the local watershed area. At 92,057 acres, the BVGB comprises about 3 percent of the IRWMP area at its center.

The IRWMP was established under the Integrated Regional Water Management Act (Senate Bill [SB]1672) which was passed in 2002 to foster local management of water supplies to improve reliability, quantity and quality and to enhance environmental stewardship. Several propositions were subsequently passed by voters to provide funding grants for planning and implementation. Beginning in early 2011, an IRWMP was developed for the Upper Pit River area and was adopted in late 2013. During 2017 and 2018, the IRWMP was revised according to 2016 guidelines.

Lassen-Modoc County Flood Control and Water Conservation District

The Lassen-Modoc County Flood Control and Water Conservation District (District) was established in 1959 by the California Legislature and was activated in 1960 by the Lassen County Board of Supervisors (LAFCo 2018). The entirety of the Lassen and Modoc counties portions of the Basin is covered by the District, extending from the common boundary northward beyond Canby and Alturas, as shown on **Figure 3-3**. In 1965, the District established Zone 2 in a nearly 1000-square mile area encompassing and surrounding Big Valley and, in 1994, the District designated ~~the same~~ boundaries for ~~Zone 2 as~~ management Zone 2A for, "…groundwater management including the exploration of the feasibility of replenishing, augmenting and preventing interference with or depletion of the subterranean supply of waters used or useful or of common benefit to the lands within the zone." (LAFCo 2018) These zones are shown on **Figure 3-4**.

Watermasters

Two entities measure water diversions for reporting to the State Water Resources Control Board (SWRCB). These include the Big Valley Water Users Association (BVWUA) and the Modoc County Watermaster. The boundaries of these two entities are shown on **Figure 3-4**. Numerous private parties also measure and report their water diversions.

Lassen County Waterworks District #1

Lassen County Waterworks District #1 (LCWD #1) was established in 1932 originally for the purpose of fire protection. Homes started being added to the system in the 1940's and eventually all residential and commercial properties became part of the system, with most properties leaving their private wells unused. LCWD #1 now provides both water and sewer services to the ~~town of Bieber. The waterworks district~~customers within its boundary ~~is~~ shown on **Figure 3-2**. (Hutchinson 2021)

Adin Community Services District

Adin Community Services District provides wastewater services to the town of Adin. The district boundary is shown on **Figure 3-2**.

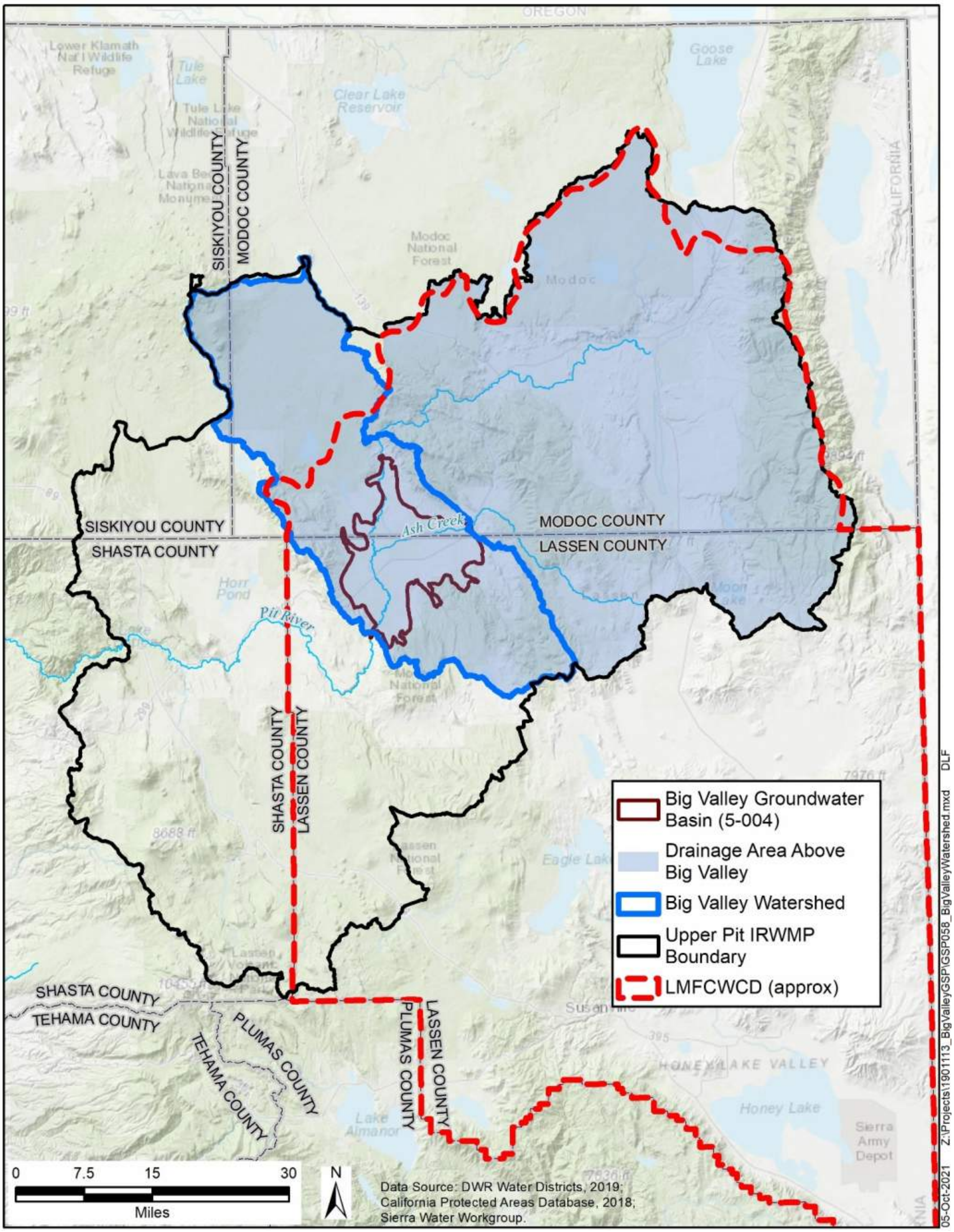


Figure 3-3 Upper Pit IRWMP, Watershed, and LMFCWCD Boundaries

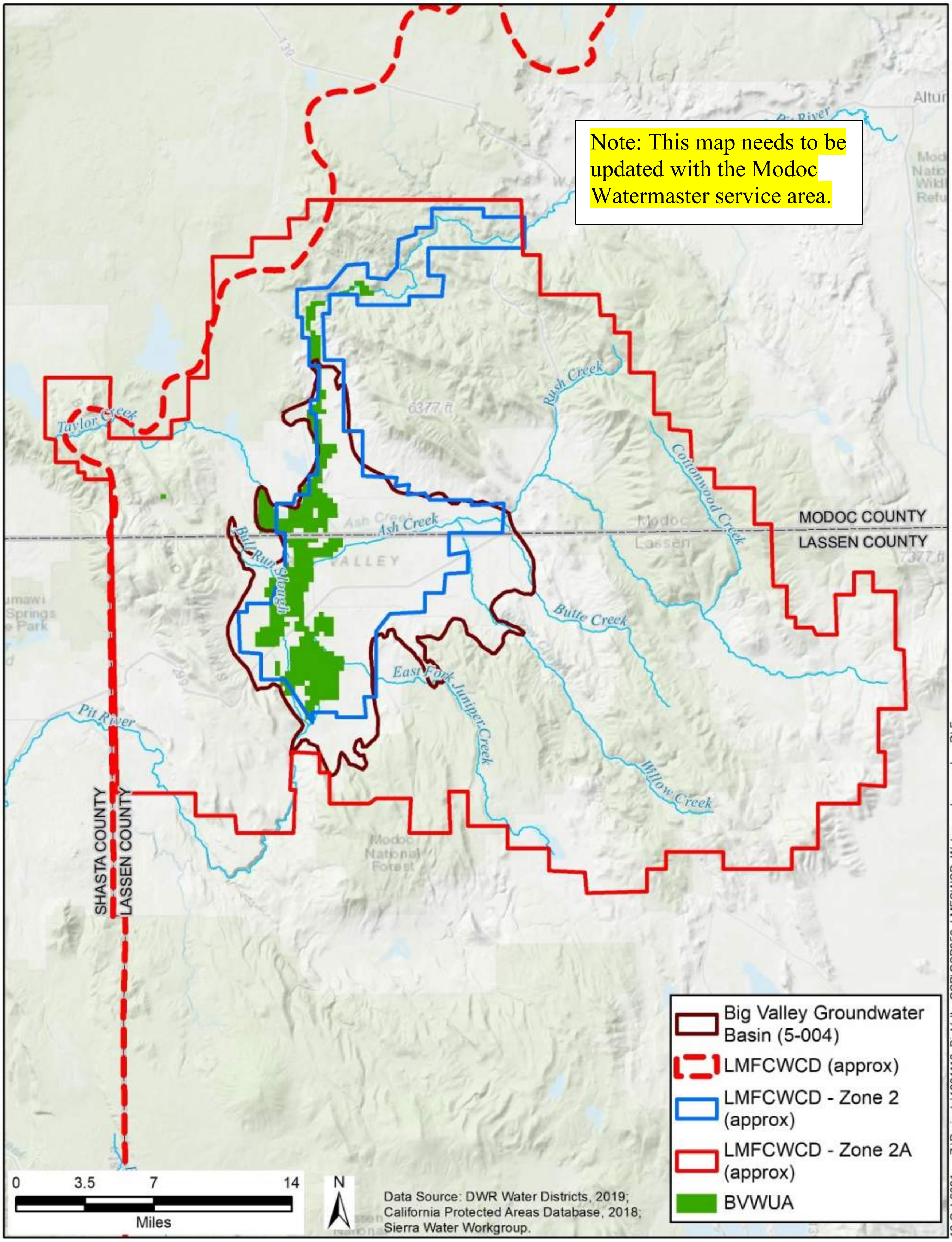


Figure 3-4 LMFCWCD Zones and Watermaster Service Areas

3.3 Land and Water Use

This section describes land use in the BVGB, water use sectors and water source types using the best available data. The most recent, best available data for distinguishing surface water and groundwater uses comes from DWR land use datasets. This data is developed by DWR "…to serve as a basis for calculating current and projected water uses." (DWR 2021d) Surveys performed prior to 2014 were developed by DWR using some aerial imagery with ~~significant~~ field verification. These previous surveys also included DWR's estimate of water source.

Since 2014, DWR has developed more sophisticated methods of performing the surveys with a higher reliance on remote sensing information. These more recent surveys do not make available the water source. **Table 3-1** is a listing of the years for which surveys are available.

Table 3-1 Available DWR Land Use Surveys

Year	Modoc County	Lassen County	Water Source Included
1997	Yes	Yes	Yes
2011	Yes	No	Yes
2013	No	Yes	Yes
2014	Yes	Yes	No
2016	Yes	Yes	No[a]

Note:
[a] DWR provided the GSAs ~~hybrid~~ a hybrid dataset with the 2011 and 2013 water sources superimposed onto the 2016 land use
Source: DWR 2020d

Land use in the BVGB is organized into the water use sectors listed in **Table 3-2**. These sectors differ from DWR's water use sectors identified in Article 2 of the GSP regulations because DWR's sectors don't adequately describe the uses in Big Valley. **Figure 3-5** shows the 2016 distribution of land uses and **Table 3-2** summarizes the acreages of each. Several data sources were used to designate land uses as described below, including information provided by DWR through a remote sensing process developed by Land IQ. (DWR 2016d) Other data sources are described below.

- **Community** This is non-agricultural, non-industrial water use in the census-designated places of Bieber, NuBieber and Adin, although some of these areas may also have some minor industrial uses. These community areas were delineated using the areas designated as "urban" by DWR (2016d). DWR's data included the areas north and northeast of Bieber (area of the former mill and medical center) as "urban." For this GSP, those areas were re-categorized from urban to industrial, as that is more descriptive of the actual land use. In addition, parcels that make up the core of Nubieber were included as community.
- **Industrial** There is limited industrial use in the Basin. The DWR well log inventory shows 6 industrial wells, all located at the inactive mill in Bieber. The areas north and northeast of Bieber, including the former mill and the medical center have been categorized as industrial. In addition, the parcels associated with railroad operations in Nubieber were added. There is some

industrial use associated with agriculture but that is included under the agricultural water use sector.

- **Agricultural** Agricultural use is spread across the Basin and was delineated using DWR's (2016g) land use data[10].
- **State Wildlife Area** The area delineated in **Figure 3-5** is the boundary of the ACWA, located within the center of the Basin. The area includes some wetlands created by the seasonal flow of 6 streams and year-round flow from Ash Creek. The area also has upland ~~habitat~~ecosystems.
- **Managed Recharge** Flood irrigation of some fields and natural flooding of lowland areas provides recharge to the Basin even though it is not of a formalized nature that would put it into this managed recharge category. Some of the future projects and management actions in this GSP include managed recharge.
- **Native Vegetation** Native vegetation is widespread throughout the Basin. Many of the areas under this category also have domestic users. Native vegetation and domestic land uses are categorized together because it is not possible to distinguish between the two with readily available data.
- **Domestic** This sector includes water use for domestic purposes, which aren't located in a community service district. Domestic use generally occurs in conjunction with agricultural and native vegetation and is best represented on the map categorized with native vegetation, as most of the agricultural area is delineated by field and does not include residences.

Table 3-2 2016 Land Use Summary by Water Use Sector

Water Use Sector	Acres	Percent of Total
Community[a]	250	<1%
Industrial	196	<1%
Agricultural	22,246	24%
State Wildlife Area[b]	14,583	16%
Managed Recharge	-	0%
Native Vegetation and Rural Domestic[c]	54,782	60%
Total	**92,057**	**100%**

Notes:
[a] Includes the use in the communities of Bieber, Nubieber and Adin
[b] Made up of a combination of wetlands and non-irrigated upland areas
[c] Includes the large areas of land in the Valley which have domestic wells interspersed
Source: Modified from DWR 2020d

Many of the lands within the Basin are enrolled in the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP). The CRP is a land conservation program administered by the Farm Service Agency (FSA). In exchange for a yearly rental payment, farmers enrolled in the program agree to promote plant species that will improve environmental health and quality. Contracts for land enrolled

[10] This dataset has been identified as being inaccurate and has been included as a data gap.

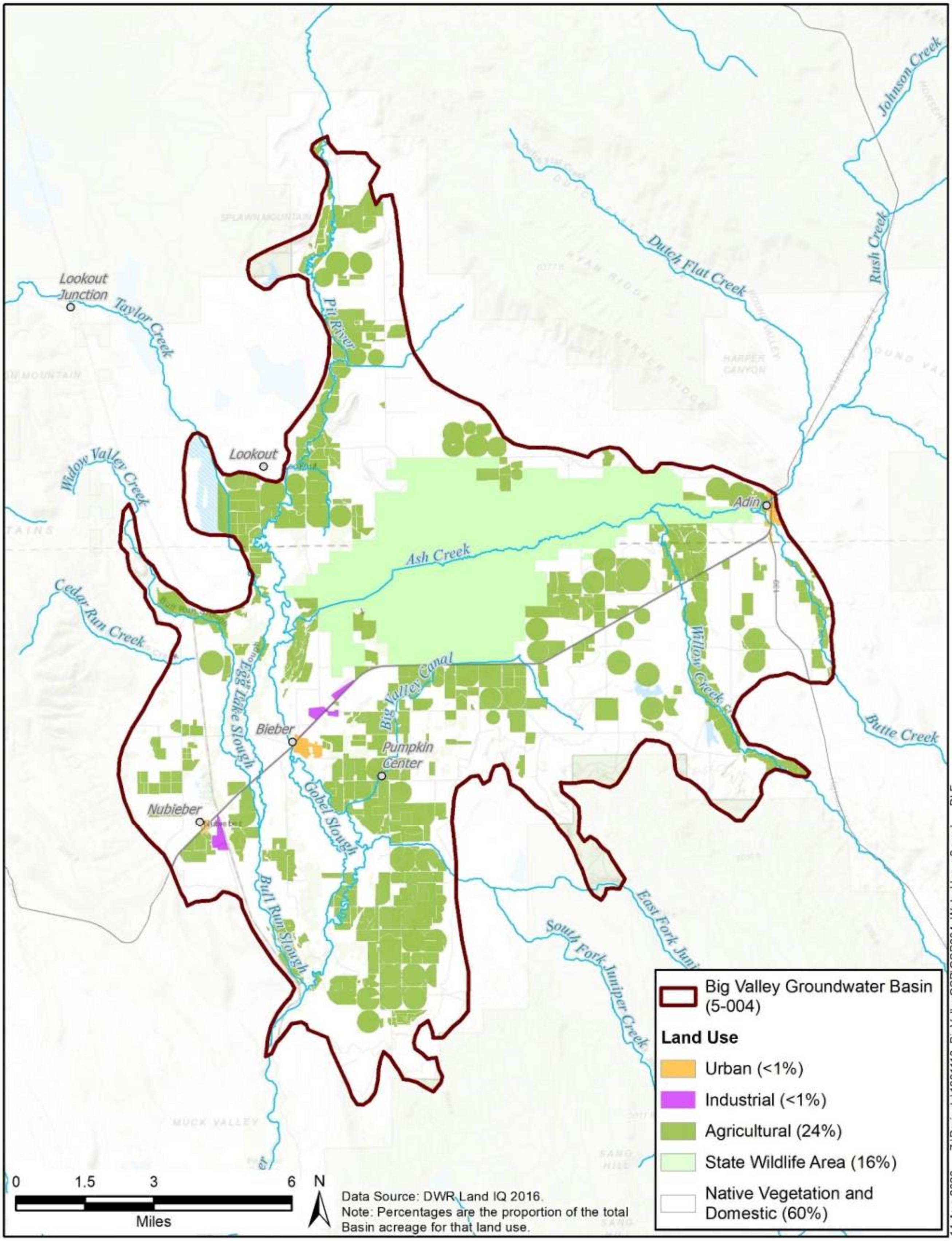


Figure 3-5 Land Use by Water Use Sector

in the CRP vary in length. The WRP is a similar program for wetlands was available for enrollment until February 7, 2014. Land enrolled in the program before the end date continues to be enrolled until the termination of the contract.

In addition to the uses described above, the Big Valley GSAs are aware of illegal land use activity within the Basin (i.e., unlicensed marijuana growers) which is likely having a negative impact on surface water quality and quantity within the Basin. This illegal activity is occurring both within the alluvial portion of the Basin and the upstream watershed and often includes groundwater use and illegal diversions of surface water. Lassen and Modoc counties have limited staff to monitor and report this situation and enforcement action is within the purview of state and federal agencies. These agencies include the Bureau of Cannabis Control, CDFW, State Water Board, USFS and the BLM. To date, these state and federal agencies have not taken aggressive enforcement action against this illegal activity and according to county staff (Norwood 2020-2021), the problem is getting noticeably worse over time. The timing and volume of these illegal diversions cannot be quantified at this time.

3.3.1 Water Source Types

The Basin has two water source types: groundwater and surface water. Recycled water[11] and desalinated water are not formally utilized in the Basin nor is stormwater used as a formal, measured supplemental water supply at the time of the development of this GSP. Informal reuse of irrigation water occurs with capture and reuse of tail water by farmers and ranchers. Storm water is stored in reservoirs for future use as a ~~formal~~ water source. **Figure 3-6** and shows an ~~estimate of the~~approximate distribution of water sources to lands throughout the Basin. Chapter 6 – Water Budget provides details on how the sources were mapped for this figure.

There are three public water suppliers (as designated by the State Water Board) in the Basin which use groundwater: ~~Lassen County Waterworks District~~LCWD #1 in Bieber, the Forest Service Ranger Station in Adin and the California Department of Forestry and Fire Protection (CAL FIRE) conservation camp west of the BVGB. The conservation camp is located outside the Basin boundary, but their supply well is inside the Basin and the water is pumped ~~up~~ to the camp. Many domestic users have groundwater wells, but there are some surface water rights from Ash Creek and the Pit River that are designated for domestic use. The ACWA is fundamentally supported by surface water, but the CDFW does have three wells that are utilized in the fall for ~~habitat~~ecological enhancement.

3.4 Inventory and Density of Wells

3.4.1 Well Inventory

The best available information about the number, distribution and types of wells in Big Valley comes from well completion reports (WCRs) maintained by DWR[12]. The most recent catalog of WCRs was provided through their website (DWR, 2018c) as a statewide map layer. This data includes an inventory

[11] Recycled water generally refers to treated urban wastewater that is used more than once before it passes back into the water cycle. (WateReuse Association, 2020)

[12] All water well drillers with a C57 drilling license in California are required to submit a well completion report to DWR whenever a well is drilled, modified, or destroyed.

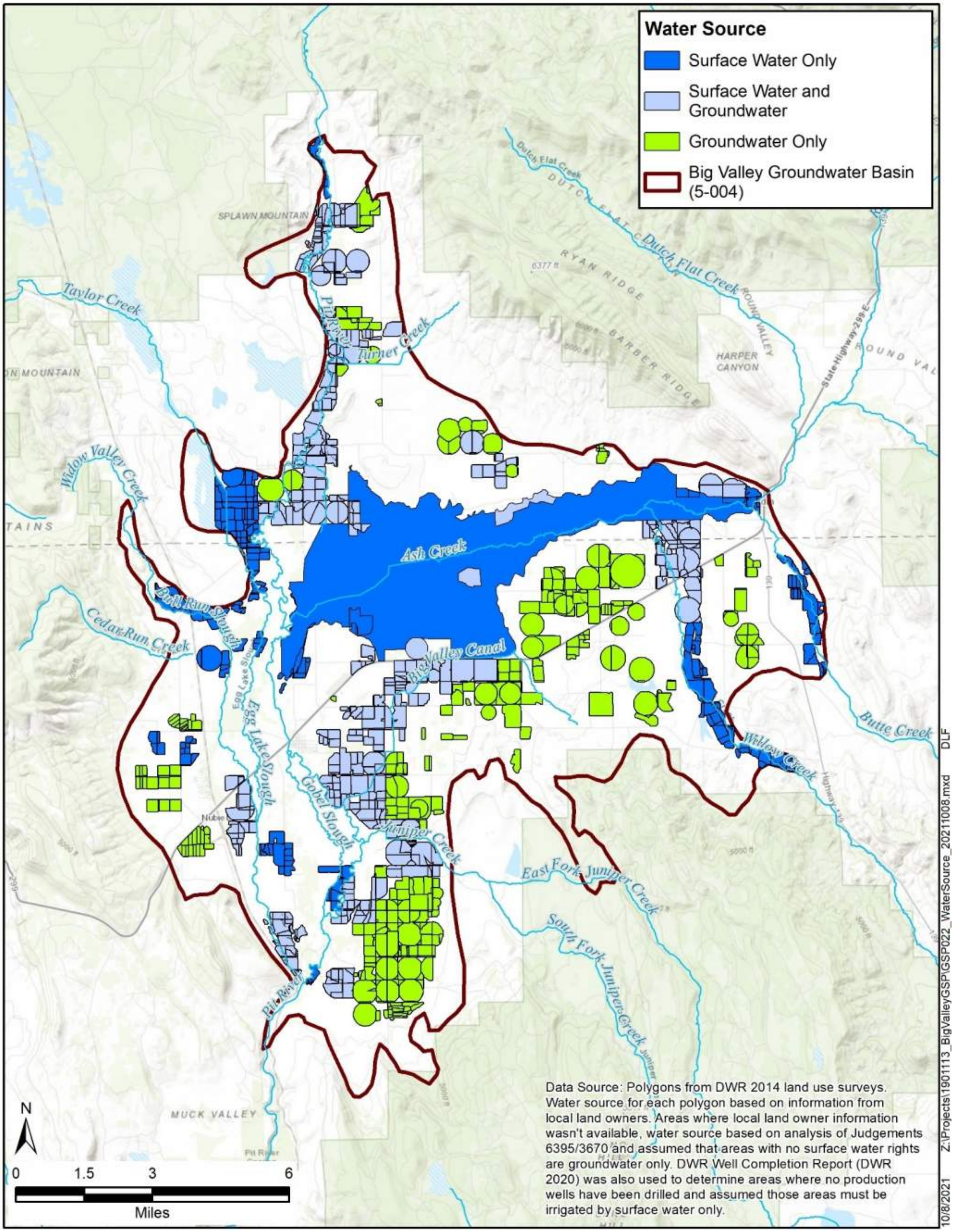


Figure 3-6 Water Sources

and statistics about the number of wells in each section[13] under three categories: domestic, production, or public supply. **Table 3-3** shows the unverified number of wells in the BVGB for each county from this data. Many wells may be inactive or abandoned and this data gap will need to be filled over time. Once this data gap is filled, Basin priority could be affected.

Table 3-3 Well Inventory in the BVGB

WCR 2018 DWR Map Layer			**DWR 2015 and 2017 WCR Inventory**		
Type of Well [a]	**Lassen County Total Wells**	**Modoc County Total Wells**	**Proposed Use of Well [b]**	**Lassen County Total Wells**	**Modoc County Total Wells**
Domestic	136	81	Domestic	142	79
Production	177	76	Irrigation	157	65
			Stock	11	5
			Industrial	6	0
Public Supply	5	1	Public	5	1
Subtotal =476	**318**	**158**	**Subtotal = 471**	**321**	**150**
			Monitor	55	0
			Test	25	29
			Other	7	2
			Unknown	27	7
Total =476	**318**	**158**	**Total = 623**	**435**	**188**

Source:
[a] DWR 2018 Statewide Well Completion Report Map Layer; downloaded April 2019.
[b] DWR Well Completion Report Inventories from DWR data provided to the counties in 2015 and 2017

~~Prior to 2018, the~~Lassen and Modoc counties had requested and received WCRs for their ~~respective~~ areas from DWR during 2015 and 2017, ~~which also included an~~respectively. An inventory of the wells was included by DWR. This data source had additional well categories included as shown in **Table 3-3**, which are more closely tied to the categories identified by the well drillers when each WCR is submitted and provides additional information about the use of the wells.

The correlation between the 2018 WCR map layer categories and the categories in the 2015 and 2017 WCR inventory provided to the counties is indicated in **Table 3-3** by the grey shading. The table shows similar totals from the two datasets for the number of domestic, production and public supply wells. It is unknown why these two datasets don't match exactly, but both datasets are provided to represent the data available for this GSP. As stated earlier, verification of the data in this table needs to occur. This table shows that more than 600 wells have been drilled, of which 476 are of a type that could involve extraction (i.e., domestic, production, or public supply)[14]. It is unknown how many wells are actively used, as some portion of them are likely abandoned. Abandoned wells no longer in use should be

[13] A section is defined through the public land survey system as a 1 mile by 1 mile square of land.
[14] It should be noted that the majority of the stock watering wells were drilled in the 2009 to 2014 timeframe as part of the EQIP program to move watering of stock away from stream channels and that this increase in the inventory of wells in the Basin was used by DWR to put Big Valley into the medium prioritization category.

formally destroyed ~~by~~in accordance with state well standards. The 2015 and 2017 inventory of WCRs showed six well destructions, all on the Lassen County side of the Basin. It should be noted that some of the recent wells in the Basin were drilled in cooperation with ~~state programs~~the EQUIP program to provide stock watering outside ~~of~~ the riparian area ~~for improvement of~~to improve surface water quality.

3.4.2 Well Density

Figure 3-7, **Figure 3-8** and **Figure 3-9** show the density of wells in the Basin per square mile for domestic, production and public supply, respectively, based on the 2018 WCR DWR map layer. These maps provide an approximation of extraction well distributions and give a general sense of where groundwater use occurs.

Figure 3-7 shows that domestic wells are ~~located~~ in 74 of the 180 sections (including partial sections) that comprise the BVGB. The density varies from 0 to 18 wells per square mile with a median value of two wells per section and an average of three wells per section. The highest densities of domestic wells are located near Adin, Bieber and Lookout and in a section to the east of Lookout and a section south of Adin. In addition, 22 wells are present in the four sections around the town of Nubieber. Virtually all the domestic wells in Bieber are no longer used since the community water system was developed. (Hutchinson 2020-2021)

Figure 3-8 shows that production wells (primarily for irrigation) are located in 93 of the 180 sections with a maximum density of nine wells per section (median: 2 wells per section, average: nearly 3 wells per section). The highest densities of production wells are located between the towns of Bieber and Adin, to the southeast of Bieber and one section northeast of Lookout.

Figure 3-9 shows that public supply wells have been drilled in four sections. It should be noted that the designation as a public supply well that is depicted on the map is from the designation provided in the WCR by the driller when ~~it~~the well was drilled. The State Water Board identifies three public water suppliers in the BVGB: ~~Lassen County Waterworks District~~LCWD #1 which is a community system with two wells serve Bieber; the Forest Service station in Adin which maintains a well for non-community supply to its employees and visitors; and the CAL FIRE conservation camp west of the Basin. These public suppliers account for three of the six public wells with WCRs. The other three are either inactive or aren't designated ~~as~~by the State Water Board as public supply. The CAL FIRE conservation camp well does not show up as a public supply well in the WCR inventory, but its location is shown on **Figure 3-9**.

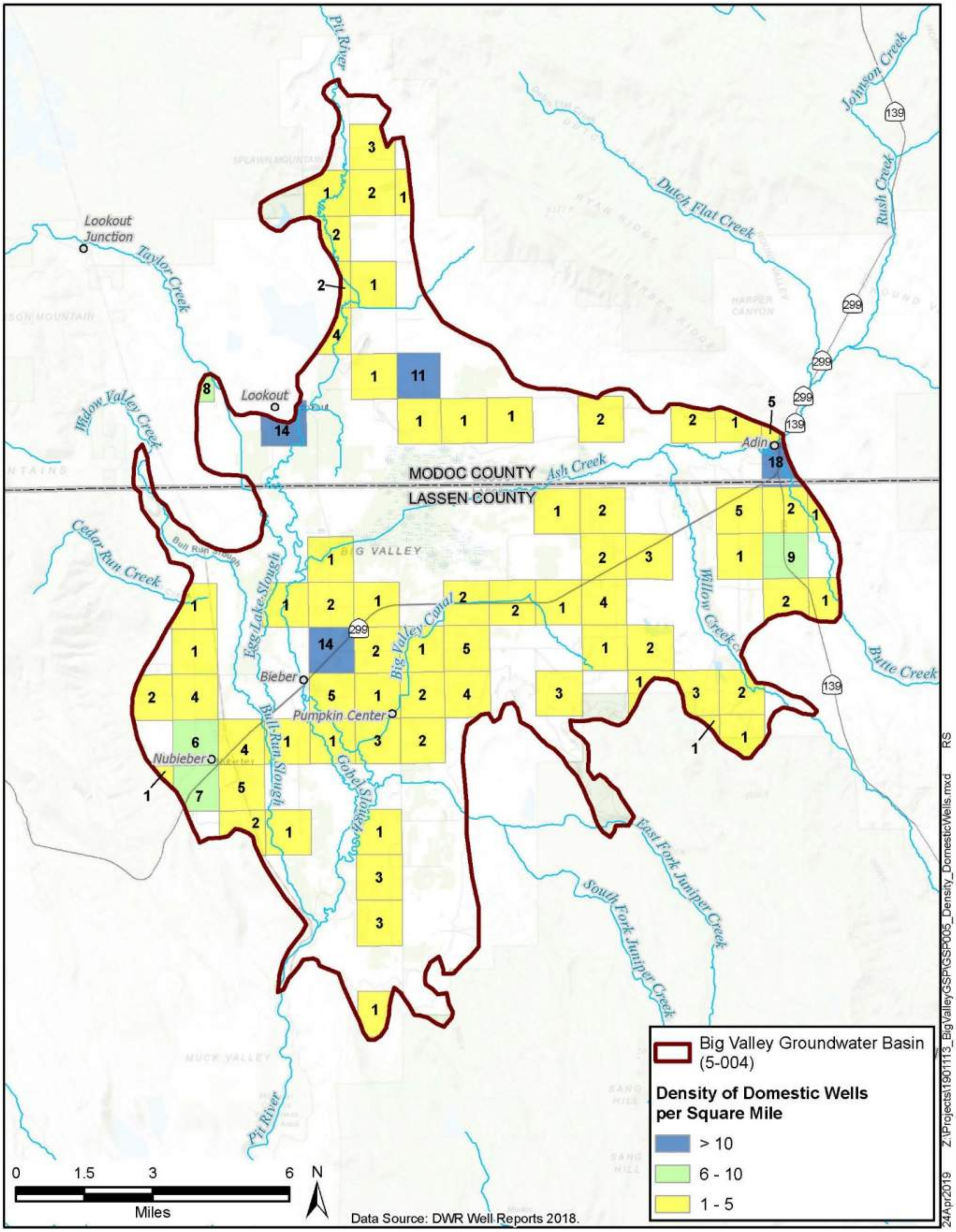


Figure 3-7 Density of Domestic Wells

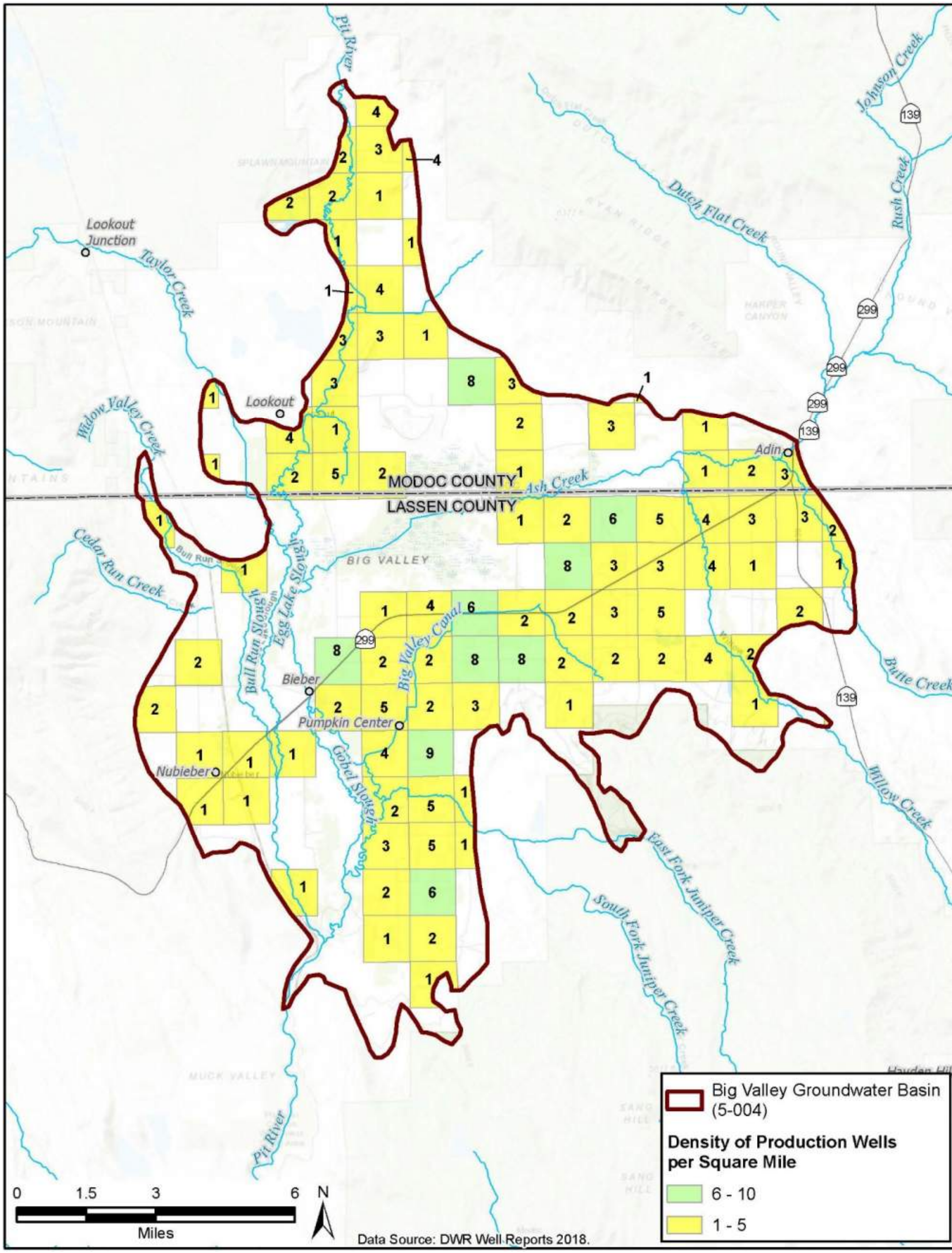


Figure 3-8 Density of Production Wells

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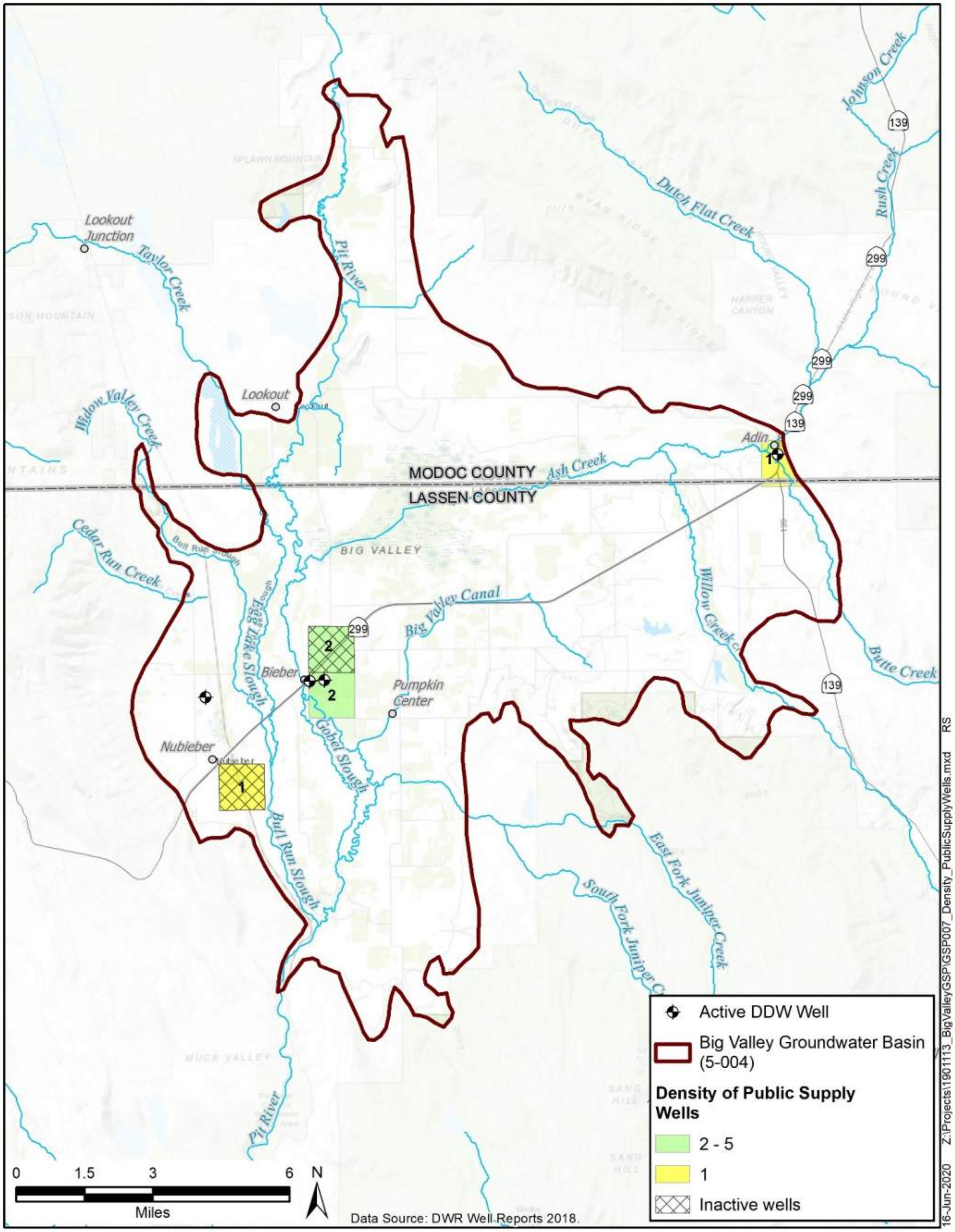

4819 **Figure 3-9 Density of Public Supply Wells**

3.5 Existing Monitoring, Management and Regulatory Programs

3.5.1 Monitoring Programs

This section describes the existing monitoring programs for data used in this GSP and describes sources that can be used for the GSP monitoring networks.

3.5.1.1 Groundwater Monitoring

Levels

Lassen and Modoc counties are the monitoring entities for the CASGEM program. Each county has an approved CASGEM monitoring plan which provides for water level measurements twice a year (spring and fall) at 21 wells. The monitoring is performed by staff from DWR on behalf of the counties. All but one of the wells have depth information ~~ranging~~and depths range from 73 to 800 feet below ground surface [ft bgs], (median: 270 ft bgs, mean: 335 ft bgs~~)~~~~[15]~~ ~~.~~). **Figure 3-10** shows the locations of the 21 CASGEM wells and one additional well which has historic data, but measurements were discontinued in the 1990’s.

Lassen and Modoc counties drilled five monitoring well clusters between 2019 and 2020. Each cluster consists of three shallow wells and one deep well. The locations of these clusters and the depth of the deep well at each site is shown on **Figure 3-10**.

Quality

Water quality is regulated and monitored under a myriad of programs. **Table 3-4** describes the programs relevant to Big Valley. The State Water Board makes groundwater data from many of these programs available on their Groundwater Ambient Monitoring and Assessment (GAMA) Groundwater Information System (GAMA GIS) website (State Water Board 2019). **Table 3-5** lists and describes the groundwater programs from which historic data is available on GAMA GIS. The locations of wells with historic water quality data from GAMA GIS are shown on **Figure 3-11.**

Along with the many programs that monitor surface water quality, the following are currently in place to monitor groundwater quality on an ongoing basis:

- Public Drinking Water Systems (State Water Board’s Division of Drinking Water [DDW])
- Monitoring associated with Underground Storage Tanks (USTs) and Waste Discharge Requirement

The BVGB contains three active public water suppliers regulated by the DDW: Lassen County Water District #1 in Bieber, the Forest Service station in Adin and the CAL FIRE conservation camp west of the Basin. Water quality monitoring at ~~their~~ wells ~~through~~regulated by the DDW can be used for ongoing monitoring in the Basin and their locations are shown on **Figure 3-11**. ~~The~~At each of five

~~[15] Well depth indicates depth to where the wells are cased.~~

newly constructed monitoring well clusters ~~were~~, the deep well at each site was sampled for water quality after construction ~~and~~. The locations of the well cluster sites are shown on **Figure 3-11**.

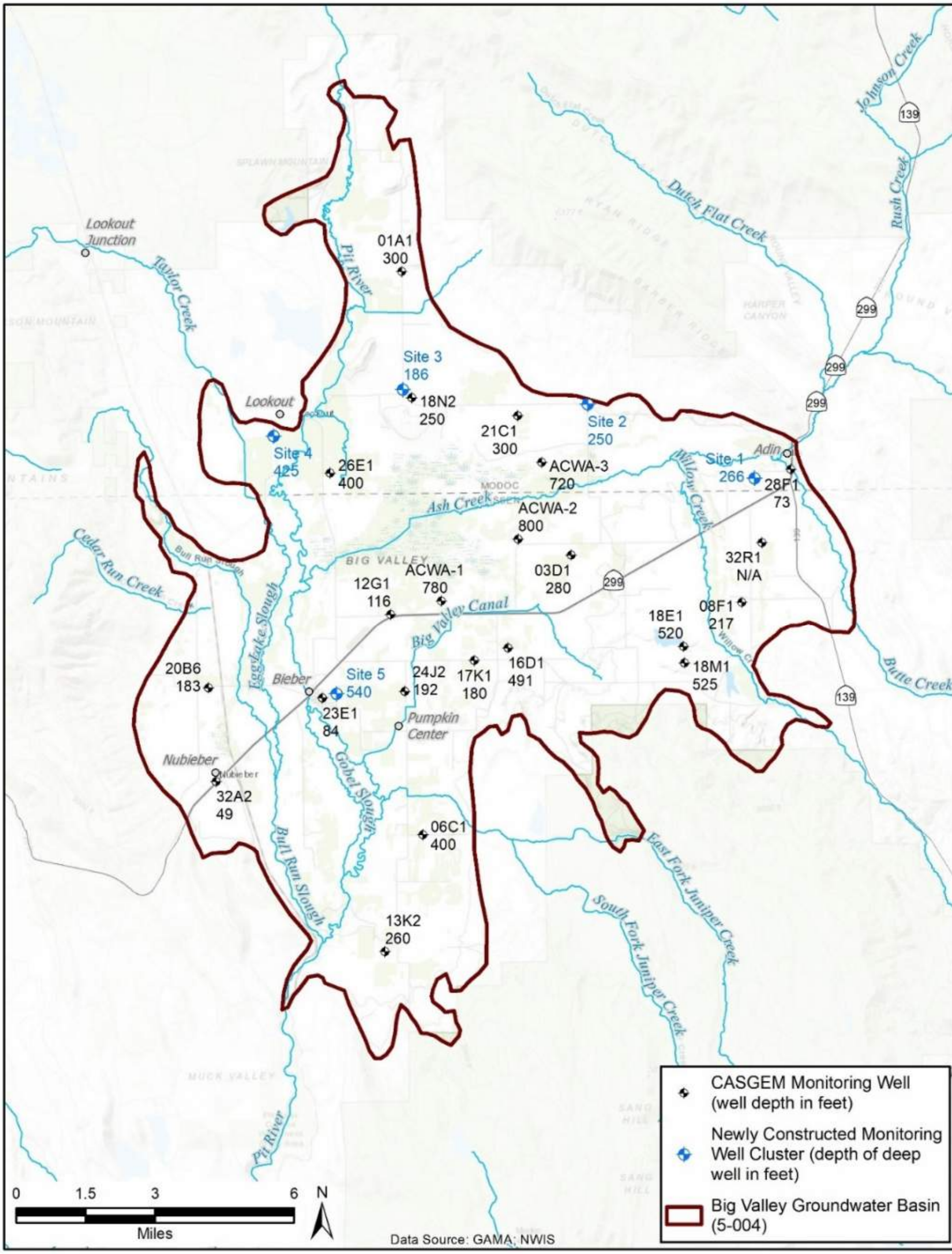

Figure 3-10 Water Level Monitoring Network

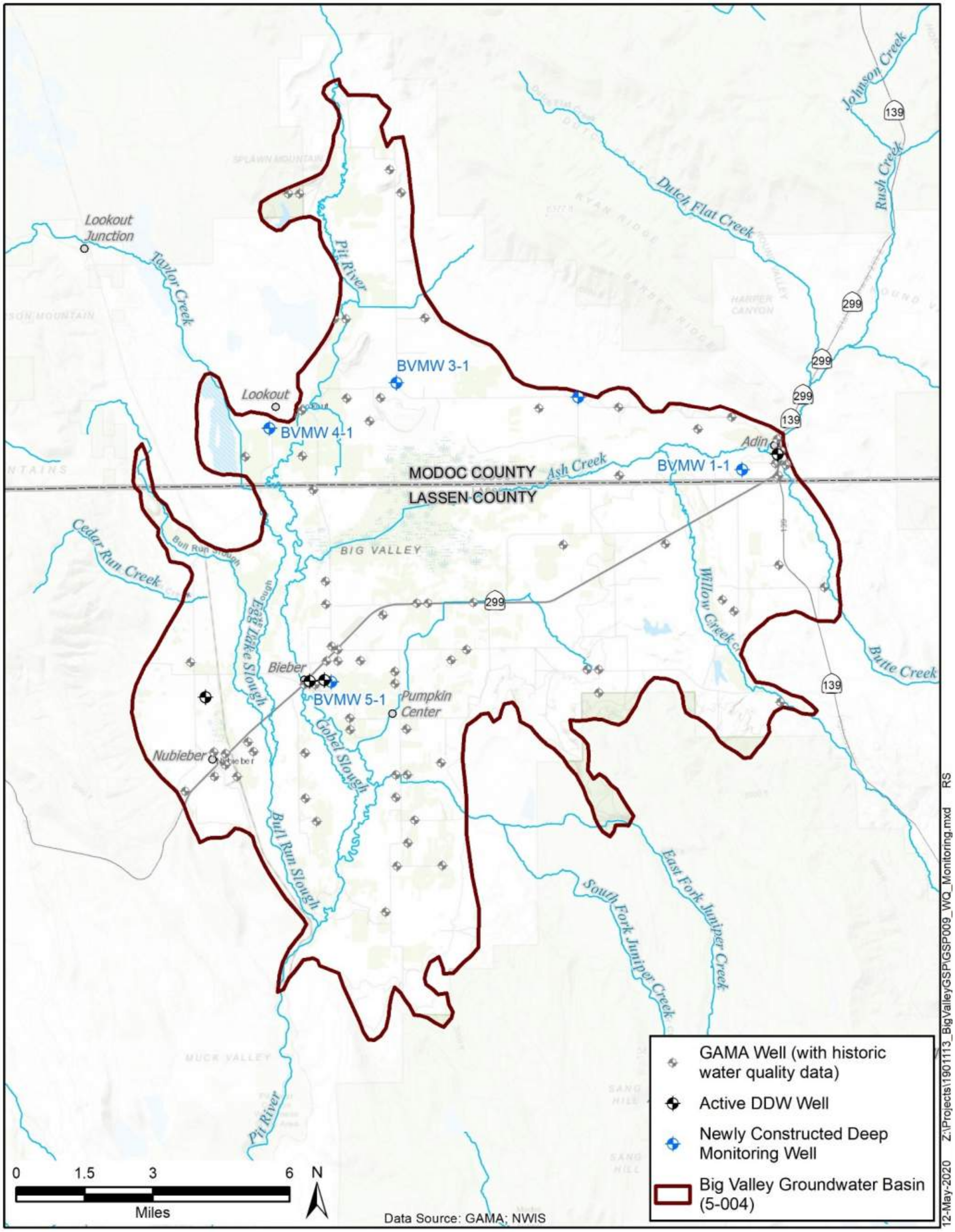

Figure 3-11 Water Quality Monitoring

Table 3-4 Water Quality Monitoring Programs

Program	Description
Irrigated Lands Regulatory Program (ILRP)	Initiated in 2003 to prevent agricultural runoff from impairing surface waters, and in 2012 groundwater regulations were added to the program. To comply with the ILRP, Big Valley growers were forced to join the Northeastern California Water Association (NECWA), which is a sub-watershed coalition of the Northern California Water Association. Growers pay increasing fees to NECWA for monitoring and compliance with the ILRP even though Big Valley farmers grow low intensity crops that generally don't require nitrogen application or cause water quality degradation.
Waste Discharge Requirements (WDR) Program	Also known as the Non-Chapter 15 Permitting, Surveillance and Enforcement Program, is a mandated program issuing WDRs to regulate the discharge of municipal, industrial, commercial and other wastes to the land that will or have the potential to affect groundwater.
Central Valley Salinity Coalition (CVSC)	Represents the stakeholder groups working with the State Water Board in the CV-SALTS collaborative basin planning process.
RWQCB Basin Plan	Adopted by the Regional Water Board and approved by the State Water Board and the Office of Administrative Law. The U.S. Environmental Protection Agency approves the water quality standards contained in the Basin Plan, as required by the Clean Water Act (CWA).
Public Drinking Water Regulations	Effective July 1, 2018, various sections of California Code of Regulations, Title 27 were revised. Revisions to Title 27 were necessary in order to reorganize, update and incorporate new parameters for administering the Unified Program and accomplishing the objectives of coordination, consolidation and consistency in the protection of human health, safety and the environment.
Total Maximum Daily Load Program (TMDL) Program	TMDLs are established at the level necessary to implement the applicable water quality standards.
Local Agency Management Programs	These programs regulate Onsite Water Treatment Systems (OWTSs) and the programs ~~is~~are designed to "correct and prevent system failures due to poor siting and design and excessive OWTS densities." (RWQCB 2021)
Underground Storage Tank Site Cleanup Program (UST)	The purpose of the UST Program is to protect the public health and safety and the environment from releases of petroleum and other hazardous substances from USTs.
National Pollutant Discharge Elimination System (NPDES)	The NPDES permit program, created in 1972 by the CWA, helps address water pollution by regulating point sources that discharge pollutants to waters of the U.S.. The permit provides two levels of control: technology-based limits and water quality-based limits (if technology-based limits are not sufficient to provide protection of the water body).
Nonpoint Source Program (NSP)	NSP focuses and expands the state's efforts over the next 13 years to prevent and control nonpoint source pollution. Its long-term goal is to implement management measures by the year 2013 to ensure the protection and restoration of the state's water quality, existing and potential beneficial uses, critical coastal areas and pristine areas. The state's nonpoint source program addresses both surface and ground water quality.
Other	Water quality samples are required when a property is sold and when a foster child is placed.

Table 3-5 Datasets Available from State Water Board's GAMA Groundwater Information System

Name	Source
DDW	Division of Drinking Water, State Water Board
DPR	Department of Pesticide Regulation
DWR	California Department of Water Resources
GAMA_USGS	Groundwater Ambient Monitoring and Assessment Program performed by USGS
USGS_NWIS	USGS National Water Information System
WB_CLEANUP	Water Board Cleanup
WB_ILRP	Water Board Irrigated Lands Regulatory Program

Source: GAMA GIS available at https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/

The Basin has five active groundwater cleanup sites in various stages of assessment and remediation, all located in the town of Bieber. These sites are not appropriate for ongoing monitoring for ~~groundwater resources in the Basin, as~~the GSP because they monitor only the shallow aquifer and represent a localized condition that may not be representative of the overall quality of groundwater resources in the Basin. One of the open sites is the Bieber Class II Solid Waste Municipal Landfill which has ongoing water quality monitoring. The Lookout Transfer Station also has ongoing water quality monitoring but is located outside the boundaries of the BVGB.

Growers in Big Valley are required to participate in the ILRP, which imposes a fee per acre, through the Sacramento Valley Water Quality Coalition (SVWQC). The SVWQC Monitoring and Reporting Plan does not include any wells within the BVGB. Basin residents have expressed concerns with regulatory programs that involve costs, especially ongoing costs, particularly ~~in light of the~~for a disadvantaged ~~status of the Basin~~community. The Goose Lake Basin, which has similar land use and land use practices, has been exempted from the ILRP.

3.5.1.2 Surface Water Monitoring

Streamflow

Streamflow gages have historically been constructed and monitored within the BVGB, but active, maintained streamflow gages for streams in BVGB are limited. For the Pit River, the closest active gage that monitors stage and streamflow is located at Canby, 20 miles upstream of Big Valley. Flow on Ash Creek was measured at a gage in Adin from 1981 to 1999 and was reactivated in Fall 2019 to provide stream stage data at 15-minute intervals. There is a gage where the Pit River exits the Basin in the south at the diversion for the Muck Valley Hydro Power Plant. Stream gages are shown on **Figure 3-12**.

Diversions

~~Surface~~ Two watermasters, described below, measure diversions in the BVGB. Those surface water ~~diversions greater~~rights holders who divert more than 10 AFY whose rights are not measured by a watermaster must ~~be reported~~ measure and report their diversions to the State Water Board ~~in compliance~~.

Diversions from the Pit River are detailed in water rights Decree #6395. In 2006, the BVWUA petitioned the Modoc Superior Court who granted permission to separate from the costly state watermaster service. A private watermaster service is now contracted by the BVWUA to

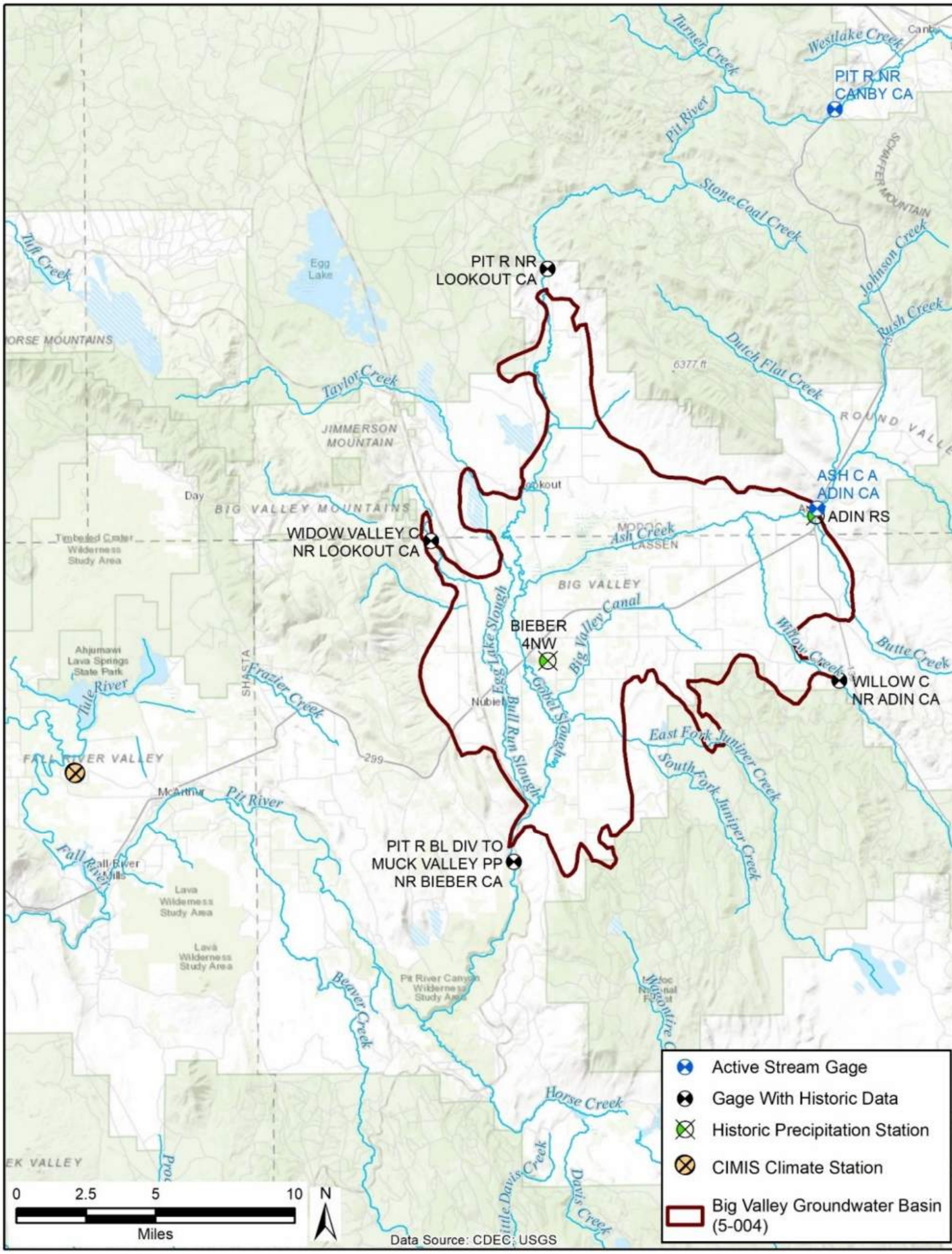

Figure 3-12 Surface Water and Climate Monitoring Network

administer/distribute allocated 2nd priority rights in conjunction with state ~~legislation (SB-88).~~watermaster guidelines during the irrigation season (April 1 through September 30) each year as a neutral 3rd party. The ~~Big Valley Water Users Association (BVWUA) employs a watermaster service to measure diversions from the Pit River for submittal~~watermaster service measures diversions every two weeks and reports the data to each water rights holder. At the end of the irrigation season, the watermaster sends each member a yearly use report. The water rights holder is responsible to submit their reports to the State Water Board. ~~However, many claimants on the river~~Currently there are five Pit River water rights holders that do ~~their own measurements and reporting.~~ not participate in the BVWUA watermaster service. (Hutchinson 2021)

Ash Creek and Willow Creek ~~diversions are monitored by the Modoc~~ are within the Ash Creek Watermaster Service Area (WMSA). The WMSA also includes Butte and Rush Creeks. The Modoc County Watermaster ~~Department.~~is under the jurisdiction of and reports to DWR. (Martinez 2021)

3.5.1.3 Climate Monitoring

The National Oceanic and Atmospheric Administration (NOAA) has two stations located in the Basin: Bieber 4 NW and Adin RS. ~~Both of these stations are no longer~~Neither station is active, thus they only ~~contain~~provide historic data. Annual precipitation at the Bieber station is shown for 1985 to 1995 in **Table 3-6**.

Table 3-6 Annual Precipitation at Bieber from 1985 to 1995

Water Year	Precipitation at Station ID: BBR (inches)
1985	14.1
1986	25.4
1987	11.6
1988	10.9
1989	20.2
1990	16.1
1991	16.5
1992	10.4
1993	28.2
1994	16.3
1995	31.8
Minimum	10.4
Maximum	31.8
Average	18.3

Source: DWR 2021b

The closest California Irrigation Management Information System (CIMIS) station, number 43, is in McArthur, CA, and measures several climatic factors that allow a calculation of daily reference evapotranspiration for the area. This station is approximately 10 miles southwest of the western boundary of the Basin. **Table 3-7** provides a summary of average monthly rainfall, temperature and reference evapotranspiration (ETo) for the Basin, and **Figure 3-13** shows annual rainfall for 1984 through 2018. The bar graph along the bottom shows annual precipitation, and the line graph on top shows the cumulative departure from average. The cumulative departure graph indicates when there are dry periods (downward slope of the line), wet periods (upward slope of the line), and average periods (flat slope of the line). Each time the line graph crosses the dashed line indicates that an average set of years has occurred. A set of average years has occurred between 1983-1997, 1997 to 2010, and 2010 to 2019. The locations of all climate monitoring stations are shown on **Figure 3-12**. Climate monitoring is a data gap that could be filled with a CIMIS station located in the Basin.

Table 3-7 Monthly Climate Data from CIMIS Station in McArthur (1984-2018)

Month	Average Rainfall (inches)	Average ET_o (inches)	Average Daily Temperature (°F)
October	1.4	3.02	49.5
November	2.3	1.21	38.2
December	2.9	0.75	32.1
January	2.5	0.89	32.5
February	2.6	1.57	36.8
March	2.4	3.01	42.4
April	1.8	4.39	48.2
May	1.6	5.93	55.1
June	0.7	7.24	62.8
July	0.2	8.17	69.1
August	0.2	7.18	66.1
September	0.4	5.02	59.5
Monthly Average	1.6	4.03	49.4
Average Water Year	18.8	48.3	49.4

Source: DWR 2020c

3.5.1.4 Subsidence Monitoring

Subsidence monitoring is available in the BVGB at a single continuous global positioning satellite station (P347) on the south side of Adin. P347 began operation in September 2007 and provides daily readings. The five monitoring well clusters constructed in 2019-2020 were surveyed and a benchmark established at each site. These sites can be reoccupied in the future to determine ~~subsidence~~changes in ground elevation at those points if needed. The surveyor's report is included as **Appendix 3A**.

In addition, DWR has provided data processed from InSAR collected by the European Space Agency. The InSAR data currently available provides vertical displacement information between January 2015 and September 2019. InSAR is a promising, cost-effective technique, and DWR will likely provide additional data and information going forward.

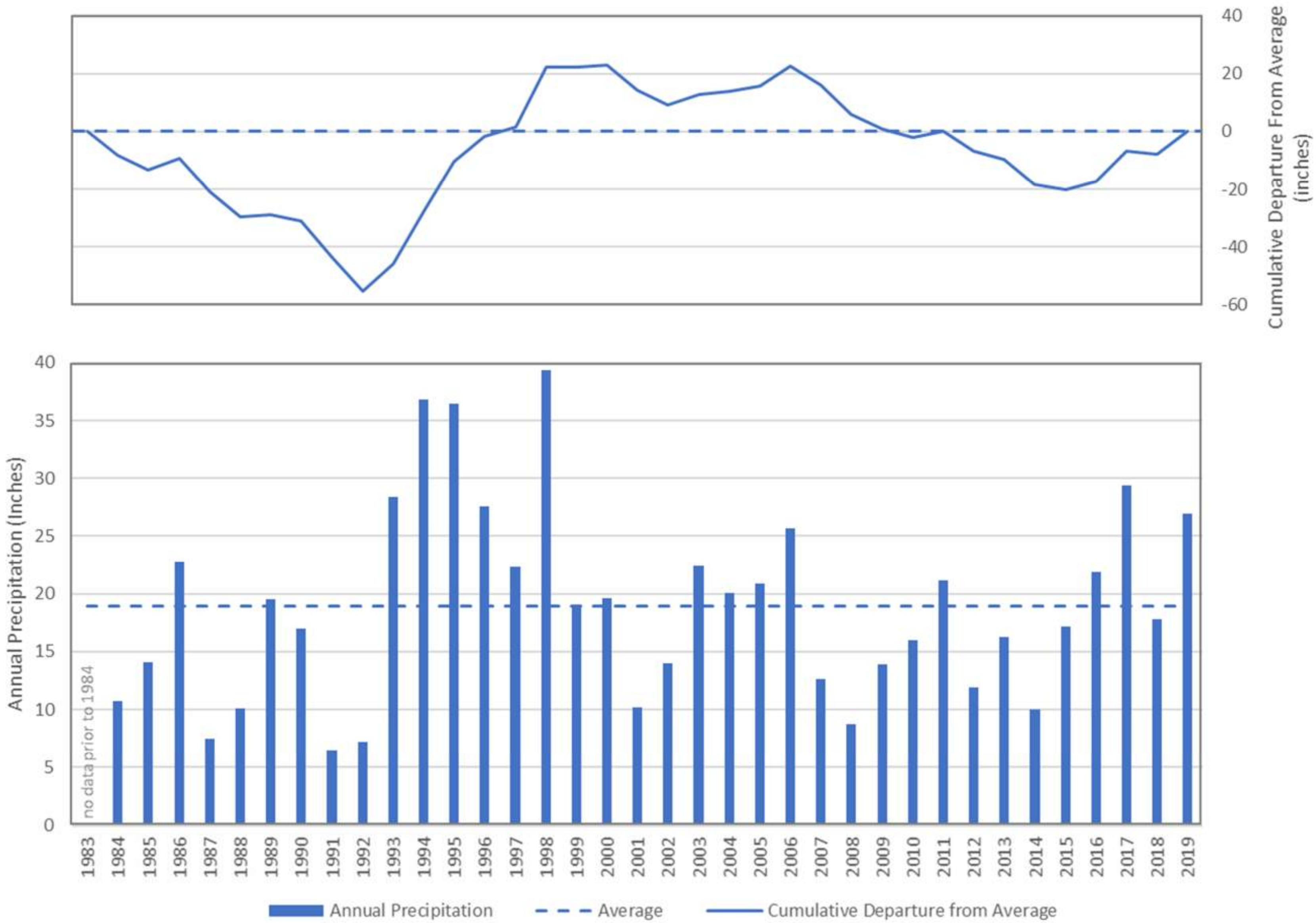

Figure 3-13 Annual Precipitation at the McArthur CIMIS Station

3.5.2 Water Management Plans

Two water management plans exist that cover the BVGB: the Lassen County Groundwater Management Plan (LCGMP) and the Upper Pit River IRWMP.

Lassen County Groundwater Management Plan

The LCGMP was completed in 2007 and covers all groundwater basins in Lassen County, including the Lassen County portion of the BVGB. The goal of the LCGMP is to, "…maintain or enhance groundwater quantity and quality, thereby providing a sustainable, high-quality supply for agricultural, environmental and urban use…" (Brown and Caldwell 2007). The LCGMP achieves this through the implementation of Basin Management Objectives[16] (BMOs), which establish key wells for monitoring groundwater levels and define "action levels," which, when exceeded, activate stakeholder engagement to determine actions to remedy the exceedance. Action levels are similar to minimum thresholds in ~~the~~ SGMA. A BMO ordinance was passed by Lassen County in 2011 and codified in Chapter 17.02.

Upper Pit River Watershed IRWMP

The Upper Pit IRWMP was adopted by the RWMG in 2013. Twenty-five regional entities were involved in the plan development, which included water user groups, federal, state and county agencies, tribal groups and conservation groups. The management of the IRWMP has now transferred to ~~the~~ North Cal-Neva who has been working to update the IRWMP. The goal of the IRWMP is to:

> …maintain or improve water quality within the watershed; maintain availability of water for irrigation demands and ecological needs (both ground and surface water); sustain/improve aquatic, riparian and wetland communities; sustain and improve upland vegetation and wildlife communities; control & prevent the spread of invasive noxious weeds; strengthen community watershed stewardship; reduce river and stream channel erosion and restore channel morphology; support community sustainability by strengthening natural-resource-based economies; support and encourage better coordination of data, collection, sharing and reporting in the watershed; improve domestic drinking water supply efficiency/reliability; address the water-related needs of disadvantaged communities; conserve energy, address the effects of climate variability and reduce greenhouse gas emissions. (NECWA 2017)

The Upper Pit IRWMP contains the entire Watershed above Burney and extends past Alturas to the northeast~~. The area~~ (see **Figure 3-3**) and includes the entire BVGB. This GSP has been identified as a "Project" in the IRWMP.

3.5.3 Groundwater Regulatory Programs

The Basin is located within the jurisdiction of the Regional Water Quality Control Board (RWQCB) Region 5 (R5) and subject to a Basin Plan, which is required by the CWC (§13240) and supported by the federal Clean Water Act. The Basin Plan for the Sacramento River Basin and the San Joaquin River

[16] Codified as Chapter 17.02 of Lassen County Code.

Basin was first adopted by the RWQCB-R5 in 1975. The current version of the Basin Plan was adopted in 2018. The Porter-Cologne Water Quality Control Act requires that basin plans address beneficial uses, water quality objectives and a program of implementation for achieving water quality objectives. Water Quality Objectives for both groundwater (drinking water and irrigation) and surface water are provided in Chapter 3 of the Basin Plan. (State Water Board, 2020c)

Lassen County Water Well Ordinance

Lassen County adopted a water well ordinance in 1988 to provide for the construction, repair, modification and destruction of wells in such a manner that the groundwater of Lassen County aquifers will not be contaminated or polluted. The ordinance ~~ensured~~ensures that water obtained from wells will be suitable for beneficial use and will not jeopardize the health, safety or welfare of the people of Lassen County. The ordinance includes requirements for permits, fees, appeals, standards and specifications, inspection, log of the well (lithology and casing), abandonment, stop work, enforcement and violations and well disinfection. Lassen County Environmental Health Department is responsible for the code enforcement related to wells.

In 1999, Lassen County adopted an ordinance requiring a permit for export of groundwater outside the county (Lassen County Code 17.01).

Modoc County Water Well Requirements

Modoc County Environmental Health Department established its requirements for the permitting of work on water wells in 1990, based on the requirements of the CWC (§13750.5). The fee structure was last revised in 2018. Modoc County also has an ordinance prohibiting the extraction of groundwater for use outside of the groundwater basin from which it was extracted. (Title 20 Chapter 20.04)

California DWR Well Standards

DWR is responsible for setting the minimum standards for the construction, alteration and destruction of wells in California to protect groundwater quality, as allowed by CWC §13700 to §13806. DWR began this effort in 1949 and has published several versions of standards in Bulletin 74, beginning in 1962 and is currently working on a significant update~~ for 2021~~, but hasn't yet released it. Current requirements are provided in Bulletin 74-81, Water Well Standards: state of California and in Bulletin 74-90 (Supplement). (DWR 2021c) Cities, counties and water agencies have regulatory authority over wells and can adopt local well ordinances that meet or exceed the state standards. Lassen and Modoc Counties are the well permitting agencies for their respective portions of the Basin.

Title 22 Drinking Water Program

The DDW was established in 2014 when the regulatory responsibilities were transferred from the California Department of Public Health. DDW regulates public water systems that provide, "…water for human consumption through pipes or other constructed conveyances that ~~has~~have 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year," as defined by the Health and Safety Code (§116275(h)). DDW further defines public water systems as:

- Community: Serves at least 15 service connections used by year-round residents or regularly serves 25-year-round residents. ~~Lassen County Water District~~LCWD #1 is a community system that provides~~ residents with~~ groundwater in Bieber.
- Non-Transient Non-Community: Serves at least the same 25 non-residential individuals during 6 months of the year. The Adin Ranger Station ~~utilizes a well for its water supply.~~and the Intermountain Conservation Camp are systems in this category which serve groundwater.
- Transient Non-Community: Regularly serves at least 25 non-residential individuals (transient) during 60 or more days per year. There is no system of this category in the BVGB.

Private domestic wells, industrial wells and irrigation wells are not regulated by the DDW.

The State Water Board-DDW enforces the monitoring requirements established in Title 22 of the California Code of Regulations for public water system wells and all the data collected must be reported to the DDW. Title 22 designates the regulatory limits (e.g., MCLs) for various constituents, including naturally occurring inorganic chemicals and metals and general characteristics; and limits for man-made contaminants, including volatile and non-volatile organic compounds, pesticides, herbicides, disinfection byproducts and other parameters.

3.5.4 Incorporation Into GSP

Information in these and other various and numerous programs ~~may be~~have been incorporated into this GSP and used during the preparation of Sustainability Management Criteria (minimum thresholds, measurable objectives, interim milestones) and ~~will be~~have been considered during development of Projects and Management Actions.

3.5.5 Limits to Operational Flexibility

While some of the existing management programs and ordinances may have the potential to affect operational flexibility, they are not likely to be a factor in the Basin. For example, runoff and stormwater quality is of high quality and would not constrain recharge options. Similarly, groundwater export ~~requirements~~limitations by Lassen County and Modoc County would be considered for any ~~sustainable groundwater management~~ decisions in the Basin.

3.6 Conjunctive Use Programs

Formally established conjunctive use programs are not currently operating within the Basin.

3.7 Land Use Plans

The following sections provide a general description of the land use plans and how implementation may affect groundwater. Section 3.2 – Jurisdictional Areas, describes the jurisdictional areas within the BVGB and many of these entities have developed land use plans for their respective jurisdictions. This includes the general plans (GPs) for Modoc County and Lassen County and the Modoc National Forest Land and Resource Management Plan.

3.7.1 Modoc County General Plan

The 1988 Modoc County GP was developed to meet a state requirement and to serve as the "constitution" for the community development and use of land. The GP discusses the mandatory elements of a GP, including land use, housing, circulation (transportation), conservation and open space, noise and safety, as well as economic development and an action program in the county. The GP was intended to serve as a guide for growth and change in Modoc County. Under the Conservation Element, Modoc County recognizes the importance of "use-capacity" for groundwater, among other issues, and the minimization of "adverse resource-use," such as "groundwater mining." The Water Resources section advocates the "wise and prudent" management of groundwater resources to support a sustainable economy as well as maintaining adequate supplies for domestic wells for rural subdivisions. Groundwater quality was recognized as ~~generally~~ good to excellent within the ~~numerous~~county's basins.

Policy items from the Modoc GP related to groundwater include:

- Cooperate with responsible agencies and organizations to solve water quality problems
- Work with the agricultural community to resolve any groundwater overdraft problems
- Require adequate domestic water supply for all rural subdivisions

The action program included several general statements for water, including:

- Initiate a cooperative effort among state and local agencies and special districts to explore appropriate actions necessary to resolve long-term water supply and quality problems in the counties
- Require as a part of the review of any subdivision approval a demonstration to the satisfaction of the county that the following conditions exist for every lot in the proposed development:
  - An adequate domestic water supply
  - Suitable soil depth, slope and surface acreage capable of supporting an approved sewage disposal system

In 2018, a GP amendment was adopted to update the housing element section.

3.7.2 Lassen County General Plan

The Lassen County GP 2000 was adopted in 1999 by the Lassen County Board of Supervisors (Resolution 99-060) to address the requirements of California Government Code Section 65300 et seq and related provisions of California law pertaining to GPs. The GP reflects the concerns and efforts of the County to efficiently and equitably address a wide range of development issues which confront residents, property owners and business operators. Many of these issues also challenge organizations and agencies concerned with the management of land and resources and the provisions of community services within Lassen County.

The goals of the GP are to:

- Protect the rural character and culture of Lassen County life
- Maintain economic viability for existing industries such as agriculture, timber and mining
- Promote new compatible industries to provide a broader economic base
- Create livable communities through carefully planned development which efficiently utilize natural resources and provide amenities for residents
- Maintain and enhance natural wildlife communities and recreational opportunities
- Sustain the beauty and open space around use in this effort

The GP addresses the mandatory elements (land use, circulation, housing, conservation, open space, noise and safety) *via* several GP documents and alternate element titles. The 1999 GP elements include land use, natural resources (conservation), agriculture, wildlife, open space, circulation and safety. Separate documents were produced for housing, noise and energy. The land use element designates the proposed general distribution and intensity of uses of the land, serves as the central framework for the entire GP and correlates all land use issues into a set of coherent development policies. The GP land use map from 1999 is shown in **Figure 3-14** shows intensive agriculture as the dominant land use within the Big Valley area, along with scattered population (small) centers. Otherwise, Extensive Agriculture is the dominant land use.

Groundwater is addressed in several elements, including agriculture, land use and natural resources. The GP identified the BVGB as a 'major ground water basin' due to the operation of wells at over 100 gallons per minute [gpm]. Moreover, the GP expressed concern about water transfers and their impact on local water needs and environmental impacts due to the possibility of water marketeers either pumping groundwater from the BVGB into the Pit River and selling it to downstream water districts or municipalities, or using groundwater to augment summer flow through the Delta. The GP recognized that safe yield is dependent on recharge and that overdraft pumping would increase operating costs due to a greater pumping lift. The GP also recognized that overdraft pumping could result in subsidence and water quality degradation. In addition, the GP referred to 1980s legislation that authorized the formation of water districts in Lassen County to manage and regulate the use of groundwater resources and to the 1959 Lassen-Modoc County Flood Control and Water Conservation District, as discussed above. The SGMA process established the requirements for a GSP in the BVGB and creation of the two GSAs. The land use element identified several issues related to groundwater, including public services where 62 percent of rural, unincorporated housing units relied on individual (domestic) wells for their water.

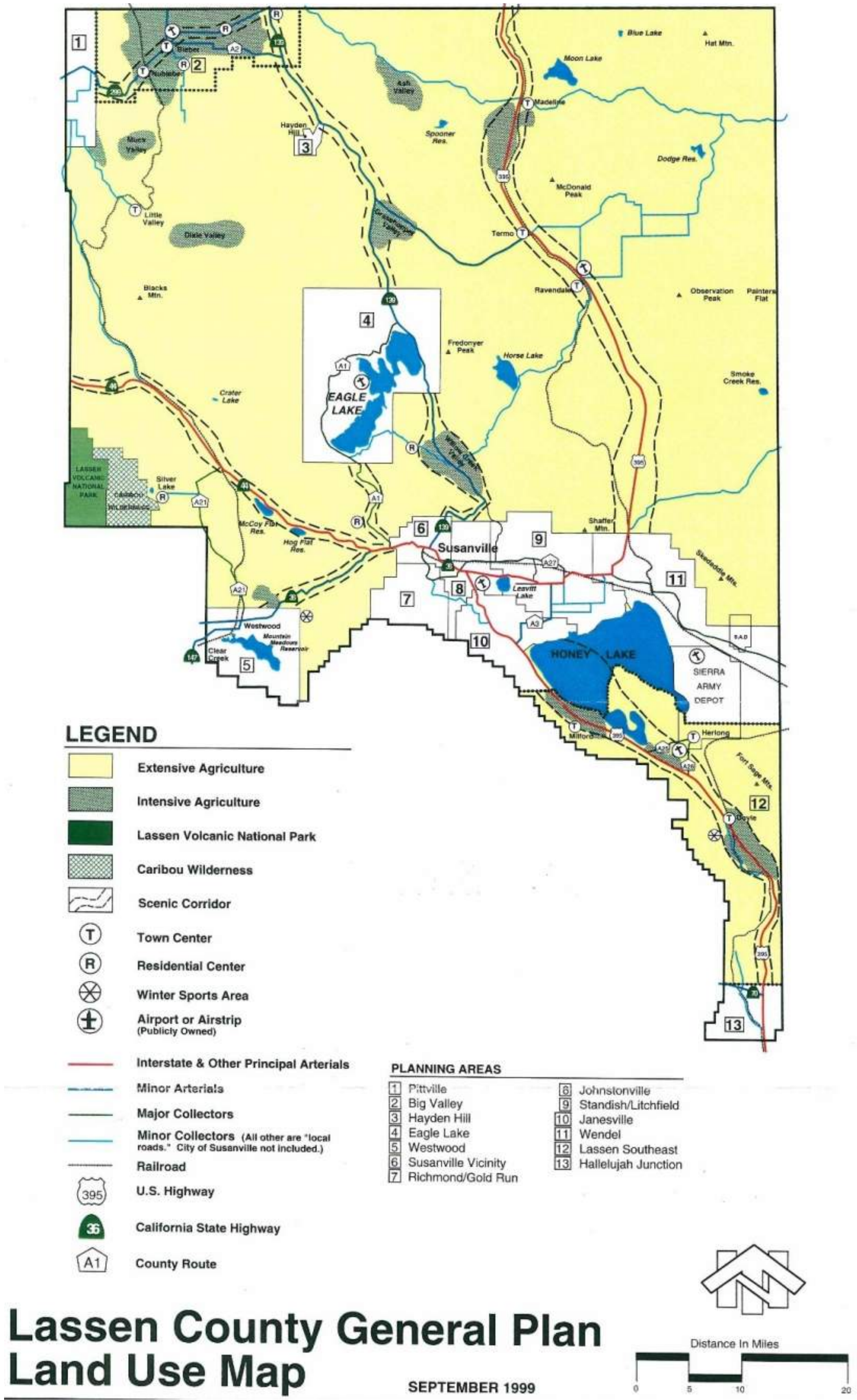

Figure 3-14 Lassen County General Plan Land Use Map

Another issue included open space and the managed production of resources, which includes areas for recharge of groundwater among others. The GP referred to the 1972 Open Space Plan, which required that residential sewage disposal systems would not contaminate groundwater supplies. The agriculture element identified an issue with incompatible land uses where agricultural pumping lowers the groundwater level and impacts the use of domestic wells. The wildlife element recognized that changes in groundwater storage could impact wet meadow ~~habitat~~ecosystem and threaten fish and wildlife species. Groundwater is included in polices under the water resources section of the Natural Resources (NR) and Open Space (OS) Elements, as listed below:

- NR15 POLICY: Lassen County advocates the cooperation of state and federal agencies, including the State Water Board and its regional boards, in considering programs and actions to protect the quality of ground water and surface water resources.
- NR17 POLICY: Lassen County supports measures to protect and ensure the integrity of water supplies and is opposed to proposals for the exportation of ground water and surface waters from ground water basins and aquifers located in Lassen County (in whole or part) to areas outside those basins.
    - Implementation Measure:

      NR-H: Lassen County will maintain ground water ordinances and other forms of regulatory authority to protect the integrity of water supplies in the county and regulate the exportation of water from ground water basins and aquifers in the county to areas outside those basins.
- NR19 POLICY: Lassen County supports control of water resources at the local level, including the formation of local ground water management districts to appropriately manage and protect the long-term viability of ground water resources in the interest of county residents and the county's resources.
- OS27 POLICY: Lassen County recognizes that its surface and ground water resources are especially valuable resources which deserve and need appropriate measures to protect their quality and quantity.
- OS28 POLICY: Lassen County shall, in conjunction with the Water Quality Control Board, adopt specific resource policies and development restrictions to protect specified water resources (e.g., Eagle Lake, Honey Lake, special recharge areas, etc.) and to support the protection of those resources from development or other damage which may diminish or destroy their resource value.
    - Implementation Measure:

      OS-N: When warranted, Lassen County shall consider special restrictions to development in and around recharge areas of domestic water sources and other special water resource areas to prevent or reduce possible adverse impacts to the quality or quantity of water resources.

3.7.3 Modoc National Forest Land and Resource Management Plan

Modoc National Forest lies in the mountain areas surrounding Big Valley to the south and northeast. A small portion of the National Forest extends into the Basin boundary in the south as shown in **Figure**

3-2. The U.S. Forest Service developed their Land and Resource Management Plan in 1991 to, "…guide natural resource management activities and establish management standards and guidelines." ~~With regard to~~Regarding water resources, the Modoc National Forest Land and Resource Management Plan seeks to "maintain and improve the quality of surface water" through the implementation of Best Management Practices (BMPs) among other goals. The plan is available on the Modoc National Forest website (USFS 1991).

3.7.4 GSP Implementation Effects on Existing Land Use

The implementation of this GSP is not expected to affect existing designation of land use.

3.7.5 GSP Implementation Effects on Water Supply

The implementation of this GSP is not expected to influence water supply. Prior to the development of this GSP, the counties had established several policies and ordinances for the management of water and land use in the BVGB. This GSP will incorporate the previous work and will establish sustainable management criteria to continue the successful use of the groundwater resources during the SGMA implementation period and beyond.

3.7.6 Well Permitting

Lassen and Modoc counties both require a permit to install a well~~ as discussed above.~~. The Lassen County Municipal Code (§7.28.030) states that, "…no person, firm, corporation, governmental agency or any other legal entity shall, within the unincorporated area of Lassen County, construct, repair, modify or destroy any well unless a written permit has first been obtained from the health officer of the county." Further, Modoc County Code (§13.12.020) states that, "…No person shall dig, bore, drill, deepen, modify, repair or destroy a water well … without first applying for and receiving a permit…"

3.7.7 Land Use Plans Outside of the Basin

Areas inside and outside the Basin are subject to the Lassen and Modoc County General Plans or the Modoc National Forest Land Resource and Management Plan. Other land use plans by organizations such as the BLM also exist in the watershed.

3.8 Management Areas

~~Because the GSP is still under development, the GSAs have not defined management areas within the BVGB.~~ SGMA allows for the Basin to be delineated into management areas which:

> "…may be defined by natural or jurisdictional boundaries, and may be based on differences in water use sector, water source type, geology, or aquifer characteristics. Management areas may have different minimum thresholds and measurable objectives than the basin at large and may be monitored to a different level. However, GSAs in the basin must provide descriptions of why those differences are appropriate for the management area, relative to the rest of the basin." (DWR 2017)

It should be noted that minimum thresholds and measurable objectives can vary throughout the Basin even without established management areas. ~~In deciding whether to implement management areas, the GSAs will need to weigh the added degree of complexity management areas bring to the GSP. For the final GSP, this section will be rewritten to reflect the GSAs decisions related to management areas.~~The GSAs have not defined management areas within the BVGB.

3.9 Additional GSP Elements, if Applicable

The plan elements from CWC Section 10727.4 require GSPs to address numerous components listed in **Table 3-8**. The table lists the agency or department with whom the GSA will coordinate or where it ~~will be~~is addressed in the GSP.

Table 3-8 Plan Elements from CWC Section 10727.4

Element of Section 10727.4	Approach
(a) Control of saline water intrusion	Not applicable
(b) Wellhead protection areas and recharge areas	To be coordinated with county environmental health departments
(c) Migration of contaminated groundwater	Coordinated with RWQCB
(d) A well abandonment and well destruction program	To be coordinated with county environmental health departments
(e) Replenishment of groundwater extractions	Chapter 9, Projects and Management Actions
(f) Activities implementing, opportunities for and removing impediments to, conjunctive use or underground storage	Chapter 9, Projects and Management Actions
(g) Well construction policies	To be coordinated with county environmental health departments
(h) Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance and extraction projects	Coordinated with RWQCB and in Chapter 9, Projects and Management Actions
(i) Efficient water management practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use	To be coordinated with county farm advisors
(j) Efforts to develop relationships with state and federal regulatory agencies	Chapter 8, Plan Implementation
(k) Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity	To be coordinated with appropriate county departments.
(l) Impacts on groundwater dependent ecosystems	Chapter 5, Groundwater Conditions

4. Hydrogeologic Conceptual Model §354.14

A hydrogeologic conceptual model (HCM) is a description of the physical characteristics of a groundwater basin related to the hydrology and geology and defines the principal aquifer, based on the best available information. The HCM provides the context for the ~~development of a~~ water budget (Chapter 6), sustainable management criteria (Chapter 7) and monitoring network (Chapter 8).

This chapter presents the HCM for the BVGB and was developed by GEI Consultants Inc. (GEI) for the Lassen and Modoc GSAs. ~~This HCM supports the development of the monitoring network, water budget and the sustainable management criteria of this GSP.~~ The content of this HCM is defined by the regulations of SGMA – Chapter 1.5, Article 5, Subarticle 2: 354.14.

Groundwater characteristics and dynamics in the Basin are variable. Located in a sparsely populated area, the amount of existing data and literature to support this HCM is limited, with the most thorough studies being conducted prior to the ~~1980's. This HCM presents the best available information, data and analyses and~~1980s. This HCM provides some limited new data and analyses that further the understanding. With that said, there are many data gaps in the HCM that have been identified in this chapter. The HCM presents best available information and expert opinion to form the basis for descriptions of elements of this GSP: basin boundary; confining conditions; definable bottom, nature of flows near or across faults, soil permeability and recharge potential. Significant uncertainty exists in this HCM and stakeholders have expressed concern about the possible regulatory repercussions associated with making decisions using incomplete and/or uncertain information that become less relevant in the future as the regulatory framework changes.

Recommendations and options for prioritizing and addressing the data gaps are part of this document. The stakeholders in the disadvantaged communities of the BVGB have limited financial means to address data gaps, so the data gaps presented at the end of this chapter are contingent on outside funding.

4.1 Basin Setting

BVGB is located in Lassen and Modoc counties in northeastern California, 50 miles north-northwest of Susanville and 70 miles east-northeast of Redding (road distances are greater). Most of BVGB is in Lassen County (~~60~~72%) with the remainder in Modoc County. At its widest points, the BVGB is approximately 21 miles long (north-south) in the vicinity of the Pit River and 15 miles wide (east-west) south of ACWA. The Basin has an irregular shape totaling about 144 square miles or 92,057 acres. (DWR 2004) The topography of BVGB is relatively flat within the central area with increasing elevations along the perimeter, particularly in the eastern portions where Willow and Ash creeks enter the Basin. Ground surface elevations range from about 4,100 feet above mean sea level (msl) near the south end of BVGB to over 4,500 feet msl at the eastern edge of the Basin. In the north central portion of the Basin, two buttes protrude from the valley (Pilot Butte and Roberts ~~buttes~~Butte). The Pit River enters the BVGB at an elevation of 4,150 feet msl and leaves the Basin at 4,100 feet msl over the course of about 30 river miles, giving the Pit River a gradient of less than 2 feet per mile. By contrast, the Pit

River above and below Big Valley has a gradient over 50 feet per mile. This low gradient in the Basin results in a meandering river morphology and widespread flooding during large storm events. Ash Creek enters the Basin at Adin at an elevation of 4,200 feet msl, eventually joining the Pit River when flows are sufficient to make it past Big Swamp. **Figure 4-1** shows the ground topography for the BVGB.

~~Topographic~~Portions of eight topographic maps (7.5-minute) ~~for~~cover the BVGB area ~~include the following towns~~and are named as follows (north-south, west-east):

Donica Mountain	Halls Canyon	
Lookout	Big Swamp	Adin
Bieber	Hog Valley	Letterbox Hill

4.2 Regional Geology and Structure

The regional geology is depicted on the Alturas Sheet~~,~~ (CGS 1958), a 1:250,000 scale map with an excerpt shown on **Figure 4-2**. ~~(CGS 1958)~~ The BVGB is in the central area of the Modoc Plateau geomorphic province. According to the California Geological Survey (CGS 2002), the Modoc Plateau is, "…a volcanic table land" broken into blocks by north-south faults. The Basin is underlain by a thick sequence of lava flows and tuffs. The volcanic material is variable in composition as described below, is Miocene to Holocene age[17] and erupted into sediment-filled basins between the block-faulted mountain ranges (Norris and Webb 1990).

According to MacDonald (1966), the Modoc Plateau is transitional between two geomorphic provinces: block faulting of the Basin and ~~Cascade~~ Range ~~(range)~~to the east and volcanism of the ~~range. This~~Cascade Range to the west. This transition can be observed on **Figure 4-2** with the numerous faults trending north-northwest surrounding Big Valley and the most recent center of volcanism (indicated by the numerous cinders [asterisks] centered around Medicine Lake, with several eruptions about 1000 years before present) about 30 miles northwest of Big Valley. Moreover, the historic volcanism and tectonics occurred concurrently, which disrupted the drainage from the province and resulted in the formation of numerous lakes, including an ancestral lake in Big Valley. Volcanic material was deposited as lava flows, ignimbrites (hot ash flows), subaerial and water-laid layers of ash (cooler) and mudflows combined with sedimentary material, although thick sections of rock can be either entirely sedimentary or volcanic. The composition of the lava flows is primarily basalt[18] and basaltic andesite[19], while pyroclastic[20] ash deposits are rhyolitic[21] composition.

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[17] Miocene is 23 million to 5.3 million years ago; Holocene is 12,000 years ago to present.

[18] Basalt is an extrusive (volcanic) rock with relatively low silica content and high iron and magnesium content.

[19] Andesite is an extrusive rock with intermediate silica content and intermediate iron and magnesium content.

[20] Pyroclastic means formed from volcanic eruptions, typically not from lava flows, but from material (clasts) ejected from the eruption such as ash, blocks, or "bombs."

[21] Rhyolitic rocks are extrusive with relatively high silica content and low iron and magnesium. Rhyolites are the volcanic equivalent of granite.

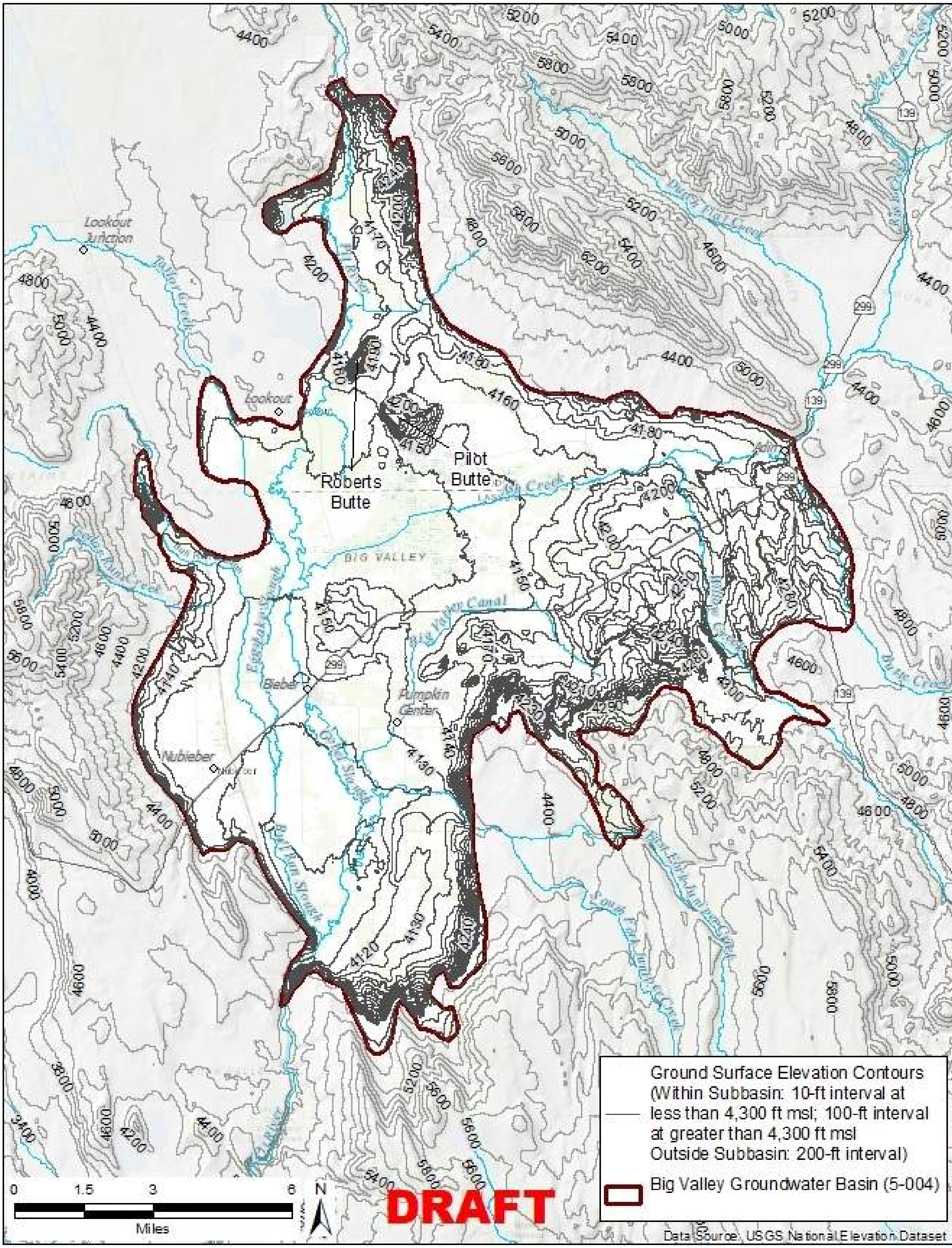

Figure 4-1 Topography
Source: USGS 2016

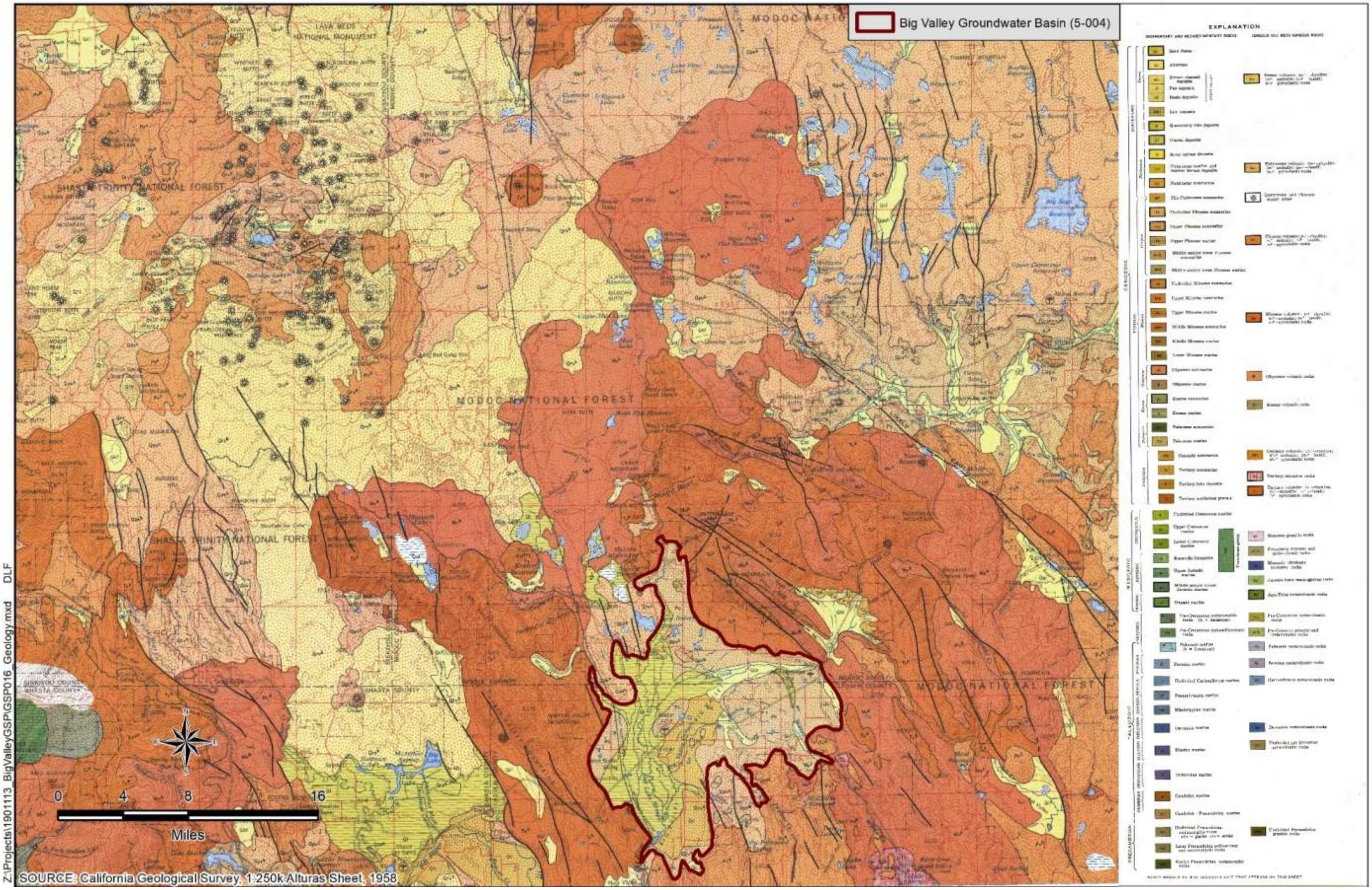

Figure 4-2 Regional Geologic Map

4.2.1 Lateral Basin Boundaries

~~A 60-year-old map (~~The CGS (1958) geology map (**Figure 4-2**) was used by DWR to draw the BVGB boundary. ~~The CGS~~That63-year-old map has proven to be inaccurate in many places, and more recent, more accurate geologic maps are available~~.~~ (DWR 1963, GeothermEx 1975~~)~~). The lateral boundaries of BVGB are described by DWR (2004) as, "…bounded to the north and south by Pleistocene and Pliocene basalt and Tertiary pyroclastic rocks of the Turner Creek Formation, to the west by Tertiary rocks of the Big Valley Mountain volcanic series, and to the east by the Turner Creek Formation." In general, the boundary drawn by DWR ~~can be described as~~was intended to define the contact between the valley alluvial deposits and the surrounding volcanic rocks. Because this boundary was drawn using a regional-scale map from 1958 that was drawn with the surface expression of geologic units, ~~it may be necessary to modify the~~a basin boundary modification at a future date ~~with~~would be more ~~precision to~~precise and would include the aquifer materials which ~~may~~ extend outside of the current boundary. This ~~includes~~future modification could include consideration of ~~including~~ the "upland recharge areas" described by DWR (1963).

Additionally, the Basin boundary ~~may be~~is inaccurate in the southeastern portion of the Basin where two fingers extend into the uplands area. The narrower of the two fingers ~~appears to extend~~extends too far into the upland elevations and intersects with East Fork Juniper Creek which doesn't drain into the finger, as shown in **Figure 4-1**. East Fork Juniper Creek actually flows to the west and is confluent with the Pit River south of Pumpkin Center. A more thorough mapping of the elevations and geologic contacts in ~~this area~~the upper area of East Fork Juniper Creek would help to refine the boundary between alluvium and upland volcanics~~. In particular, a finger of the boundary extends up to East Fork Juniper Creek in the south-central part of the Basin and includes elevations and~~ as some areas ~~that~~ are clearly not underlain by alluvial deposits.

In the northeastern portion of the Basin, the boundary curves around the base of the Barber Ridge and Fox Mountain. The CGS contact between the alluvium and volcanics here is well below the change in slope of the mountain range. More recent mapping ~~and geology~~ (GeothermEx 1975) extends alluvium 1.5 miles further upslope as shown on **Figure 4-3**. This 1975 mapping also shows other locations along the current basin boundary that should be modified, including the aforementioned narrow finger at East Fork Juniper Creek.

4.3 Local Geology

Several geologic maps were available at a more detailed scale than the CGS (1958) map. Two of them had accompanying studies that more thoroughly described the geology. Although relatively old studies, they both provide useful information. However, they differ slightly on some details, particularly the ~~surficial~~surface geology and further refinement of their contacts may be necessary. The two maps are shown on **Figure 4-3** and **Figure 4-4**.

The two different reports were written for different purposes, with DWR (1963) being developed as a general investigation of the potential ~~of~~ groundwater resources and GeothermEx (1975) as ~~an~~a specific investigation ~~specifically performed to evaluate~~of potential hydrothermal groundwater resources. All reviewed sources agree that the BVGB is surrounded by mountain blocks of volcanic rocks of somewhat variable composition, but primarily basalt. Although these mountains are outside of the groundwater basin, they may be underlain by alluvial formations. The mountains capture and accumulate precipitation, which produces runoff that flows into BVGB. Moreover, DWR (1963) ~~suggested~~stated that these mountains serve as "upland recharge areas" and provide subsurface recharge to the BVGB. These recharge areas suggested by DWR are shown in red shading on **Figure 4-5** and correlate with Pliocene

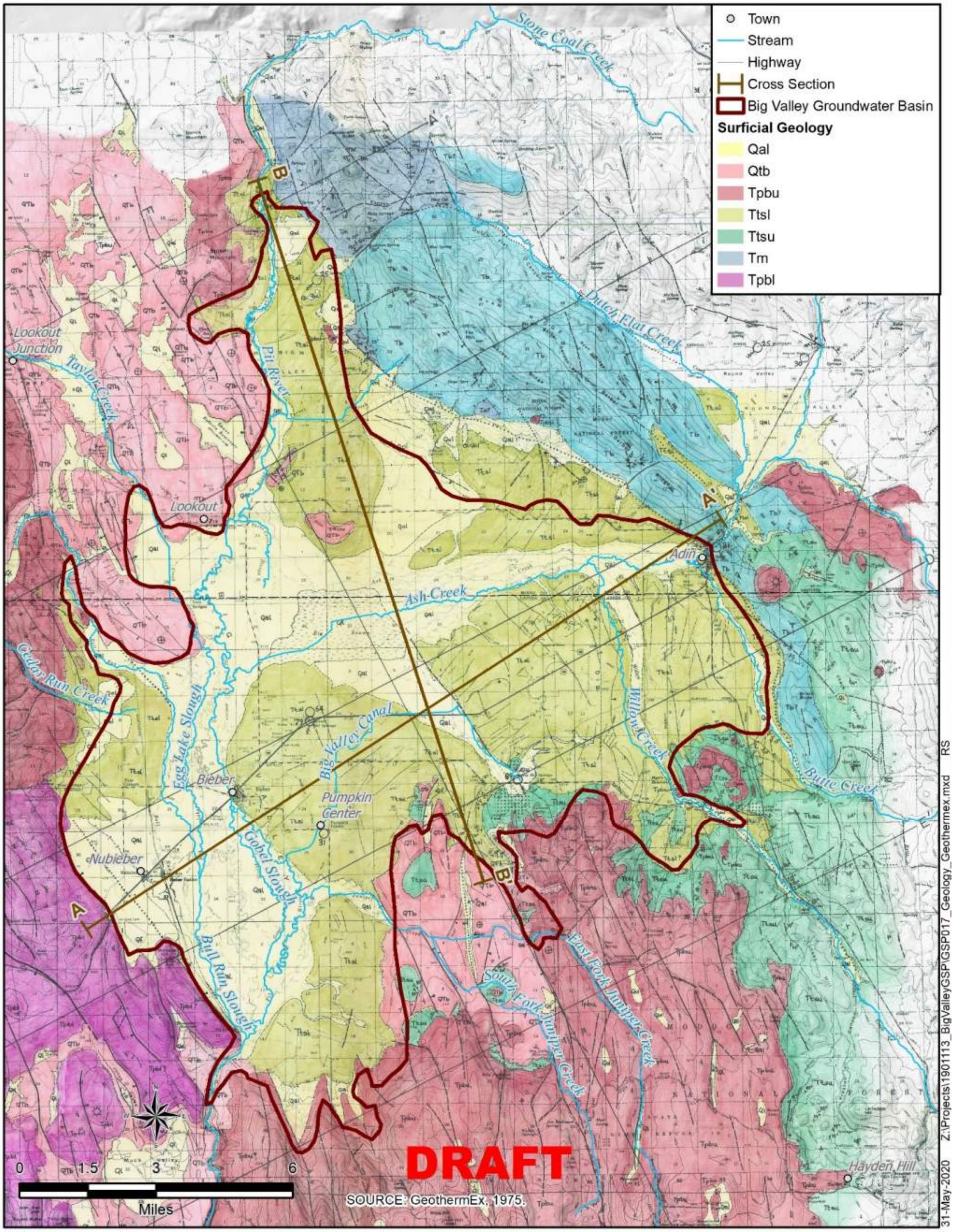

Figure 4-3 GeothermEx 1975 Local Geologic Map

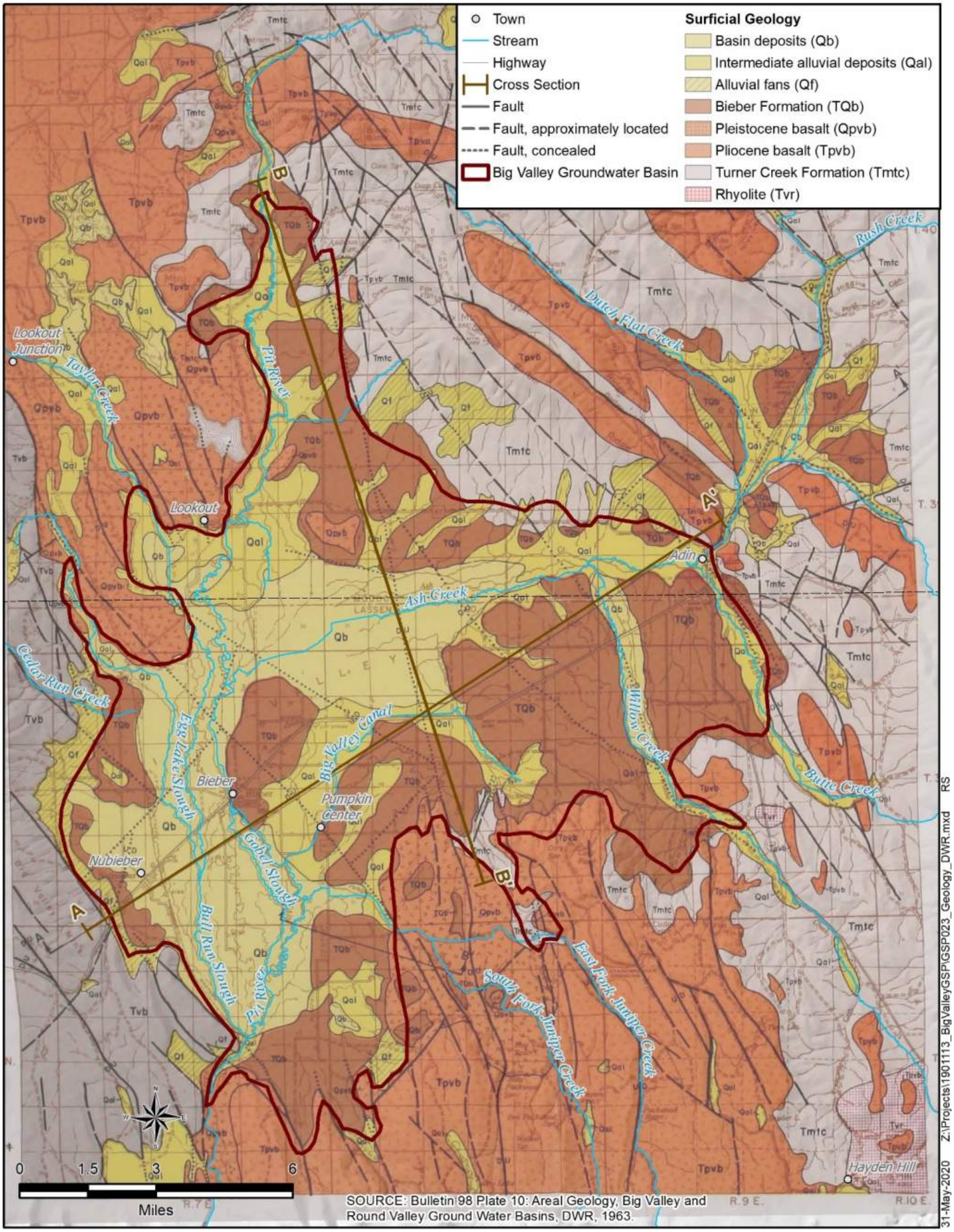

Figure 4-4 DWR 1963 Local Geologic Map

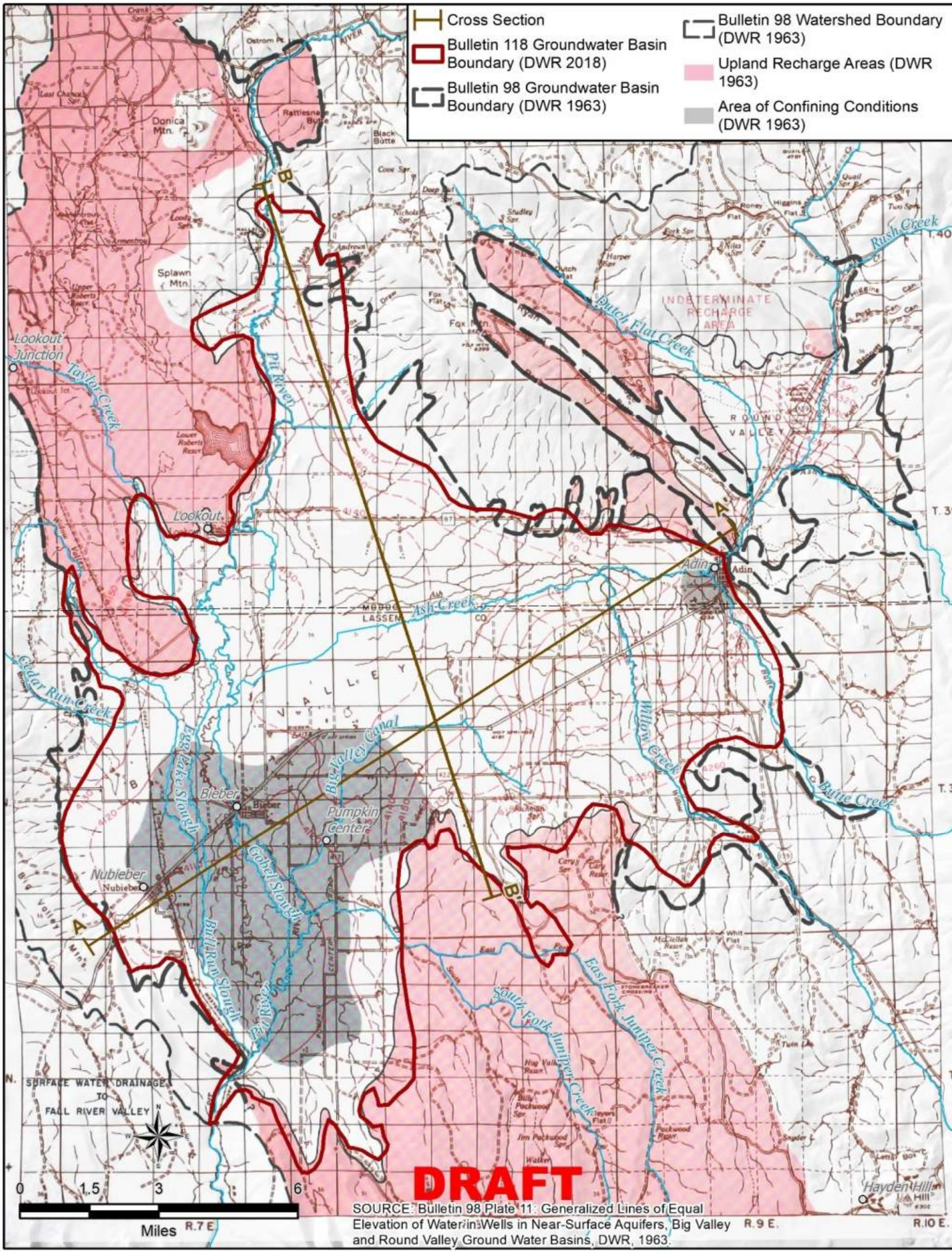

Figure 4-5 DWR 1963 Upland Recharge Areas and Areas of Confining Conditions

to Pleistocene[22] basalts (Tpbv and Qpbv). These units are mapped by DWR (1963) outside the Basin to the northwest and southeast as well as along the crests of Barber and Ryan Ridges to the northeast of Big Valley.[23] GeothermEx (1975) generally concurs with this mapping, except for the areas along Barber and Ryan Ridges, which they map as a much older unit (Miocene) which is corroborated by a radiometric age date measured at 13.8 million years. This distinction is important because an older unit is more likely to underlie the Basin sediments and is less likely to be hydraulically connected to the BVGB. At the northwestern end of Barber Ridge, GeothermEx mapped the oldest unit in the BVGB area (Tm) of ~~Andesitic~~andesitic composition. This unit contains the site of the Shaw Pit quarry.

4.4 Principal Aquifer

4.4.1 Formation Names

The Pliocene-Pleistocene[22] age Bieber Formation (TQb) is the main formation of aquifer material defined within BVGB and DWR (1963) estimates that it ranges in thickness from a thin veneer to over 1,000 feet. It meets the ground surface around the perimeter of the Basin, especially on the southeast side (DWR 1963). The formation was deposited in a lacustrine (lake) environment and is comprised of unconsolidated to semi-consolidated layers of interbedded clay, silt, sand, gravel and diatomite[24]. Layers of black sand and white sand (pumiceous) were identified as highly permeable but discontinuous and mostly thin. GeothermEx (1975) did not embrace the DWR name and identified this formation as an assemblage of tuffaceous, diatomaceous lacustrine and fluvial sediments (Ttsu, Ttsl). Both investigations identified the formation in the same overall location, based on a comparison of the two geologic maps, but the GeothermEx map provides more detail and resolution than the DWR map. For the purposes of the GSP, the name Bieber Formation will be used.

Recent Holocene[25] deposits (labeled with Q) were mapped within the center of the Basin and along drainage courses from the upland areas and are identified by DWR (1963) as alluvial fans (Qf), intermediate alluvium (Qal) and Basin deposits (Qb). The composition of these unconsolidated deposits varies from irregular layers of gravel, sand and silt with clay to poorly sorted silt and sand with minor clay and gravel (Qal) to interbedded silt, clay and "organic muck" (Qb). The latter two deposits occur in poorly drained, low-lying areas where alkali[26] could accumulate. The thickness of these sediments is estimated to be less than 150 feet. GeothermEx (1975) identified these deposits as older valley fill (Qol), lake and swamp deposits (Ql), fan deposits (Qf) as well as undifferentiated alluvium (Qal). All these recent deposits are aquifer material[27] and are part of the Big Valley principal aquifer. There is discrepancy between the two maps is in the northeastern portion of the Basin, where GeothermEx

[22] 5.3 million years to ~~11,700~~12 thousand years ago.

[23] The GSAs specifically requested a basin boundary modification to include these upland recharge areas within the Basin boundary. The request was denied by DWR as not being sufficiently substantiated. (*See* **Appendix 1A**)

[24] Diatomite is a fine-grained sedimentary rock made primarily of silica~~. It~~, and is formed from the deposition of diatoms ~~who make their~~, which are microscopic creatures with shells made from silica.

[25] Recent geologic period from ~~11,700~~12 thousand years old to present.

[26] Alkali means relatively high in alkali and alkali earth metals (primarily sodium, potassium, calcium and magnesium) and generally results in a high pH (greater than 7 or 8).

[27] Meaning they contain porous material with recoverable water.

extends the alluvial sediments much further upslope toward Barber Ridge and Fox Mountain as discussed in Section 4.3 – Local Geology.

The principal aquifer consists of the Bieber Formation (TQb and recent deposits (Qal, Qg, Qb). While DWR (1963) delineates an "area of confining conditions" in the southwest area of the Basin on **Figure 4-5**, the data to support the confinement and the definition of a broad-scale, well-defined aquitard[28] is not currently available.

As described ~~above and below~~herein, aquifer conditions vary greatly throughout the Basin. However, clearly defined, widespread distinct aquifer units have not been identified, and with the data currently available all the water bearing units in the Basin ~~will be~~are defined as a single principal aquifer for this GSP.

4.4.2 Geologic Profiles

Figure 4-6 and **Figure 4-7** show cross-sections across Big Valley. The locations of the cross-sections are shown on **Figure 4-3**, **Figure 4-4** and **Figure 4-5**. The locations of these sections were drawn to be similar to those drawn by DWR (1963) and GeothermEx (1975) and characterize the aquifers in two directions (southwest-northeast and northwest-southeast). The sections show the lithology of numerous wells across the ~~valley~~Basin. Very little geological correlation could be made across each section which is likely to be related to the concurrent block faulting and volcanic and alluvial depositional input from various highland areas flowing radially into Big Valley. These complex structural and depositional variables result in great stratigraphic variation over short distances. The pertinent information from cross-sections presented by DWR (1963) and GeothermEx (1975) are shown on the sections.

4.4.3 Definable Bottom

The SGMA and ~~DWR's~~DWR GSP regulations do not provide clear guidance for what constitutes a "definable bottom" of a basin. However, ~~DWR's~~DWR (2016a) Bulletin 118 Interim Update describe the "physical bottom" as where the porous sediments contact the underlying bedrock and the "effective bottom" as the depth below which water ~~is~~could be unusable because it is brackish or saline.

The "physical bottom" of BVGB is difficult to define because few borings have been drilled deeper than 1200 ft and the compositions of the alluvial and bedrock formations are similar (derived from active volcanism), with contacts that are gradational. Also, some of the lavas ~~probably~~most likely flowed into Big Valley forming lava lenses that are now interlayered~~ below, above and laterally~~ with permeable aquifer sediments. Moreover, the base of the aquifer system is likely variable across BVGB due to the concurrent volcanism and horst/graben faulting of the bedrock.

The deepest lithologic information in the Basin is derived from two test borings by DWR to depths of 1843 and 1231 feet and from two geothermal test wells near Bieber to depths of 2125 and 7000 feet. The 7000-foot well is east of Bieber, but only has lithologic descriptions to a depth of 4100 feet, including

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28 Layer of low permeability that prevents significant flow, except at very slow rates.

descriptions of aquifer-type materials (sands) throughout. The other three deep lithologies give similar indication of aquifer material to their total depth.

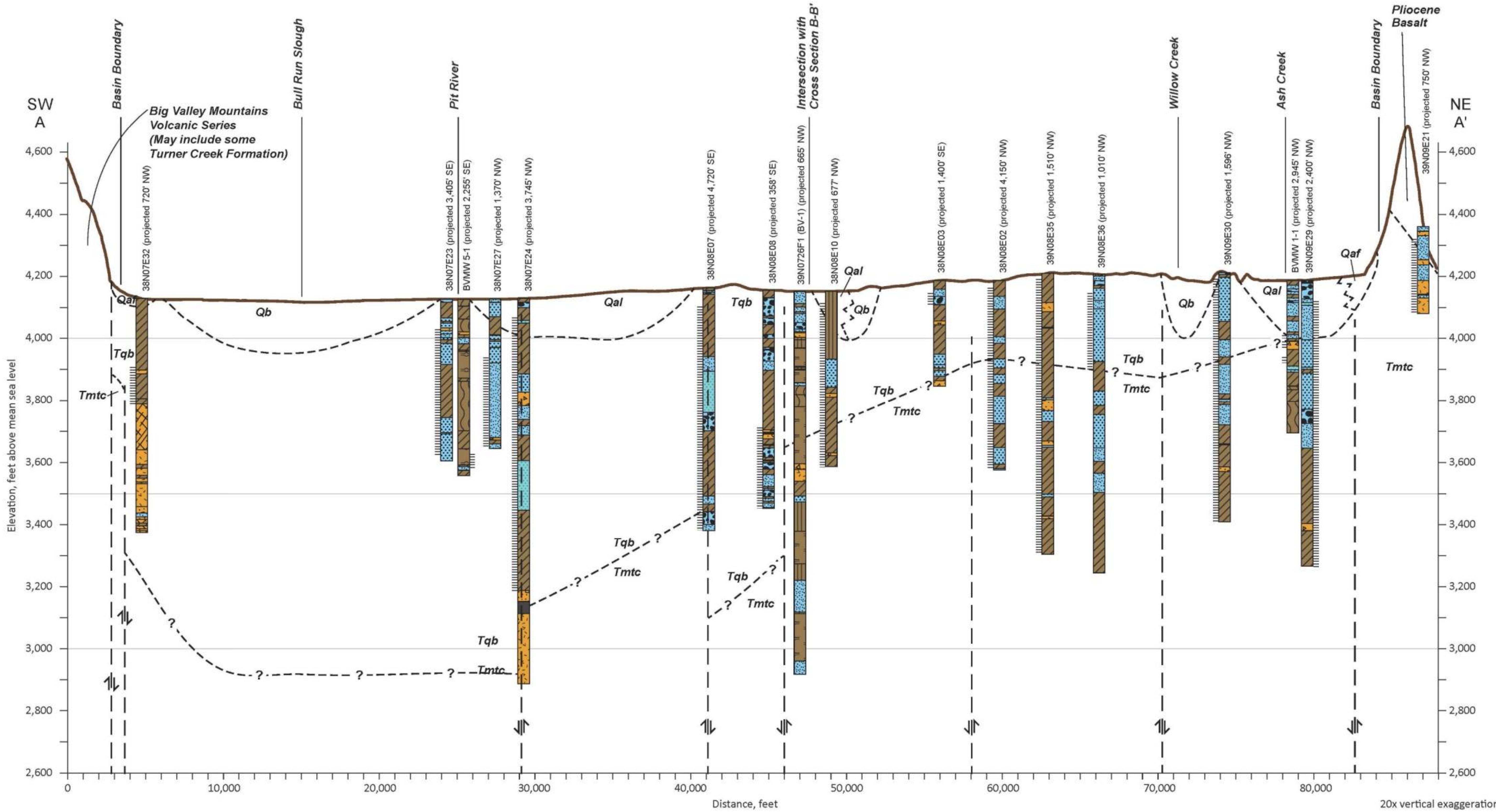

Figure 4-6 Geologic Cross Section A-A'

Note: Key to lithologic symbologies is in development and will be included in future draft(s)

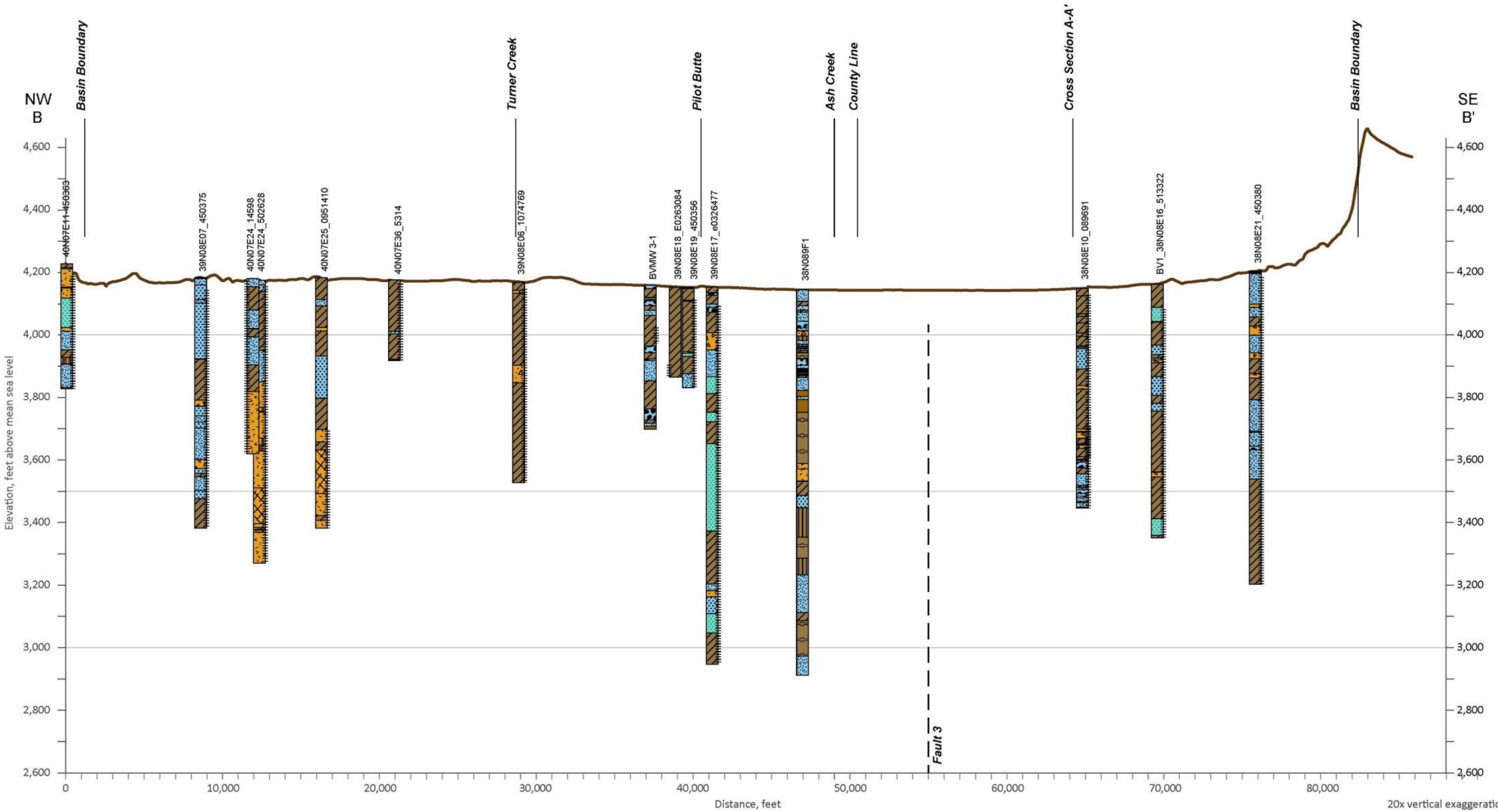

Figure 4-7 Geologic Cross Section B-B’

Note: Key to lithologic symbologies is in development and will be included in future draft(s)

~~The deepest wells drilled in the Basin include two test borings by DWR to depths of 1843 and 1231 feet and two geothermal test wells near Bieber to depths of 2125 and 7000 feet. The deepest 7000 foot well is east of Bieber, but only has lithologic descriptions to a depth of 4100 feet. These descriptions indicate aquifer-type materials (sands) throughout. The other three deep well lithologies give similar indication of aquifer material to their total depth.~~

The two geothermal wells also had temperature logs and some water quality. Water temperatures increased to over 100°F ~~beyond~~at depths of about 2000 to 3000 feet. ~~The~~One of them located near the Bieber School~~ Well~~ had water quality samples collected from the 1665- to 2000-foot interval and indicated water quality higher in total dissolved solids (632 milligrams per liter) than is present in shallower portions of the Basin.

The information from these two wells indicated that temperature and water quality concerns increase with depth, but a clear delineation of where water becomes unusable cannot be determined with the data available. With ~~no~~limited scientific evidence to clearly define a physical or effective bottom of the aquifer, an approach to define a practical bottom is being used to satisfy the GSP Regulations which require the aquifer bottom to be defined (§ 354.14(a)(1)), as described below.

The approach for defining the practical bottom is to ensure that all known water wells are included within the aquifer. DWR's well log inventory shows that over 600 wells have been installed in the BVGB. Although DWR's well log inventory does not completely and precisely assess the total number or status of the wells (i.e., abandoned), it is the only readily available data. The well inventory has been identified as a data gap within this GSP. Wells in this inventory with known depths are summarized in **Table 4-1**. The only ~~wells~~borings drilled deeper than 1,200 feet are the two DWR test borings and two geothermal wells discussed ~~above~~previously.

Table 4-1 Well Depths in DWR Inventory

Depth Interval (ft bgs)	Deepest Well per Section[a]		Count of All Wells
< 200	10%		41%
200 – 400	16%	43%	25%
400 – 600	27%		17%
600 – 800	28%	42%	12%
800 – 1000	14%		4%
1000 – 1200	4%		1%
> 1200[b]	1%		< 1%

Notes:
[a] ~~A section~~Section is a 1 mile by 1 mile square. There are 134 sections in the BVGB
[b] Test borings: BV-1 and BV-2 ~~are only water wells~~were drilled deeper than 1200 ~~ft~~feet

For this GSP, the "practical bottom" of the aquifer is set at 1200 feet but may extend to 4,100 or deeper. This delineation of 1200 feet is consistent with DWR's approach, established over 50 years ago, which declared a practical bottom of 1000 feet. A depth of 1200 feet encompasses the levels where groundwater can be accessed and monitored for beneficial use but does not preclude drilling and pumping from greater depths.

4.4.4 Structural Properties with Potential to Restrict Groundwater Flow

Faults can sometimes affect flow, but sufficient evidence has not been gathered and analyzed to determine whether any of the faults in Big Valley restrict or facilitate flow. The mountains around BVGB are heavily faulted, with older basalt units more faulted than younger basalt units.

Most of the faults trend to the north/northwest with some perpendicular faulting oriented northeasterly. **Figure 4-8** is an excerpt of the regional fault map by the California Geological Survey (2010). Faults on the western side of BVGB are shown to be Quaternary in age while faults on the eastern side are pre-Quaternary (older than 2.6 million years). Note that numerous faults to the west of BVGB were identified as ~~later~~late Quaternary to Holocene-age faults (displacement during the last 700,000 years or within the last ~~11,700~~12 thousand years, respectively).

Some of the faults extend across the Basin, concealed beneath the alluvial materials. Two hot springs are located in the Basin near these faults. DWR (1963) acknowledged the potential restriction of groundwater flow by faults but did not provide specific information. However, such fault impacts on groundwater flow cannot be determined with certainty at this time with the available groundwater level data, given the limited number and the wide spacing of ~~widely spaced~~ wells~~ with groundwater level data,~~ and the absence of a pumping test to verify restricting conditions.

4.4.5 Physical Properties and Hydraulic Characteristics

The physical properties of a groundwater system are typically defined by the hydraulic conductivity[29], transmissivity[30] and storativity[31] of the aquifer. The preferred method of defining hydraulic characteristics is a pumping test with pumping rates and water levels monitored (either in the pumping well or preferably a nearby monitoring well) throughout the test. Such pumping tests were performed after the construction of five sets of monitoring wells (MWs) in late 2019 and early 2020.

The tests were performed by pumping each 2.5-inch-diameter ~~well~~MW for 1 hour at a rate of 8 gpm while measuring water level drawdown in the pumping well. A well efficiency[32] of 70 percent was assumed, and the length of the well screen was used as a proxy for the aquifer thickness (b). **Table 4-2**

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[29] Hydraulic conductivity (K) is defined as the volume of water that will move in a unit of time under a unit hydraulic gradient through a unit area. It is a measure of how easily water moves through a material and is usually given in gallons per day per square foot (gpd/ft^2) or feet per day (ft/day).

[30] Transmissivity (T) is the product of K and aquifer thickness (b) and is a measure of how easily water moves through a thickness of aquifer. It is usually expressed in units of gallons per day per foot of aquifer (gpd/ft) or square feet per day (ft^2/day).

[31] Storativity (S, also called storage coefficient) is defined as the volume of water that an aquifer releases from or takes into storage per unit surface area per unit change in groundwater elevation. High values of S are indicative of unconfined or water table aquifers, while low values indicate confined (pressurized) aquifers. S does not have units.

[32] ~~Pumping tests with water levels measured in the~~ A pumping well will experience more groundwater level drawdown than ~~elsewhere in~~a nearby non-pumping well due to inefficiency in the movement of groundwater from the aquifer~~.~~ into the well. The predicted drawdown divided by the actual drawdown is well efficiency.

shows the results of the Theis[33] solution that best matched the drawdown curve at each well. Storativity (S) ranged from highly confined ($3.0x10^{-6}$ at BVMW 3-1) to unconfined ($1.5x10^{-1}$ at BVMW 4-1). Hydraulic

[33] Theis is a mathematical solution ~~for predicting drawdown in a well and is commonly used~~ to estimate K, T, and S~~.~~ and is based on pumping rate and the resultant rate of groundwater level drawdown (Theis, 1935).

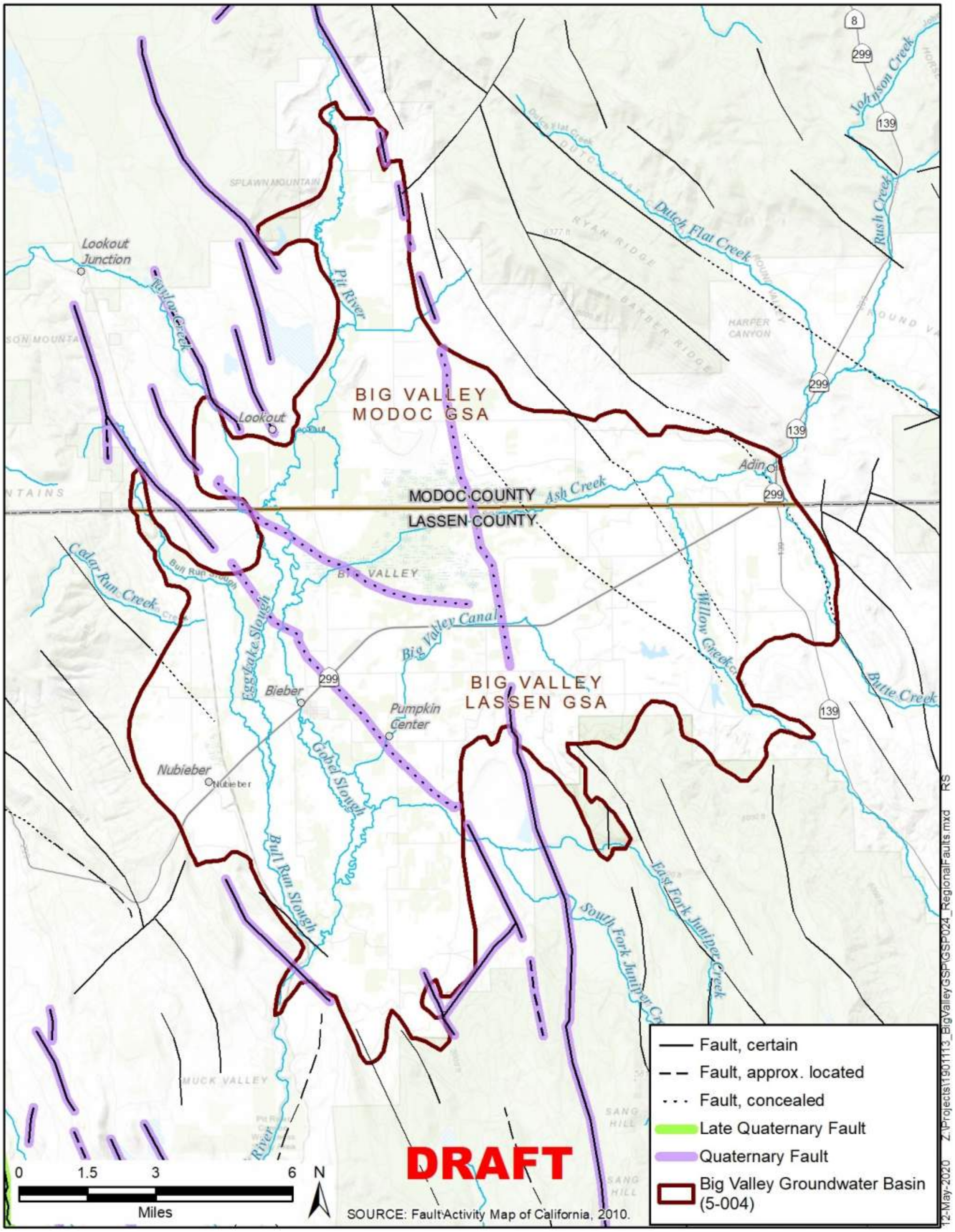


Figure 4-8 Local Faults

Table 4-2 Aquifer Test Results

Parameter	Units	BVMW 1-1	BVMW 2-1	BVMW 3-1	BVMW 4-1	BVMW 5-1
Well depth	ft	265.5	250.5	185.5	425	540
Thickness[a] (b)	ft	50	40	50	30	50
Flow (Q)	gpm	8	8	8	8	8
Drawdown after 1 hour	ft	4.3	16.0	27.5	2.0	3.0
Transmissivity (T)	gpd/ft	3000	750	700	4200	4500
Storativity (S)	unitless	$1.5\text{x}10^{-3}$	$1.0\ \text{x}10^{-3}$	$3.0\text{x}10^{-6}$	$1.0\ \text{x}10^{-1}$	$2.0\ \text{x}10^{-3}$
Hydraulic Conductivity (K)	ft/d	8	3	2	19	12

[a] Assumed to be the length of the screen interval

Source: GEI 2021

conductivity (K) ranged from 2 feet per day (ft/d) to 19 ft/d, ~~although these~~ which is consistent with silty sand and clean, fine sand. The K values ~~likely~~may range higher since pumping tests in larger wells with larger pumps ~~in larger wells~~ for longer periods of time tend to give higher T and K values. The results of these five pumping tests are documented further in **Appendix 4A**. More thorough assessment of Basin aquifer characteristics is needed and is identified as a data gap.

~~The specific~~Specific yield (SY) is another important aquifer characteristic, as it defines the fraction of the aquifer that contains recoverable water and therefore governs the volume of groundwater stored in the Basin. Reclamation (1979) discussed the SY in Big Valley and postulated that it varies with depth, at 7 percent for the first 100 ft bgs, 6 percent for the 100 to 200 feet bgs and 5 percent from 200 to 1000 ft bgs. However, Reclamation doesn't give any supporting evidence for these percentages. SY in the Sacramento Valley has been estimated to vary between 5 to 10 percent (DWR 1978). Since Big Valley aquifer materials were primarily deposited in a lacustrine environment (as opposed to Sacramento Valley which has a higher percentage of riverine deposits), Big Valley's SY is likely on the lower end at 5 percent. This conservative percentage will be used for all depth intervals in this GSP.

4.5 Soils

Information on soils within the BVGB were obtained from the Soil Survey Geographic Database (SSURGO) of the NRCS. The SSURGO data includes two categories of information relevant to the GSP: taxonomic soil orders and hydrologic soil groups. Taxonomic data include general characteristics of a soil and the processes of formation while hydrologic data relate to the soil's ability to transmit water under saturated conditions and is an important consideration for hydrology, runoff and groundwater recharge. The following section describes the soils of BVGB.

4.5.1 Taxonomic Soil Orders

Of the 12 established taxonomic soil orders, three were found within the BVGB, as listed below, and their distributions are presented in **Figure 4-9**. Descriptions below were taken from the Illustrated Guide to Soil Taxonomy (NRCS, 2015):

- Alfisol – Naturally fertile soils with high base saturation and a clay-enriched subsoil horizon. Alfisols develop from a wide range of parent materials and occur under broad environmental conditions, ranging from tropical to boreal. The movement of clay and other weathering products from the upper layers of the soil and their subsequent accumulation in the subsoil are important processes. The soil-forming processes are in relative balance. As a result, nutrient bases (such as calcium, magnesium and potassium) are supplied to the soil through weathering and the leaching process is not sufficiently intense to remove them from the soil before plants can use and recycle them.
- Mollisol – Very dark-colored, naturally very fertile soils of grasslands. Mollisols develop from predominantly grasslands in temperate regions at mid-latitudes and result from deep inputs of organic matter and nutrients from decaying roots, especially the short, mid and tall grasses common to prairie and steppe areas. Mollisols have high contents of base nutrients throughout their profile due to mostly non-acid parent materials in environments (subhumid to semiarid) where the soil was not subject to intense leaching of nutrients.
- Vertisol – Very clayey soils that shrink and crack when dry and expand when wet. Vertisols are dominated by clay minerals (smectites) and tend to be very sticky and plastic when wet and very firm and hard when dry. Vertisols are commonly very dark in color and distinct soil horizons are often difficult to discern due to the deep mixing (churning) that results from the shrink-swell cycles. Vertisols form over a variety of parent materials, most of which are neutral or calcareous, over a wide range of climatic environments, but all Vertisols require seasonal drying.

Mollisols are the most prominent soil order within the BVGB occupying nearly 78 percent of the total area. Vertisols occupy over 16 percent and are found mostly on the southwestern side of BVGB within the floodplain of the Pit River. Small patches of Vertisols are scattered in the remainder of the Basin. Alfisols occupy over 5 percent of the Basin and are found mostly on the west side of the Basin and along Hot Spring Slough in the south-central portion of the Basin.

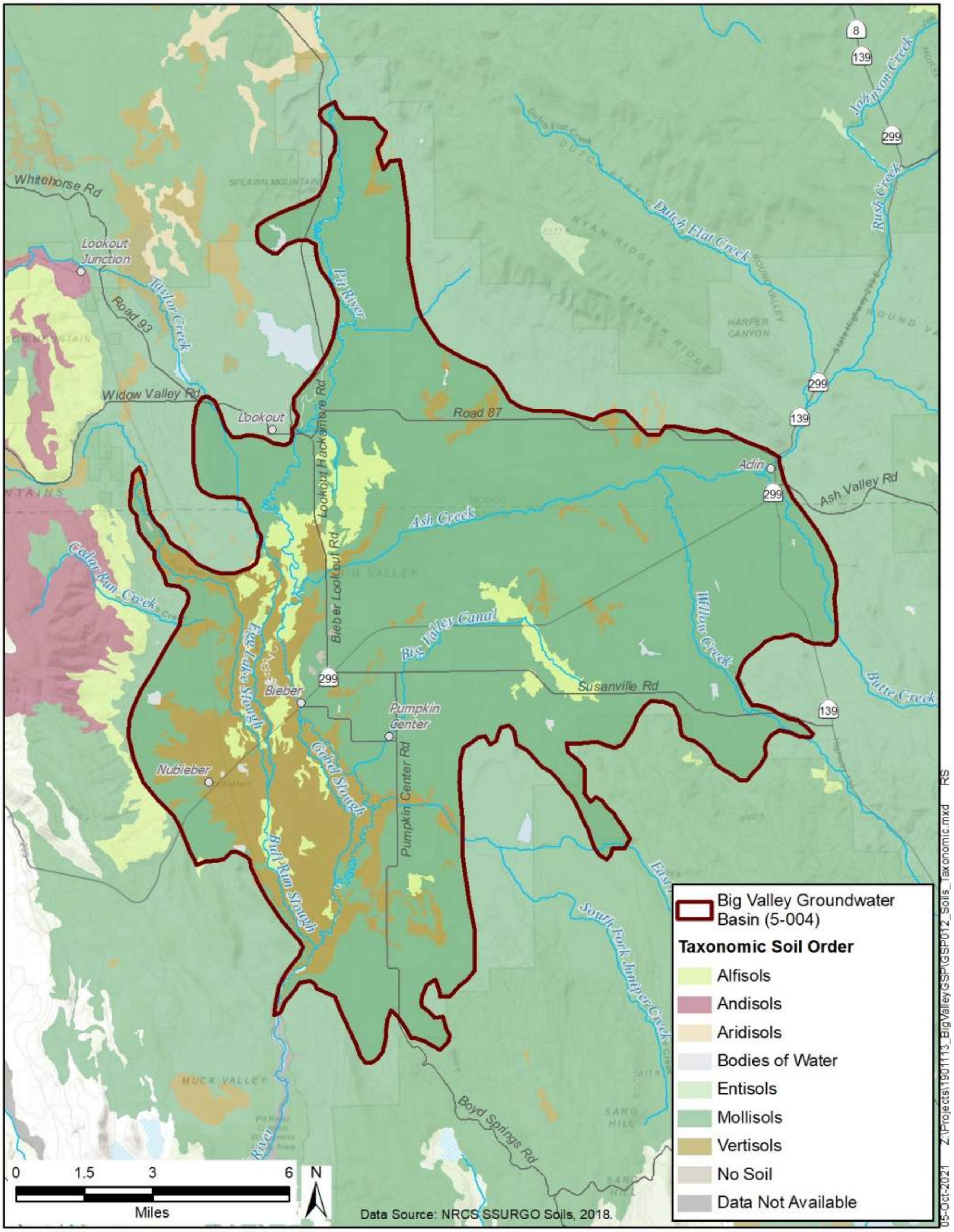


Figure 4-9 Taxonomic Soils Classifications

4.5.2 Hydrologic Soil Groups

The NRCS Hydrologic Soils Group (HSG) classifications provide an indication of soil infiltration potential and ability to transmit water under saturated conditions, based on hydraulic conductivities of shallow, surficial soils. **Figure 4-10** shows the distribution of the hydrologic soil groups, where higher conductivities (greater infiltration) are labeled as Group A and lowest conductivities (lower infiltration) as Group D. As defined by the NRCS (2012), the four HSGs are:

- Hydrologic Group A – "Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10% clay and more than 90% sand or gravel and have gravel or sand textures." Group A soils have the highest conductivity values (greater than 5.67 inches per hour [in/hr]) and therefore a high infiltration rate[34] ~~and the greatest recharge potential~~.

  Hydrologic Group B – "Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission is unimpeded. Group B soils typically have between 10 and 20% clay and 50 to 90% sand and have loamy sand or sandy loam textures~~.~~." Group B soils have a wide range of conductivity values (1.42 in/hr to 5.67 in/hr), ~~a moderate infiltration rate[32]~~ and a moderate ~~potential for recharge.~~infiltration rate.

- Hydrologic Group C – "Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 and 40% clay and less than 50% sand and have loam, silt loam, sandy clay loam, clay loam and silty clay loam textures." Group C soils have a relatively low range of conductivity values (0.14 to 1.42 in/hr), and a slow infiltration rate[35] ~~and limited potential for groundwater recharge due to their fine textures~~.

- Hydrologic Group D – "Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40% clay, less than 50% sand and have clayey textures. In some areas, [Group D soils]also have high shrink-swell potential." Group D soils have conductivity values less than 0.14 in/hr, a very slow infiltration ~~rate[33] and a very limited capacity to contribute to groundwater recharge.~~rate.

A dual hydrologic group (C/D) is assigned to an area to characterize runoff potential under drained and undrained conditions, where the first letter represents drained conditions, and the second letter applies to undrained conditions.

According to this HSG dataset, ~~no areas~~ BVGB does not show high infiltration rates (Group A) and only a tiny area (<0.1%) of Group B soil (moderate infiltration) are present, located on the western edge of the Basin at the top of Bull Run Slough near Kramer Reservoir. The remainder of the Basin is shown with hydrologic soils Groups C and D, slow to very slow infiltration rates (Group C at 30% and Group D at 58% of Basin area). Most of the ACWA is underlain by the dual hydrologic group C/D (11% of

[34] ~~Soil Survey Staff, NRCS, United States Department of Agriculture. Web Soil Survey~~
[35] ~~Soil Survey Staff, NRCS, United States Department of Agriculture. Web Soil Survey~~

Basin area) and due to the wetland nature of this area contains primarily undrained soils corresponding to the very slow infiltration rates.

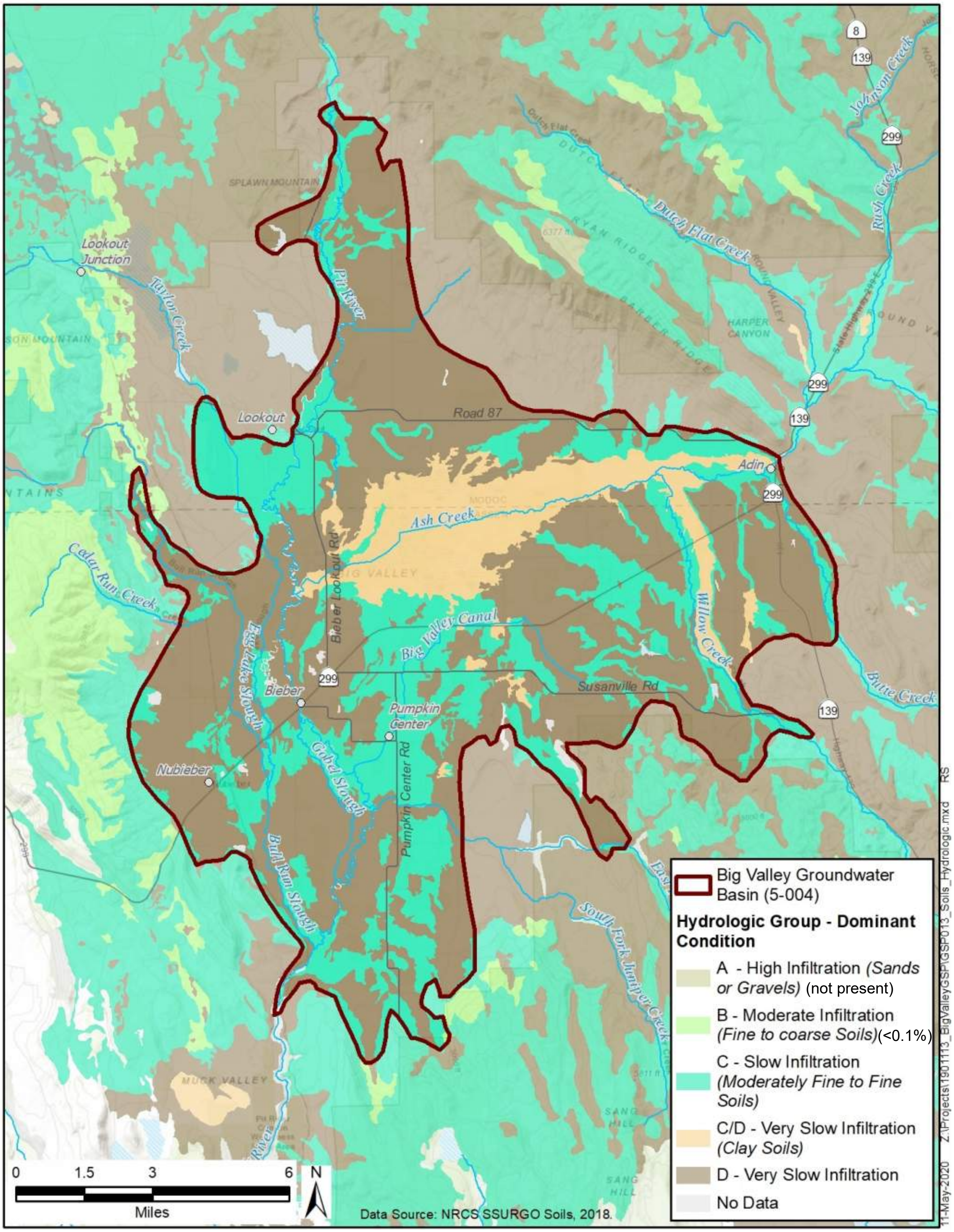


Figure 4-10 Hydrologic Soils Group Classifications

It should be noted that the NRCS develops these maps using a variety of information including remote sensing and some limited field data collection and does not always capture variations that may occur on a small scale. Historical experience from landowners and additional field data could identify areas of better infiltration. These soils groups do not necessarily preclude vertical movement of water and, while recharge may be slower than desired, recharge ~~may~~is still ~~be~~ possible. Additionally, Group C and D soils may have slow infiltration rates due to shallow hardpan, and groundwater recharge could potentially be enhanced if this hardpan can be disrupted. ~~More research on soil~~Soil permeability ~~is being conducted through grant funding~~has been identified as a data gap, particularly at the small scale.

4.5.3 Soil Agricultural Groundwater Banking Index

The University of California at Davis has established the Soil Agricultural Groundwater Banking Index (SAGBI) using data within the SSURGO database, which gives a rating of suitability of the soils for groundwater recharge. This index expands on the HSG to include topography, chemical limitations and soil surface condition. This effort has resulted in a mapping tool that illustrates six SAGBI classes (excellent-very poor) and has been completed for much of the state. This mapping tool is only available for the Modoc County portion of BVGB as shown on **Figure 4-11**, and the ~~indices vary~~index varies mostly between moderately poor to very poor. Small areas of moderately good are present along the Pit River as it enters BVGB and to the west of Adin. It should be noted that the SAGBI is a large-scale, planning level tool and does not preclude local site conditions that are good for groundwater recharge.

4.6 Beneficial Uses of Principal Aquifer

Primary beneficial uses of groundwater in the BVGB include agricultural, environmental, municipal and domestic uses. A description of each is provided below.

Agricultural

Agricultural users get their supply from surface water diversions, groundwater, or a combination of the two. **Figure 3-6** from the previous chapter illustrates DWR's estimate of the primary source being used around the Basin. The primary crops are grain and hay crops (primarily alfalfa) with some wild rice.

Industrial

Industrial groundwater use is limited in the BVGB. According to DWR well logs, six industrial wells have been drilled, all of them near Bieber at Big Valley Lumber, which is not currently in operation. **Figure 3-5** shows some areas of industrial use, but more use is likely present throughout the Basin as agricultural users have some associated industrial needs.

Environmental

Environmental uses for wetland and riparian botanical and wildlife habitat occur ~~primarily~~ within the ACWA in the center of the Basin, near the overflow channels adjacent to the Pit River in the southern portion of the Basin and along the riparian corridors of some of the minor streams that flow into Big Valley. Additionally, private lands throughout the Basin provide for environmental uses, including those enrolled in the CRP and WRP programs discussed in Section 3.3.

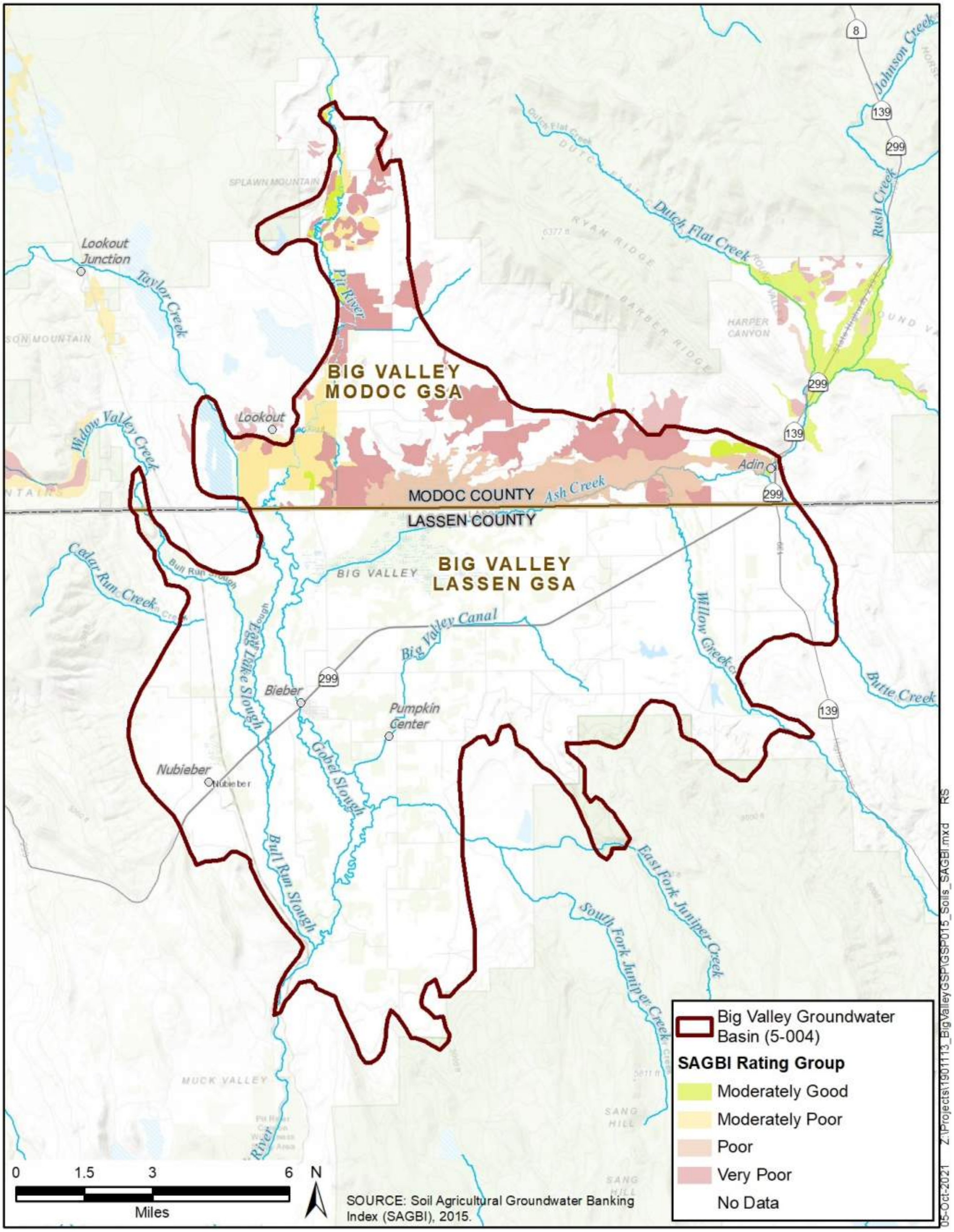


Figure 4-11 SAGBI Classifications

Municipal

The State Water Board recognizes three public water systems that use groundwater under the purview of the DDW: ~~Lassen County Waterworks District #1 (LCWWD#1)~~LCWD #1 which serves the community of Bieber, the Forest Service Station in Adin which provides groundwater to a non-community, non-transient population and the CAL FIRE conservation camp west of the Basin whose well is located within the Basin boundary.

Domestic

Domestic users include residents that use their own well for household purposes. The BVGB has a population of about 1,046. With the 312 Bieber residents receiving water from municipal supply, the majority of the remaining 734 residents are domestic users.

4.7 General Water Quality

Previous reports have characterized the water quality as excellent~~.~~ (DWR 1963, Reclamation 1979). The central area of the Basin, where naturally occurring hot springs influence the chemistry, has elevated levels of sulfate, fluoride, boron and arsenic (Reclamation 1979). These localized areas with higher mineral content occur near the major faults that traverse the valley.

Figure 4-12 shows a Piper Diagram for water samples that were collected in late 2019 and early 2020, and characterizes the relative concentrations of the major cations (Ca, Mg, Na, K) and anions (SO_4, Cl, HCO_3). The dominant cations are derived from the minerals in the aquifer and range from sodium rich to mixed with higher amounts of calcium and magnesium which increases the water hardness. The major anion is strongly bicarbonate which is derived from carbon dioxide in the atmosphere and soil zone and indicates that the water is generally young in geologic terms.

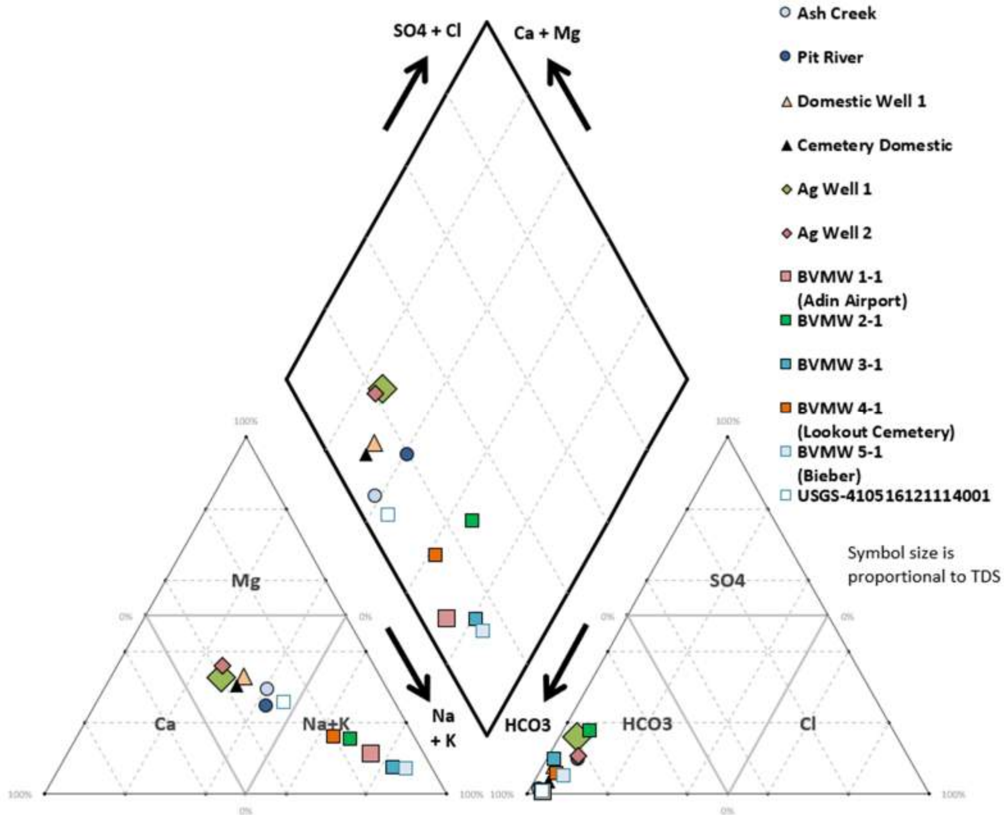


Figure 4-12 Piper Diagram showing major cations and anions

Some areas in the Basin have elevated levels of iron, manganese and/or arsenic, all of which are naturally occurring in volcanic terrains such as Big Valley. The nature and distribution of these constituents will be discussed further in Chapter 5 – Groundwater Conditions.

4.8 Groundwater Recharge and Discharge Areas

4.8.1 Recharge

Groundwater recharge in BVGB likely occurs *via* several mechanisms discussed below.

Underflow from adjacent upland areas and other areas outside the Basin

The upland areas consist of fractured basalt flows where the precipitation infiltrates vertically through joints and fractures until it reaches underlying aquifer material and then travels horizontally into the Basin. DWR has postulated that the areas shown in pink on **Figure 4-13** provide recharge in such a way. However, other areas adjacent to the Basin could provide some recharge in a similar fashion. In addition, underflow ~~could enter~~enters the Basin where the Pit River and Ash Creek enter the Basin. A Basin boundary modification is needed to encompass other important recharge areas outside the currently defined Basin boundary.

Infiltration of precipitation on the valley floor

Some direct infiltration of rain and snow on the valley floor ~~likely~~ occurs. However, because the aquifer materials in the Basin are largely lacustrine and much of the soils have slow infiltration rates, a high proportion of the precipitation likely runs off or is ~~consumed through~~

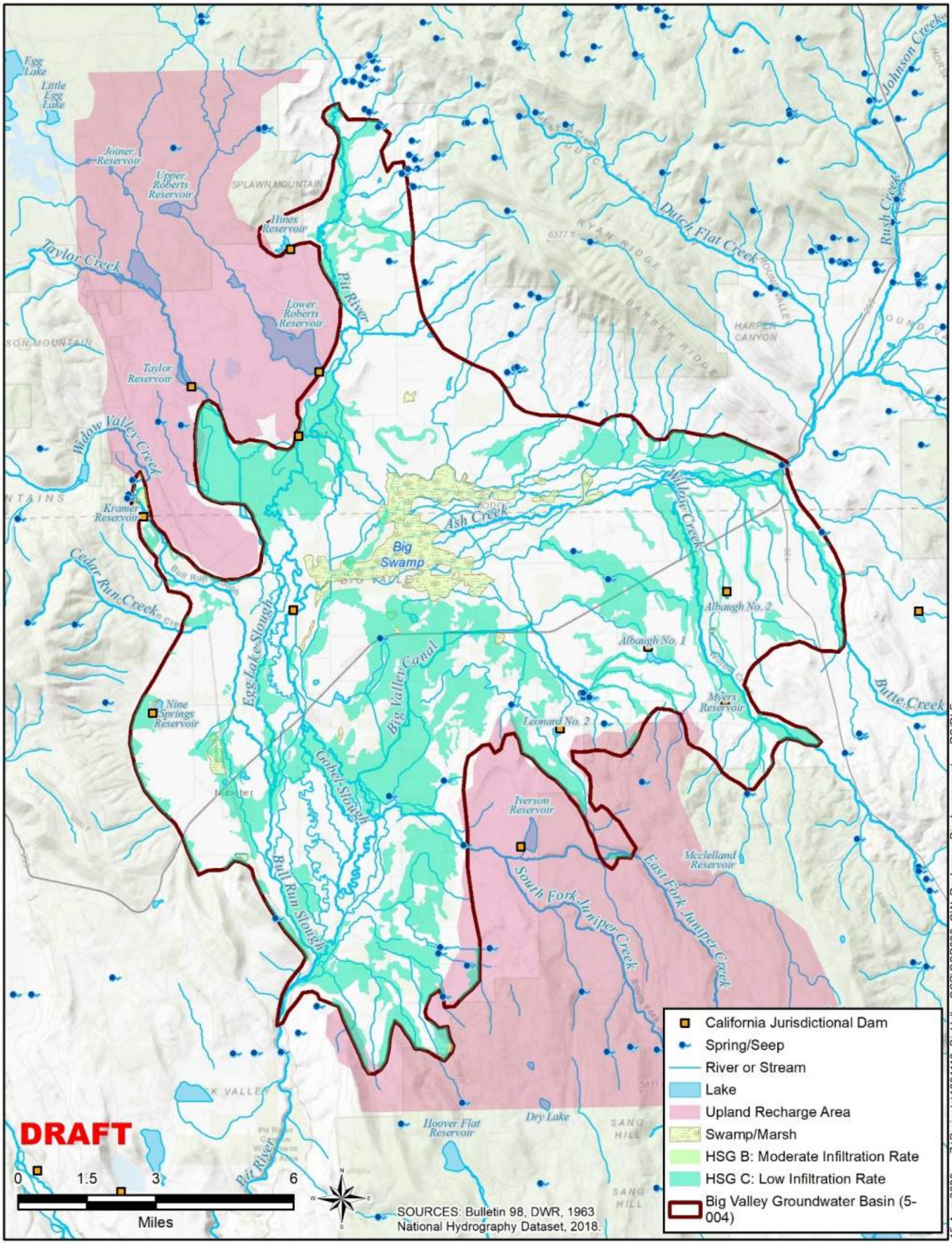
~~evapotranspiration.~~evapotranspirated. **Figure 4-13** shows the areas from the NRCS datasets that may have a slightly higher infiltration rate (HSG B and HSG C) than the other areas and therefore potentially more recharge.

Rivers and streams that flow through the Basin

Streams that flow through the Basin lose water to the aquifer, particularly where they enter the Basin. Aquifer materials are typically coarser on the fringes of the Basin where the stream gradient begins to flatten. In general, recharge likely occurs in the eastern portions of the Basin along Ash Creek, Butte Creek and Willow Creek and then flows westerly through the subsurface. As Ash Creek flows to the center of the Basin and Big Swamp, the water slows and spreads out into a large marsh. The CDFW has recently enhanced this slowing and spreading of water through "pond and plug" projects which bring the water up out of the previously incised channel. Other pond and plug projects have been successfully implemented in the region. Even though the soils and aquifer materials in this portion of the Basin have slow infiltration rates, recharge ~~still~~ is likely to occur from Big Swamp because of the long period of time that the shallow soils remain wet and saturated. Support from the public has been received at outreach meetings to conduct more pond and plug projects within and near the Basin.

Deep percolation of irrigation water

Depending on the irrigation method, particularly flood irrigation, deep percolation of irrigation water into the aquifer occurs. Flood irrigation is an active practice in the Basin and provides valuable recharge.



5649 **Figure 4-13 Recharge, Discharge and Major Surface Water Bodies**

4.8.2 Discharge

Historically, flow out of the groundwater aquifer (and out of the Basin) most likely occurred at the southern portion of the Basin where the aquifer discharged to the Pit River. DWR (1963) indicates that artesian[36] conditions occurred in this southwestern area. The gaining river[37] then transported the water out of the Basin. However, based on currently documented water levels, this area is no longer artesian and likely hasn't been a gaining stream for decades. There are numerous springs throughout the Basin shown on **Figure 4-13** where groundwater is discharged, including several hot springs in the center of the Basin. Evapotranspiration may also be a significant discharge mechanism.

4.9 Surface Water Bodies

Figure 4-14 shows the numerous small streams that enter the Basin and flow towards the center where they connect with the two major streams: Pit River and Ash Creek. The figure also shows the many small ponds and several reservoirs ~~that~~ that are in and around the perimeter of the Basin. The dams that are within the jurisdiction of ~~DWR's~~the DWR Division of Safety of Dams are shown. While many of these impoundments are located outside of Basin boundaries, they represent supplies that hydrologically flow to/through the Basin. The reservoirs provide options for the timing of release of those waters, rather than importing supplies from sources external to the Basin.

4.10 Imported Water Supplies

BVGB users do not import surface water into the Basin~~, where the~~ because all surface water used in the Basin originates in ~~a~~the watershed ~~other than the one in which~~of the Pit River or the watershed of a local BVGB ~~is located~~stream.

4.11 Data Gaps in the Hydrogeologic Conceptual Model

As discussed in the introduction, hydrogeology has inherent uncertainties due to sparse data and in the case of Big Valley, a limited number of detailed studies on the groundwater resources in the Basin. Identified below are some of the uncertainties associated with the hydrogeology in the Basin. In some instances, this uncertainty can be reduced while other uncertainties will remain. The filling of the data gaps below is contingent on the needs that arise as the GSP is developed and implemented and the level of available outside funding.

Basin Boundary

The current, inaccurate Basin boundary was drawn by DWR with a regional scale map (CGS 1958) and was not drawn with as much precision as subsequent geologic maps. Additionally, the "uplands" areas outside the Basin boundary are postulated to be recharge areas interconnected to the Basin, which is contrary to DWR's definition of a lateral Basin boundary as being, "…features that significantly impede groundwater flow" (DWR 2016c). Further refinement of the Basin boundary is desired and necessary, particularly in the areas of, "upland recharge" mapped by DWR, the fingers in the southeastern portion of the Basin and in the northeastern portion of the Basin below Barber Ridge and Fox Mountain.

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[36] Artesian aquifers are under pressure and wells screened in them flow ~~from~~at the surface.

[37] Gaining rivers are where groundwater flows toward the river and contributes to surface water flow.

Confining Conditions

Confining conditions probably exist throughout much of the Basin. Often, the confinement is simply a result of depth and the fact that horizontal hydraulic conductivities are ~~about~~ 10 times (or more) greater than vertical~~.~~ conductivities. However, in the southwest portion of the Basin, DWR (1963) ~~has~~ documented an area of ~~confining~~confined groundwater conditions. It is unknown whether ~~the~~that confinement is due to a single, coherent aquitard or is just a result of depth. It is also unknown whether the confinement is significant enough to warrant separate principal aquifers, which could have implications for the GSP. In addition, aquifer characteristics in the various areas of the Basin are not thoroughly understood as discussed in Section 4.4.5 and an assessment in needed on how aquifer characteristics vary throughout the Basin in shallow and deep portions of the aquifer.

Definable Bottom

This HCM has used the "practical" depth of 1,200 feet as the definable bottom. If stakeholders seek to develop groundwater deeper than this depth, newly constructed wells will demonstrate that the "physical bottom" and~~/or~~ the base of fresh water ("effective bottom") extend deeper.

Faults as Barriers to Flow

It is unknown if the faults which traverse the Basin are barriers to flow. On the Lassen County side of the Basin, this condition has bearing on understanding whether the eastern portions of the Basin near Willow Creek are interconnected with the southwestern portions of the Basin near Pumpkin Center. Groundwater contours indicate that there is east to west flow, but this flow is uncertain due to a mapped fault between the two areas. This uncertainty could be reduced by conducting a pumping test with observation well(s) on the other side of the fault.

Soil Permeability

The NRCS mapping of soils indicates primarily low to very low permeability soils throughout the Basin. However, there is some variation of permeabilities indicated by the maps, which are drawn at a large scale with limited field verification. Further field investigation of soils and permeability tests could help identify more permeable areas where groundwater recharge could be enhanced.

Recharge

The recharge sources below have been identified, but the rate and amount of recharge is unknown. In the water budget (*see* Chapter 6 – Water Budget), the amount of recharge is roughly estimated. Below are the data gaps related to recharge.

- Effect of Ash Creek on recharge (including Big Swamp)
- Effect of Pit River on recharge (including overflow channels)
- Effect of smaller streams on recharge (including Willow Creek)
- Amount of recharge from direct precipitation
- Amount of recharge from deep percolation of applied water
- Amount of recharge from upland recharge areas
- Amount of recharge from seepage of ditches, canals and reservoirs

5. Groundwater Conditions §354.16

This chapter presents available information on groundwater conditions for the BVGB developed by GEI for the Lassen County and Modoc County GSAs. This chapter provides some of the information needed for the development of the monitoring network and the sustainable management criteria of this GSP. The content of this chapter is defined by the regulations of SGMA (Chapter 1.5, Article 5, Subarticle 2: 354.16). GEI ~~Certified Hydrogeologists~~Professional Geologists provided the content of this chapter and will affix their professional stamps (as required by the regulations) certifying that it was developed under their supervision once the chapter is finalized into the GSP.

5.1 Groundwater Elevations

Historic groundwater elevations are available from a total of 22 wells in Big Valley, six located in Modoc County and 16 in Lassen County as shown on **Figure 5-1** and listed in **Table 5-1**. Twenty of the wells are part of Lassen and Modoc counties' monitoring network, which was approved by the counties in 2011, in compliance with the CASGEM program. DWR staff measure water levels in these wells twice annually (spring and fall) on behalf of the counties. Some measurements from wells are missing, which is typically a result of access issues to the wells sites or occasionally a well owner who has removed their well from the monitoring program. These wells may or may not be used as part of the GSP monitoring network, which will be addressed in Chapter 8 – Monitoring Networks.

The first water level measurements in the BVGB began in the late 1950s at two wells near Bieber (17K1) and Nubieber (32A2). Regular monitoring of these two wells began in the mid-1960s and monitoring began in most of the other wells during the late 1970s or early 1980s. Three wells located on the ACWA were added to the CASGEM networks in 2016. Of the 22 historically monitored wells, one well (12G1) has not been monitored since 1992 and one well (06C1) has no measurements since 2015. Construction details are not available for one well (32R1) and could benefit from a 'downhole' video inspection of the well casing to determine the depth interval associated with the water levels.

In addition to these 22 wells, five well clusters were constructed in late 2019 and early 2020 to support the GSP. Their locations are also shown on **Figure 5-1**. Each cluster consists of a deep well (200-500 feet) and three shallow wells (60-100 feet). These wells were drilled to explore the geology, with the deep well giving water level information for the main portion of the aquifer at that location. The three shallow wells are screened shallow to determine the direction and magnitude of flow in the shallow subsurface and potentially to give an indication if groundwater interacts with surface water and possibly the location of groundwater recharge. Limited water level information is available from these five clusters.

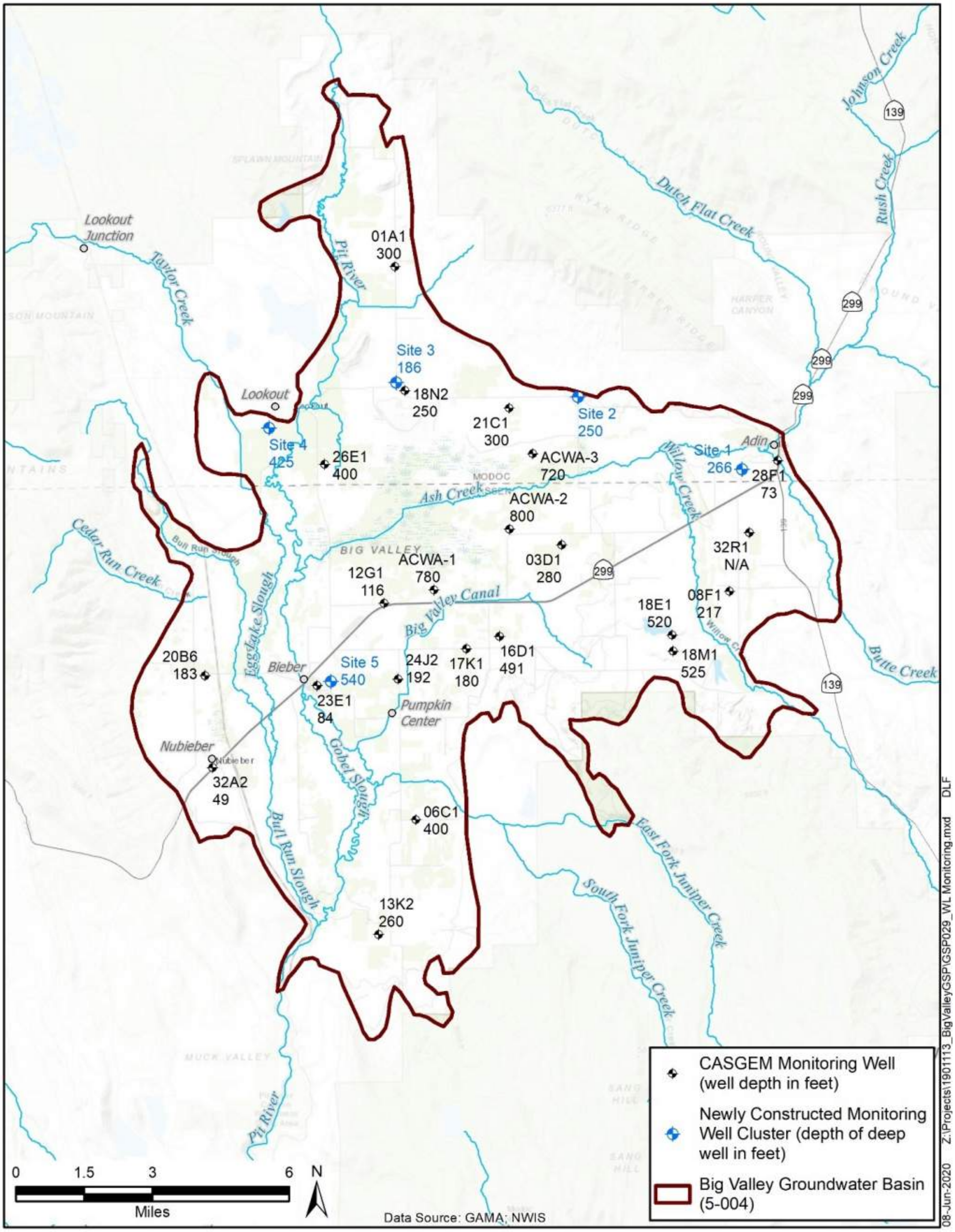


Figure 5-1 Water Level Monitoring

Table 5-1 Historic Water Level Monitoring Wells

Well Name	State Well Number	CASGEM ID	County	Well Use	Well Depth (feet bgs)	Ground Elevation (feet msl)	Reference Point Elevation (feet msl)	Period of Record Start Year	Period of Record End Year	Number of Measure-ments	Minimum Groundwater Elevation (feet msl)	Maximum Groundwater Elevation (feet msl)
18E1	38N09E18E001M	411356N1209900W001	Lassen	Irrigation	520	4248.40	4249.50	1981	2019	73	4198.20	4234.10
23E1	38N07E23E001M	411207N1211395W001	Lassen	Residential	84	4123.40	4123.40	1979	2020	81	4070.40	4109.10
260	39N07E26E001M	411911N1211354W001	Modoc	Irrigation	400	4133.40	4135.00	1979	2020	79	4088.90	4131.30
01A1	39N07E01A001M	412539N1211050W001	Modoc	Stockwatering	300	4183.40	4184.40	1979	2020	81	4035.40	4163.90
03D1	38N08E03D001M	411647N1210358W001	Lassen	Irrigation	280	4163.40	4163.40	1982	2020	71	4076.60	4148.60
06C1	37N08E06C001M	410777N1210986W001	Lassen	Irrigation	400	4133.40	4133.90	1982	2016	69	4066.20	4126.80
08F1	38N09E08F001M	411493N1209656W001	Lassen	Other	217	4253.40	4255.40	1979	2020	83	4167.90	4229.50
12G1	38N07E12G001M	411467N1211110W001	Lassen	Residential	116	4143.38	4144.38	1979	1993	28	4130.98	4138.68
13K2	37N07E13K002M	410413N1211147W001	Lassen	Irrigation	260	4127.40	4127.90	1982	2018	70	4061.90	4109.70
16D1	38N08E16D001M	411359N1210625W001	Lassen	Irrigation	491	4171.40	4171.60	1982	2020	74	4078.73	4162.40
17K1	38N08E17K001M	411320N1210766W001	Lassen	Residential	180	4153.30	4154.30	1957	2020	146	4115.08	4150.00
18M1	38N09E18M001M	411305N1209896W001	Lassen	Irrigation	525	4288.40	4288.90	1981	2020	74	4192.30	4232.70
18N2	39N08E18N002M	412144N1211013W001	Modoc	Residential	250	4163.40	4164.40	1979	2020	80	4136.60	4160.20
20B6	38N07E20B006M	411242N1211866W001	Lassen	Residential	183	4126.30	4127.30	1979	2019	80	4076.94	4116.60
21C1	39N08E21C001M	412086N1210574W001	Modoc	Irrigation	300	4161.40	4161.70	1979	2020	79	4082.10	4148.50
24J2	38N07E24J002M	411228N1211054W001	Lassen	Irrigation	192	4138.40	4139.40	1979	2019	77	4056.70	4137.70
28F1	39N09E28F001M	411907N1209447W001	Modoc	Residential	73	4206.60	4207.10	1982	2020	76	4194.57	4202.10
32A2	38N07E32A002M	410950N1211839W001	Lassen	Other	49	4118.80	4119.50	1959	2020	133	4106.70	4118.80
32R1	39N09E32R001M	411649N1209569W001	Lassen	Irrigation	unknown	4243.40	4243.60	1981	2020	64	4161.20	4205.50
ACWA-1	38N08E07A001M	411508N1210900W001	Lassen	Irrigation	780	4142.00	4142.75	2016	2020	8	4039.15	4126.35
ACWA-2	39N08E33P002M	411699N1210579W001	Lassen	Irrigation	800	4153.00	4153.20	2016	2020	8	4126.40	4139.35
ACWA-3	39N08E28A001M	411938N1210478W001	Modoc	Irrigation	720	4159.00	4159.83	2016	2020	7	4136.23	4150.58

Notes:
bgs = below ground surface
msl = above mean sea level
source: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

5.1.1 Groundwater Level Trends

Figure 5-2 and **Figure 5-3** show hydrographs for the two wells with the longest monitoring records along with background colors representing the Water Year (WY) type: wet, below normal, above normal, dry and critical dry. These WY types are developed from the Sacramento River Index (SRI), which is calculated from annual runoff of the Sacramento River Watershed, of which the Pit River is a tributary. The SRI (no units) ~~varies~~has varied between 3.1 and 15.3 (average: 8.1) over its 115-year history (1906-2020) and ~~are~~is divided into the five WY categories. For 1983 to 2018, the average SRI is 7.9.

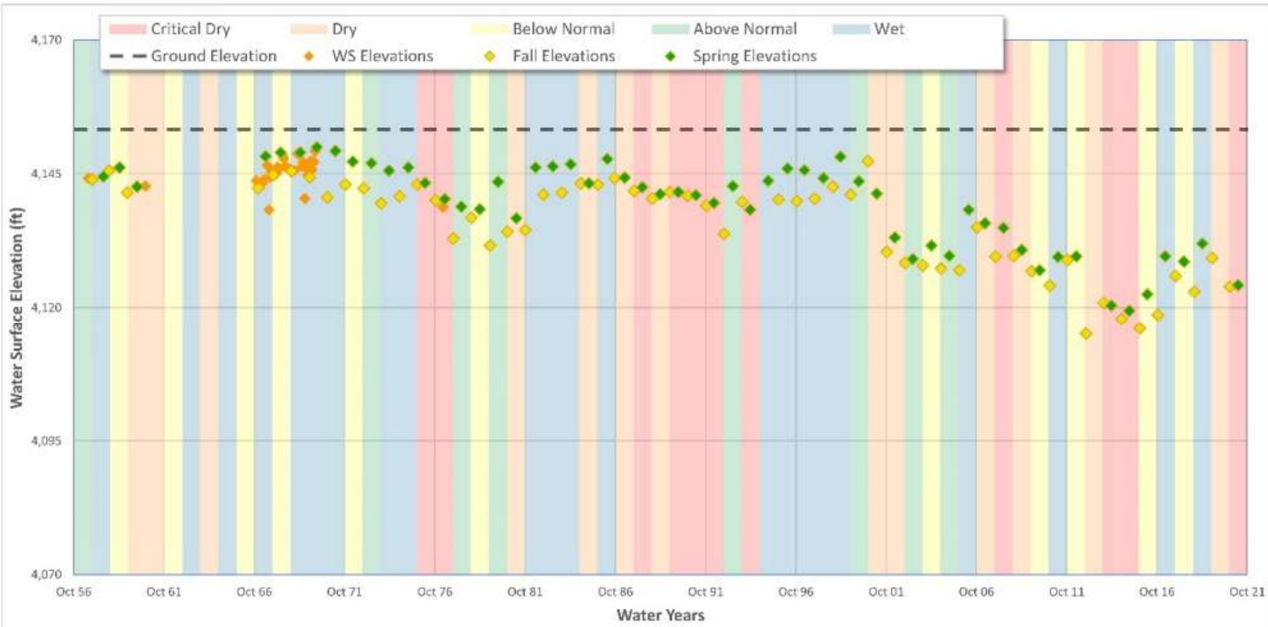


Figure 5-2 Hydrograph of Well 17K1

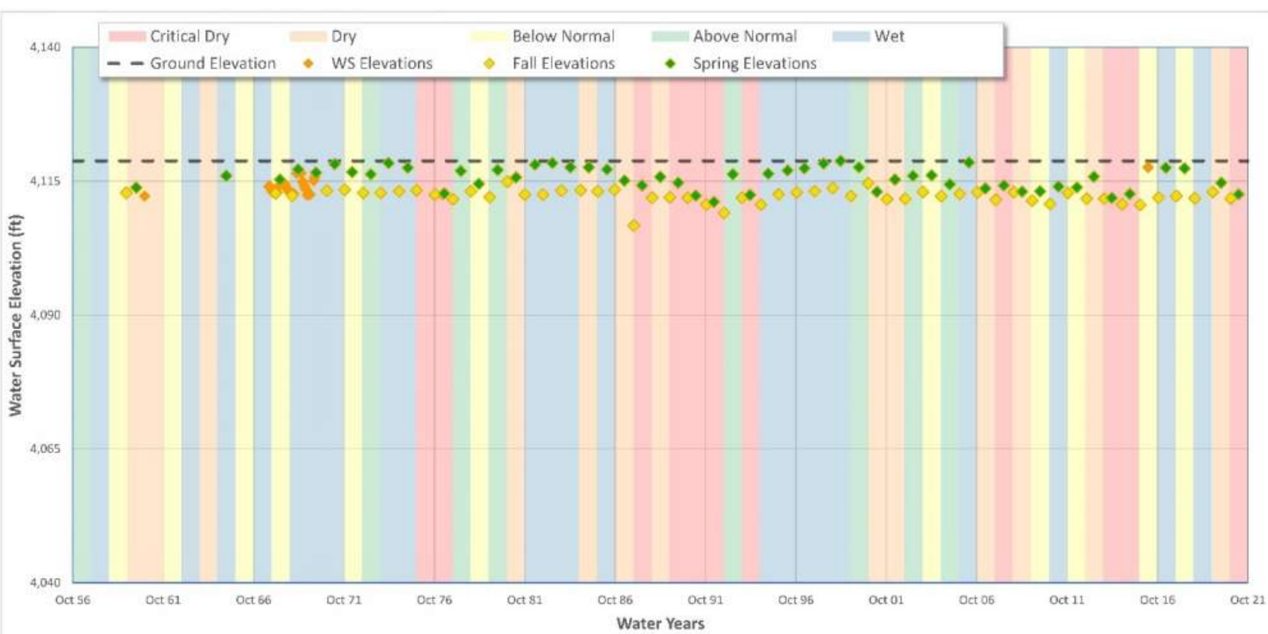


Figure 5-3 Hydrograph of Well 32A2

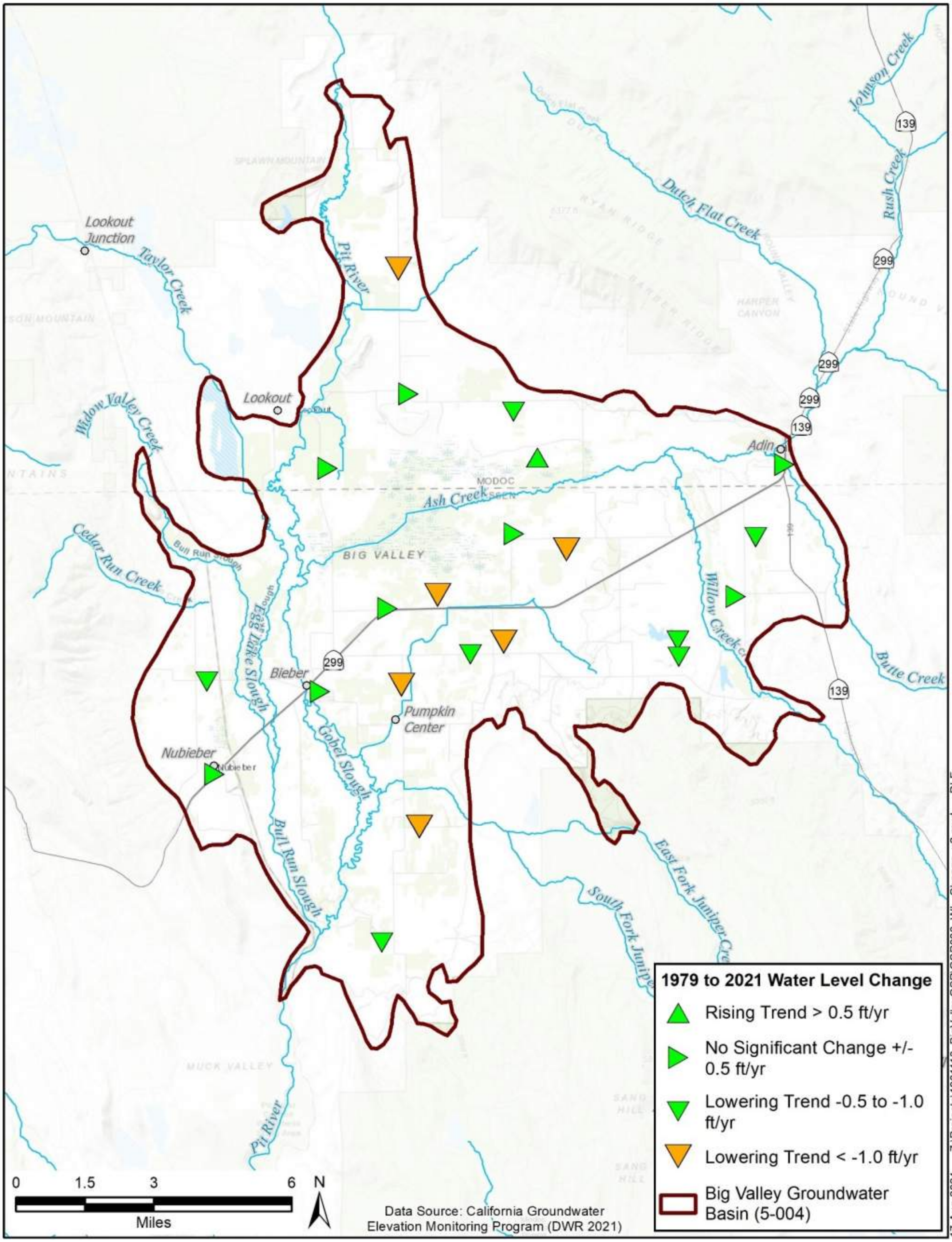
The water level record for these two wells illustrates that some areas of the Basin have experienced little to no change in water levels, while other areas have fluctuated~~.~~ and declined during the last 20 years. Declines during the drought period of the late 1980s and early 1990s were offset by recovery during the wet period of the late 1990s. Water levels in some wells have declined during the sustained dry period that has occurred since 2000. Hydrographs for all 22 wells are presented in **Appendix 5A**. On each of these hydrograph~~ in the appendix,~~ an orange trend line is shown, which is determined from a ~~linear regression~~line of best fit for the spring water level measurements between WY 1979 and 2021. The average water level change during that period, in feet per year, is also shown. Sixteen wells show relatively stable (less than -1.0 foot per year [ft/yr] of decline) or rising water levels and six wells show declining water from -1.0 ft/yr to -3.1 ft/yr. ~~These~~The locations of these water level changes are shown graphically on **Figure 5-4** with the stable or rising water levels shown in green and areas with declines in excess of -1.0 ft/yr in orange.

5.1.2 Vertical Groundwater Gradients

Vertical hydraulic gradients are apparent when groundwater levels in wells screened deep in the aquifer differ from water levels measured shallow in the aquifer at the same general location. ~~Vertical~~Significant vertical gradients can indicate that the deep portion of the aquifer is separate from the shallow (e.g., by a very low permeability clay layer) and/or that pumping in one of the aquifers has occurred and the vertical flow between the aquifers is in progress of stabilizing. Chapter 4 – Hydrogeologic Conceptual Model defines a single principal aquifer in the BVGB~~; therefore, there is no vertical gradient that needs to be described between principal aquifers.~~. However, vertical gradients likely exist, and the five recently constructed well clusters will have data to describe these gradients once sufficient water level data ~~is~~are available from those wells. The locations of the clusters are shown on **Figure 5-1**.

5.1.3 Groundwater Contours

Spring and fall 2018 water level measurements from the 21 active CASGEM wells were used to illustrate current groundwater conditions. The 2018 data was used to illustrate current conditions because there were several wells without data for 2019 or 2020. **Figure 5-5** and **Figure 5-6** show the 2018 seasonal high and seasonal low groundwater elevation contours, respectively~~.~~, which were interpolated from the locations of the 21 active wells. Each contour line shows equal groundwater elevation. Groundwater flows from higher elevations to lower elevations, perpendicular to the contour lines. The direction of flow is emphasized on the figures in certain areas with arrows. In general, groundwater is highest in the east, where Ash, Willow and Butte creeks enter the Basin. The general flow of water is to the west and south. The contours do indicate, however, northerly flow from the lower reaches of Ash Creek. In the southern portions of the BVGB, groundwater flows toward the east.



5804
5805 **Figure 5-4 Average Water Level Change Since 2000 Using Spring Measurements**

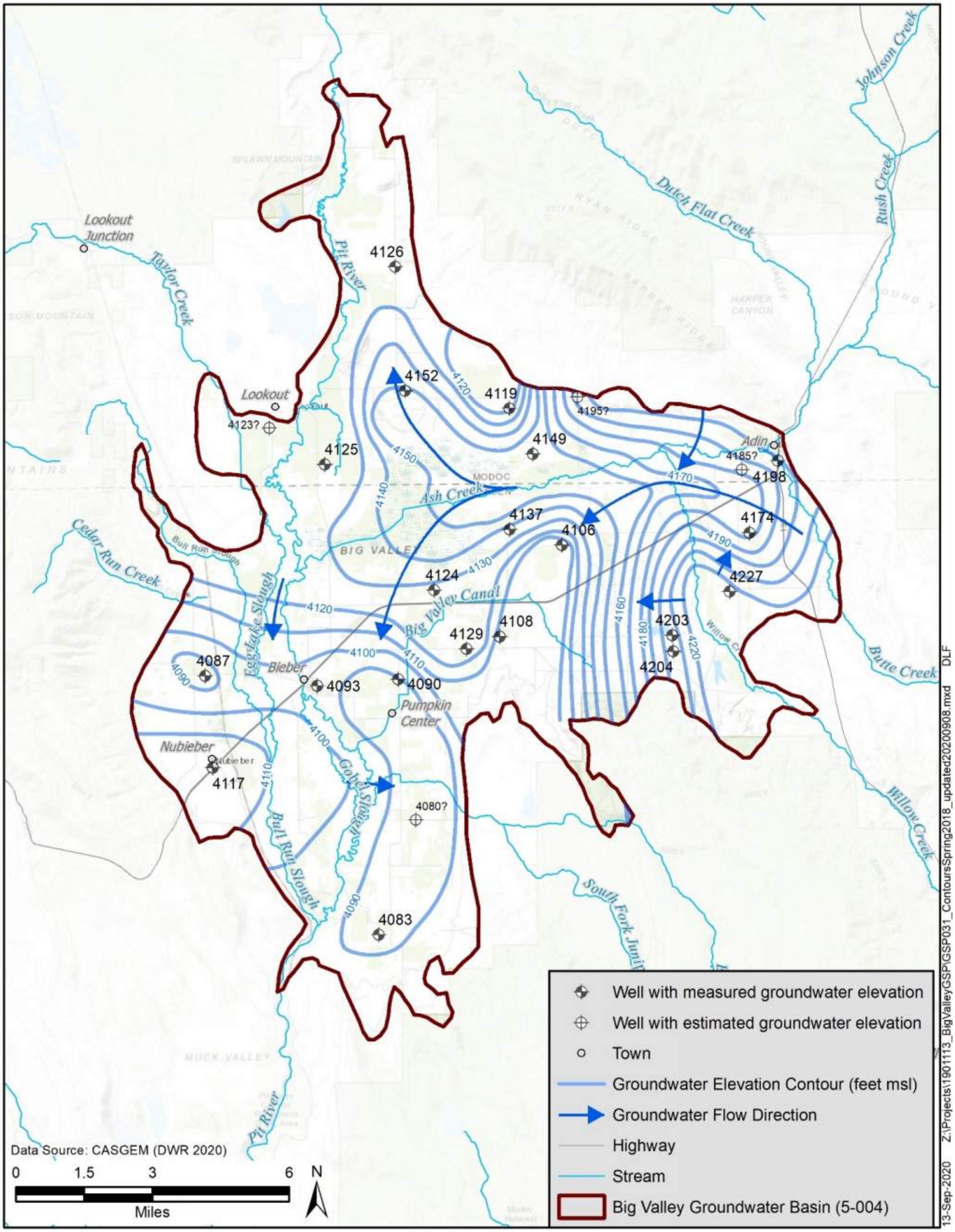


Figure 5-5 Groundwater Elevation Contours and Flow Direction Spring 2018

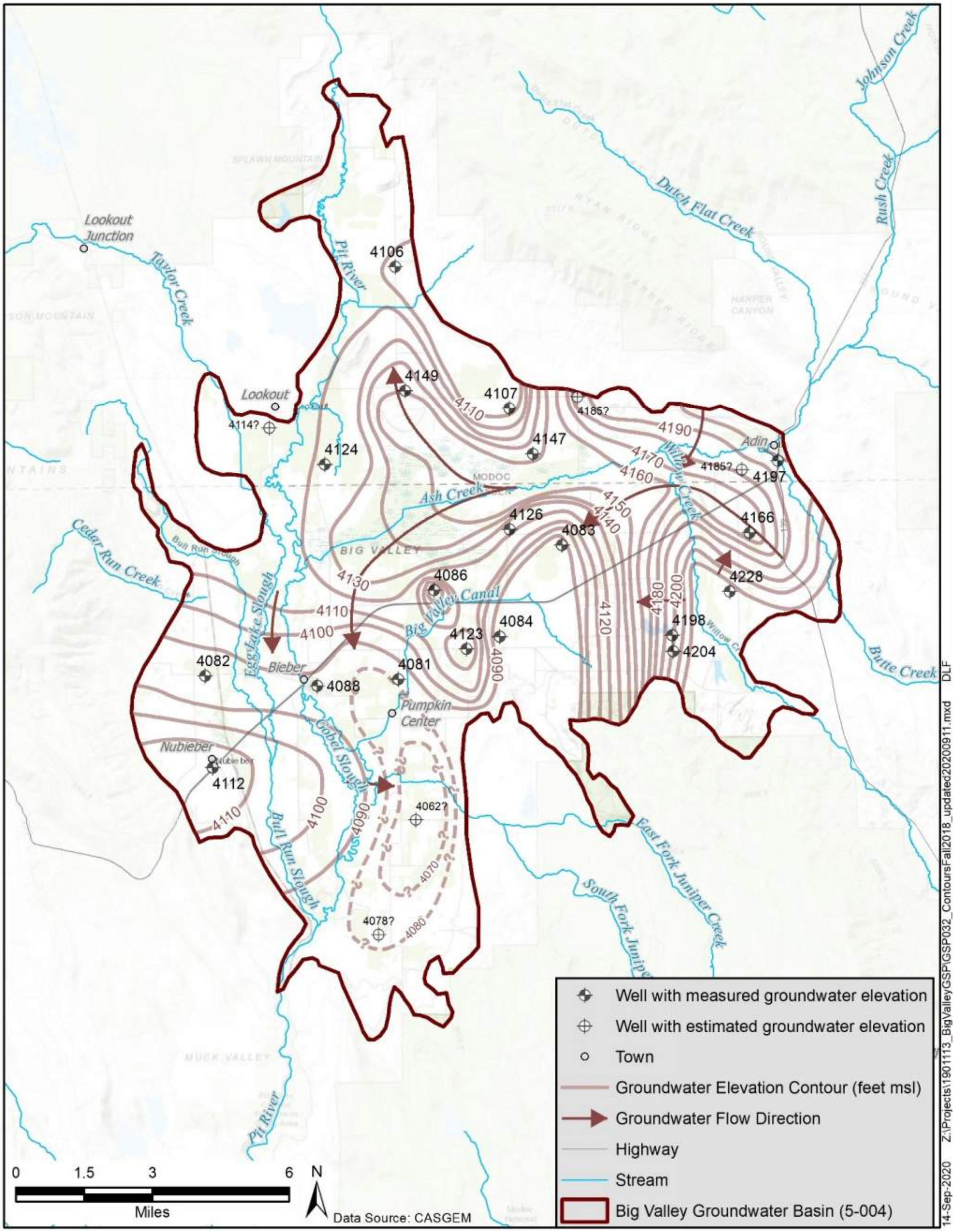


Figure 5-6 Groundwater Elevation Contours and Flow Direction Fall 2018

5.2 Change in Storage

To determine the annual and seasonal change in groundwater storage, groundwater elevation contoured surfaces[38] were developed for spring and fall for each year between 1983 and 2018. These surfaces are included in **Appendix 5B**. The amount of groundwater in storage for each set of contours was calculated~~. This calculation was performed~~ using software which can subtract the groundwater elevation surface from the ground elevation surface (using a digital elevation model) at each ~~raster~~grid cell (pixel) and calculate the average depth to water (DTW) ~~throughout~~for the entire Basin. This average DTW was then subtracted from the ~~definable~~practical bottom of the Basin (1,200 feet), multiplied by the area of the Basin and multiplied by 5 percent, which is used as the specific yield[39].

Table 5-2 shows, from 1983 to 2018, the total ~~water~~groundwater in storage~~, the change in storage from the previous~~ for each year and the cumulative change in storage. The highest SRI occurred in 1983 and the fourth lowest SRI occurred in 2015. Moreover, this 36-year period also include five of the lowest ten SRIs and five of the highest ten SRIs, which demonstrates the high degree of variability in climatic conditions.

Figure 5-7 shows this information graphically, along with the annual precipitation from the McArthur station. This graph shows that groundwater storage generally declines during dry years and stays stable or increases during normal or wet years. During the early portion of the 36-year period~~ from 1983 to 2000~~, groundwater levels dipped, then recovered to 1983 conditions by 1999 due to six consecutive years of above average precipitation. Since 2000, groundwater storage has generally declined by about 96,000 acre-feet (AF) (using spring measurements) which is a slight increase from the historic low of about 116,000 AF in spring 2015. ~~During this same period (2000-2015), precipitation has gone through an average cycle of wet and dry years.~~

Annual groundwater use is not shown on **Figure 5-7** as required by SGMA regulations. Groundwater use will be addressed in Chapter 6 – Water Budget.

5.3 Seawater Intrusion

The BVGB is not located near the ocean, and therefore seawater intrusion is not applicable to this GSP.

5.4 Groundwater Quality Conditions

As noted in Chapter 4, previous~~,~~ reports have characterized the water quality in the BVGB as excellent (DWR 1963, Reclamation 1979). Groundwater is generally suitable for all beneficial uses and only localized contamination plumes have been identified in the BVGB. This section presents an analysis of

[38] Groundwater elevation surfaces are developed using a kriging mathematically method and the known groundwater elevations at wells throughout the Basin~~ and using kriging.~~. Kriging~~ is a mathematical method that~~ predicts (interpolates) what groundwater levels are between known points. The kriging surface consists of a grid (pixels) covering the entire basin that has interpolated groundwater elevation values for each node of the grid~~ cell~~.

[39] The fraction of the aquifer material that contains recoverable water. ~~This~~Specific yield is described in more detail in Chapter 4 – Hydrologic Conceptual Model.

recent groundwater quality conditions and the distribution of known groundwater contamination sites in compliance with GSP Regulation §354.16(d).

Table 5-2 Change in Storage 1983-2018

Year	Average Spring Depth to Water[1] (feet)	Spring Storage[2] (Acre-feet)	Spring Cumulative Change in Storage[3] (Acre-feet)
1983	29.3	5,390,192	-
1984	29.4	5,389,508	(684)
1985	31.4	5,380,526	(9,666)
1986	31.0	5,382,539	(7,653)
1987	32.6	5,375,135	(15,057)
1988	34.9	5,364,459	(25,733)
1989	35.2	5,363,150	(27,042)
1990	35.6	5,360,976	(29,216)
1991	36.8	5,355,677	(34,515)
1992	38.0	5,350,297	(39,895)
1993	36.9	5,355,293	(34,899)
1994	37.5	5,352,221	(37,971)
1995	35.3	5,362,737	(27,456)
1996	32.4	5,375,861	(14,332)
1997	31.8	5,378,600	(11,592)
1998	31.1	5,382,014	(8,179)
1999	29.5	5,389,070	(1,122)
2000	32.3	5,376,287	(13,905)
2001	38.0	5,350,015	(40,177)
2002	39.3	5,344,357	(45,835)
2003	39.4	5,343,881	(46,311)
2004	39.2	5,344,515	(45,677)
2005	41.5	5,334,164	(56,028)
2006	36.7	5,356,175	(34,017)
2007	38.8	5,346,641	(43,551)
2008	41.6	5,333,712	(56,480)
2009	42.5	5,329,337	(60,856)
2010	46.4	5,311,440	(78,752)
2011	45.9	5,313,710	(76,482)
2012	44.9	5,318,299	(71,893)
2013	49.3	5,298,013	(92,179)
2014	51.7	5,287,059	(103,133)
2015	54.4	5,274,644	(115,548)
2016	51.3	5,288,702	(101,490)
2017	49.7	5,296,127	(94,066)
2018	50.1	5,294,464	(95,728)

Note: Parentheses indicate negative numbers

[1] From water surface elevation contours - Appendix 5A

[2] Calculated from average depth to water, area of basin, 1,200 foot aquifer bottom, and specific yield of 5%

[3] This is the total change in storage since the baseline, defined as Spring 1983.

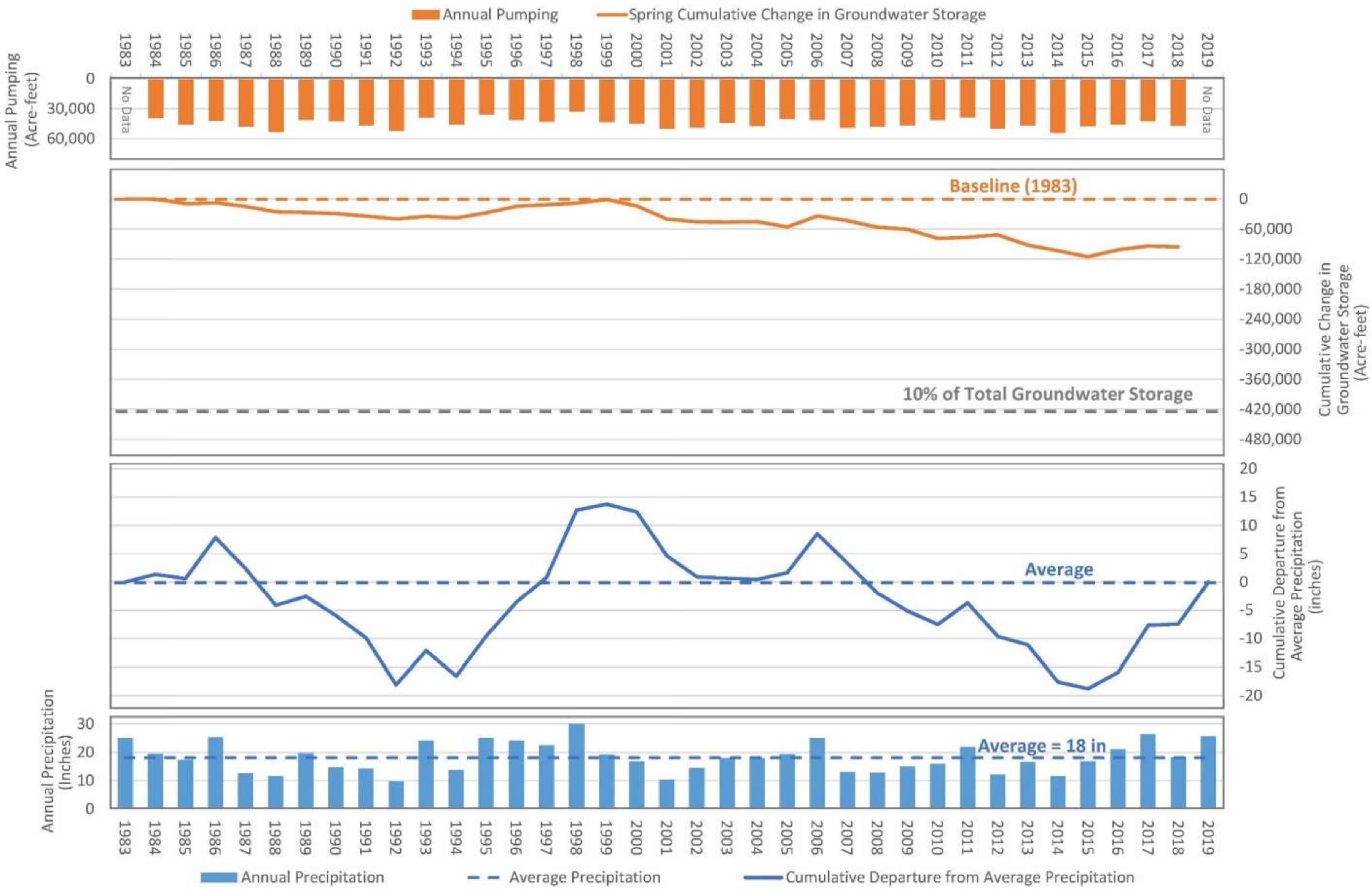


Figure 5-7 Precipitation, Pumping and Change in Groundwater Storage

5.4.1 Naturally Occurring Constituents

The concentration of naturally occurring constituents varies throughout the BVGB. Previous reports have noted the potential elevated concentrations of arsenic, boron, fluoride, iron, manganese and sulfate. (DWR 1963, Reclamation 1979) All of these constituents are naturally occurring and in these historic reports, they indicate that most of these constituents are associated with localized thermal waters found near hot springs in the center of the Basin.

More recent conditions were analyzed using a statistical approach ~~using data~~on available data from the ~~state's~~ GAMA Groundwater Information System [GAMA GIS] (State Water Board 2020a). The GAMA GIS data provides the most comprehensive, readily available water quality dataset and contains results from numerous programs, including:

- Division of Drinking Water (public supply systems)
- Department of Pesticide Regulation
- Department of Water Resources (historic ambient monitoring)
- Environmental Monitoring Wells (regulated facilities and cleanup sites)
- U.S. Geological Survey (USGS) GAMA program
- USGS National Water Information System data

Water quality results in these datasets go back to the 1950s. Because conditions can change as groundwater is used over time, data prior to the WY 1983 were eliminated from the statistical analysis of the data. WY 1983 was chosen because the bulk of the historic water level wells (**Figure 5-1**) came online by 1983. ~~In addition, data~~Data from the Environmental Monitoring Wells programs were also eliminated since water quality issues associated with these regulated sites are typically highly localized, often are associated with isolated, perched groundwater and are already regulated. The nature and location of groundwater contamination sites are discussed in Section 5.4.2. – Groundwater Contamination Sites and Plumes.

Table 5-3 shows the statistical evaluation of the filtered GAMA water quality data along with the water quality results obtained from the five well clusters constructed to support the GSP. The constituents selected to assess the suitability in the Basin are based on thresholds for different beneficial uses. For domestic and municipal uses, the inorganic constituents that are regulated under state drinking water standards are shown. Boron and sodium are also shown because elevated concentrations can affect the suitability of the water for agricultural uses. The suitability threshold concentration for each constituent is shown, using either the MCL or agricultural threshold, whichever was lower. Iron and manganese were evaluated for both drinking water and agricultural thresholds. It is assumed that water suitable for domestic, municipal and agricultural purposes would also be suitable for environmental and industrial beneficial uses.

Table 5-3 Water Quality Statistics

Constituent Name	Suitability Threshold Concentration	Suitability Threshold Type	Total # of Meas	min	max	# Meas Above Threshold	% of Meas Above Threshold	# Wells With Meas	# Wells with Average Above Threshold	% of Wells with Average Above Threshold	# Wells with Most Recent Meas Above Threshold	% of Wells with Most Recent Meas Above Threshold	Comment
Aluminum	200	DW1	41	0	552	2	5%	18	1	6%	0	0%	Low concern due to only two threshold exceedances and zero recent measurements above MCL
Antimony	6	DW1	45	0	36	1	2%	20	1	5%	0	0%	Low concern due to only one threshold exceedance and zero recent measurements above MCL
Arsenic	10	DW1	53	0	12	4	8%	23	3	13%	3	13%	
Barium	1000	DW1	49	0	600	0	0%	23	0	0%	0	0%	
Beryllium	4	DW1	48	0	1	0	0%	23	0	0%	0	0%	
Cadmium	5	DW1	49	0	1	0	0%	23	0	0%	0	0%	
Chromium (Total)	50	DW1	36	0	20	0	0%	13	0	0%	0	0%	
Chromium (Hexavalent)	10	DW1*	13	0.05	3.29	0	0%	13	0	0%	0	0%	
Copper	1300	DW1	34	0	190	0	0%	21	0	0%	0	0%	
Fluoride	2000	DW1	42	0	500	0	0%	16	0	0%	0	0%	
Lead	15	DW1	28	0	6.2	0	0%	16	0	0%	0	0%	
Mercury	2	DW1	44	0	1	0	0%	19	0	0%	0	0%	
Nickel	100	DW1	46	0	10	0	0%	20	0	0%	0	0%	
Nitrate (as N)	10000	DW1	151	0	4610	0	0%	24	0	0%	0	0%	
Nitrite	1000	DW1	62	0	930	0	0%	20	0	0%	0	0%	
Nitrate + Nitrite (as N)	10000	DW1	2	40	2250	0	0%	2	0	0%	0	0%	
Selenium	50	DW1	49	0	5	0	0%	23	0	0%	0	0%	
Thallium	2	DW1	46	0	1	0	0%	20	0	0%	0	0%	
Chloride	250000	DW2	66	1400	79000	0	0%	43	0	0%	0	0%	
Iron	300	DW2	50	0	11900	26	52%	21	8	38%	9	43%	Low human health concern due to being a secondary MCL for aesthetics
Iron	5000	AG	50	0	11900	2	4%	21	2	10%	2	10%	
Manganese	50	DW2	45	0	807	28	62%	21	12	57%	11	52%	Low human health concern due to being a secondary MCL for aesthetics
Manganese	200	AG	45	0	807	22	49%	21	7	33%	7	33%	
Silver	100	DW2	36	0	20	0	0%	19	0	0%	0	0%	
Specific Conductance	900	DW2	66	125	1220	3	5%	42	1	2%	1	2%	
Sulfate	250000	DW2	60	500	1143000	1	2%	40	0	0%	0	0%	Low concern due to only one threshold exceedance and zero recent measurements above MCL
Total Dissolved Solids (TDS)	500000	DW2	57	131000	492000	0	0%	39	0	0%	0	0%	
Zinc	5000	DW2	34	0	500	0	0%	20	0	0%	0	0%	
Boron	700	AG	40	0	100	0	0%	34	0	0%	0	0%	
Sodium	69000	AG	33	11600	69000	0	0%	21	0	0%	0	0%	

Sources:

GAMA Groundwater Information System, accessed June 5, 2020 (SWRCB 2020)

University of California Cooperative Extension Farm Advisor (UCCE 2020)

Notes:

GAMA data was filtered to remove all measurements before Oct 1, 1982 and all GeoTracker cleanup sites

Constituents listed are all inorganic naturally occurring elements and compounds that have a SWRCB drinking water maximum contaminant limit (MCL), plus Boron, which has a threshold for agricultural use.

All measurements in micrograms per liter, except specific conductance which is measured in microsiemens per centimeter.

Green indicates less than 1%

Yellow indicates between 1% and 10%

Red indicates greater than 10%

Threshold Types:

DW1: Primary drinking water MCL

DW2: Secondary drinking water MCL (for aesthetics such as taste, color, and odor)

AG: Agricultural threshold based on guidelines by the Food and Agricultural Organization of the United Nations (Ayers and Westcot 1985)

* Hexavalent chromium was regulated under a primary drinking water MCL until the MCL was invalidated in 2017. The SWRCB is working to re-establish the MCL.

The subset of water quality data was analyzed to determine which constituents to investigate further. **Table 5-3** shows that most constituents have not had concentrations measured above their corresponding threshold since 1983 and were not investigated further. Sulfate, aluminum and antimony only had one or two detections above their threshold, and none of these values were recent so these constituents were not investigated further. Arsenic (As), iron (Fe), manganese (Mn), specific conductance (SC) and total dissolved solids (TDS) were investigated further. All of these constituents are naturally occurring.

Arsenic, Iron and Manganese

As, Fe, and Mn show elevated concentrations in over 10 percent of the wells. Although iron and manganese are regulated under secondary drinking water standards (for aesthetics such as color, taste, and odor) and are not of concern for human health as drinking water, these constituents were still chosen for further investigation because they also have multiple detections above the agricultural suitability threshold. (Ayers and Westcot 1985). **Figure 5-8** through **Figure 5-10** show the trends over time. Wells with single measurements are shown as dots, where wells that had multiple measurements shown as lines. These figures indicate that the number of wells with highly elevated concentrations of arsenic and manganese concentrations may have decreased over the last 40 years of groundwater use. Iron concentrations are generally below the agricultural suitability threshold (Ayers and Westcot, 1985), with two recent elevated measurements from the monitoring wells constructed in support of the GSP.

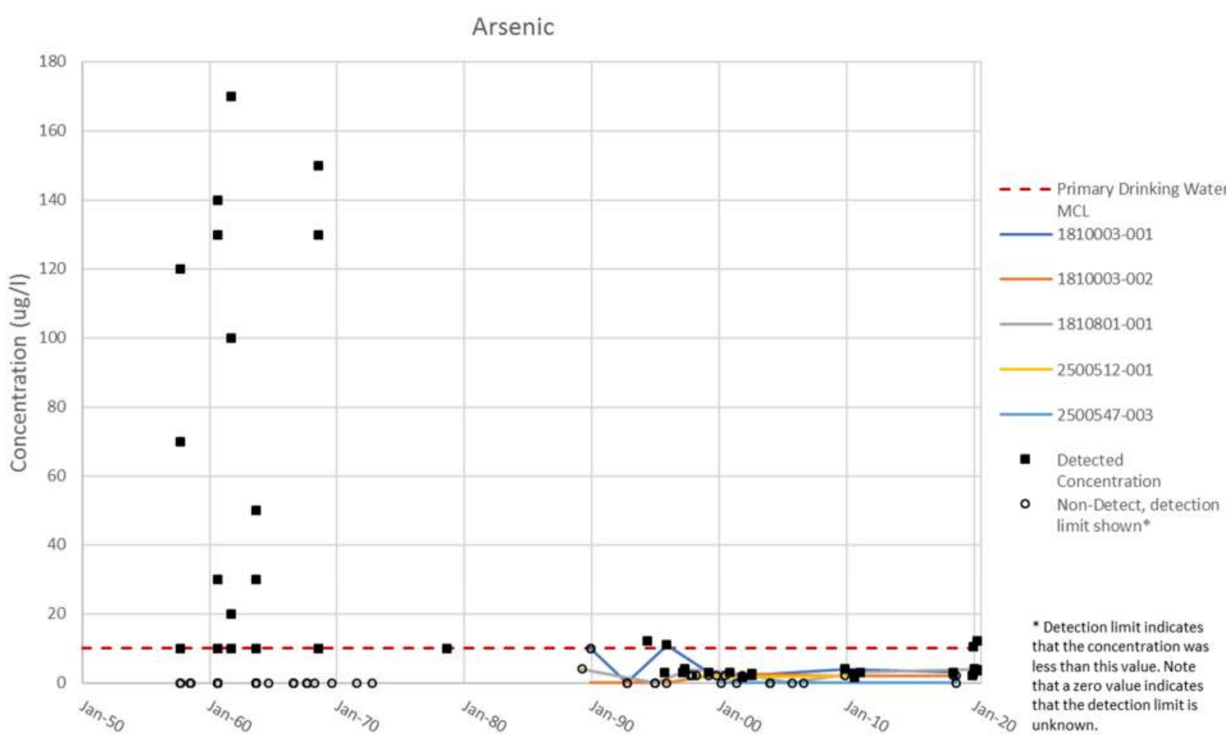


Figure 5-8 Arsenic Trends

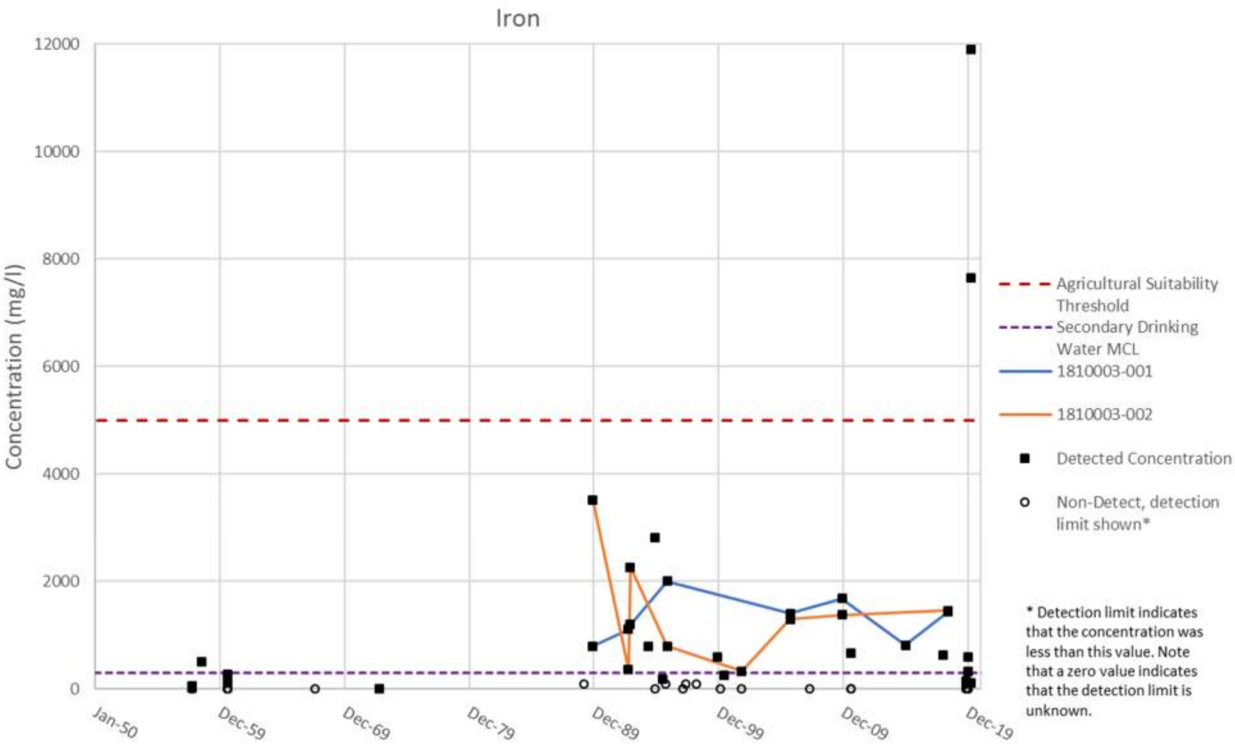


Figure 5-9 Iron Trends

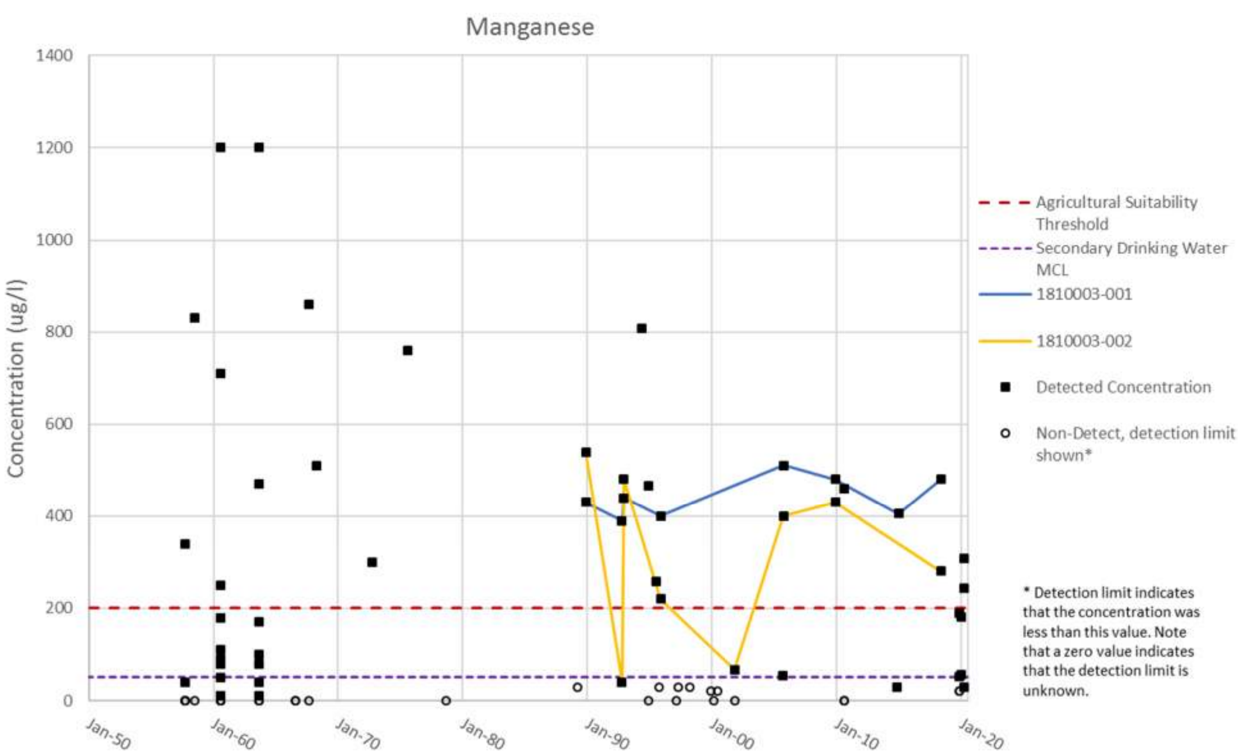


Figure 5-10 Manganese Trends

Specific Conductance and Total Dissolved Solids

SC is a measure of the water's ability to conduct electricity. TDS is a measure of the total amount of dissolved materials (i.e., salts) in water. SC and TDS are related to one another (higher TDS results in higher SC) and SC is often used as a proxy for TDS. Although there was only one recent measurement over the MCL for SC, both SC and TDS were investigated further because they are important indicators of general water quality conditions.

Figure 5-11 and **Figure 5-12** show the trends over time. Wells with single measurements are shown as dots, where wells that had multiple measurements shown as lines. These figures indicate that the number of wells with highly elevated concentrations of SC and TDS may have decreased over the last 40 years. **Figure 5-13** and **Figure 5-14** show the distribution of elevated levels of SC and TDS around the Basin.

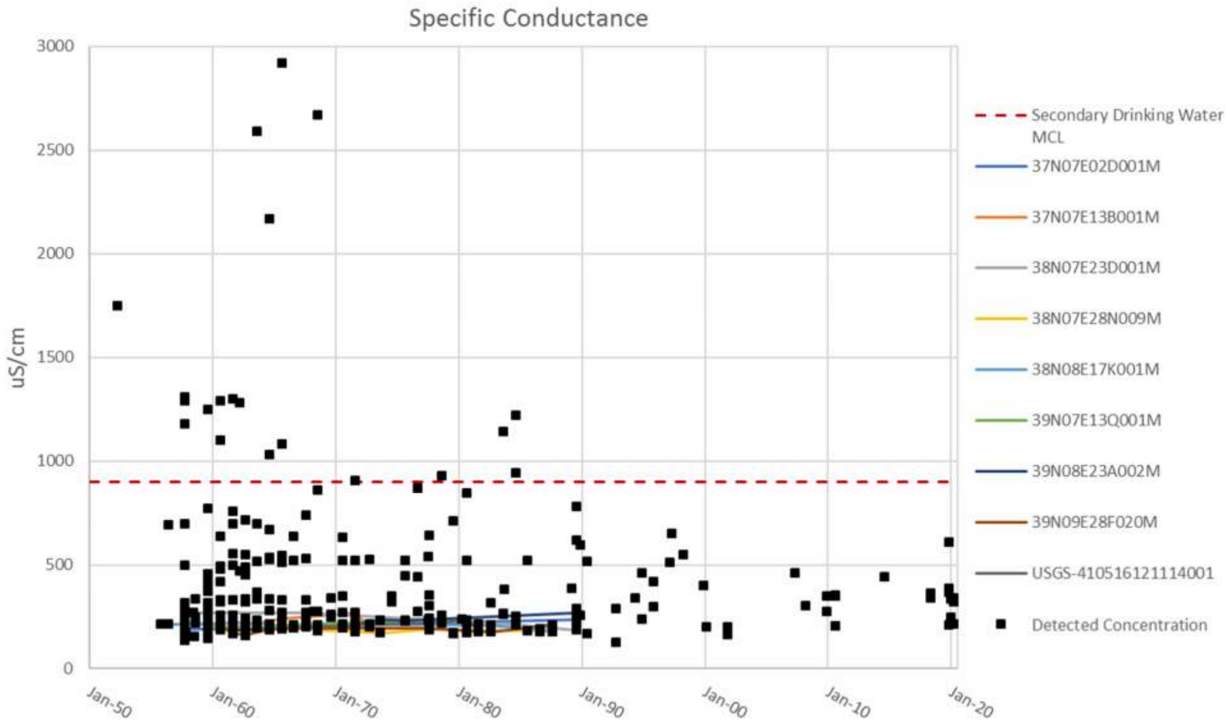


Figure 5-11 Specific Conductance Trends

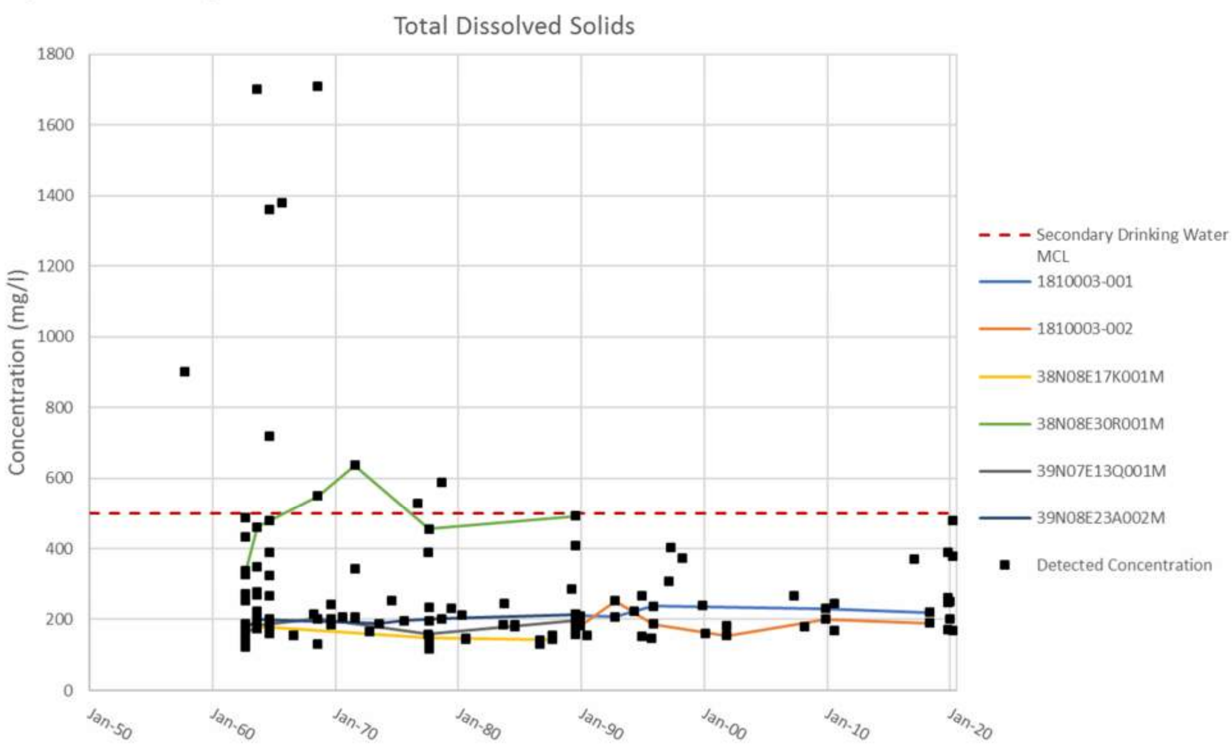


Figure 5-12 TDS Trends

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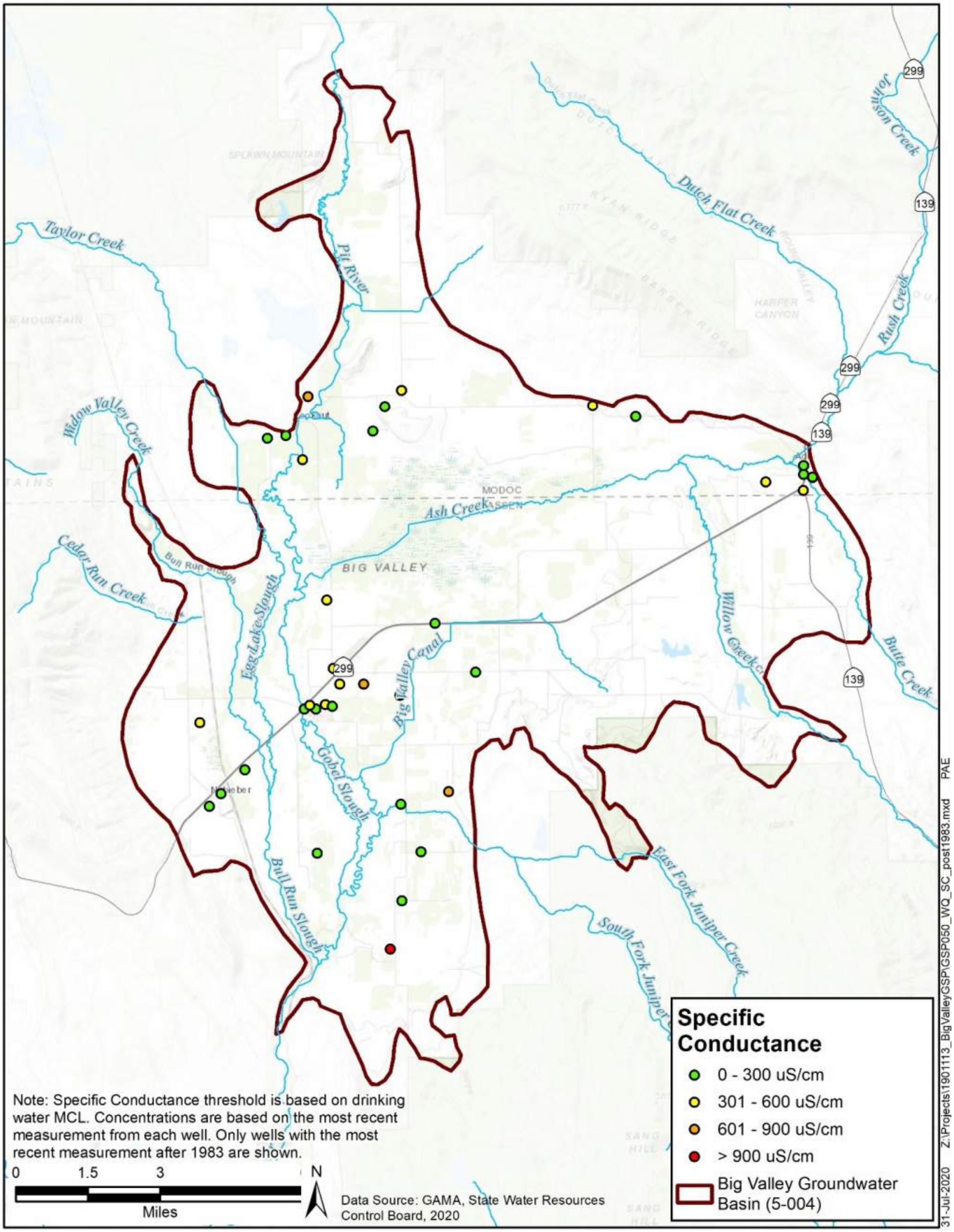


5925 **Figure 5-13 Distribution of Elevated Specific Conductance**

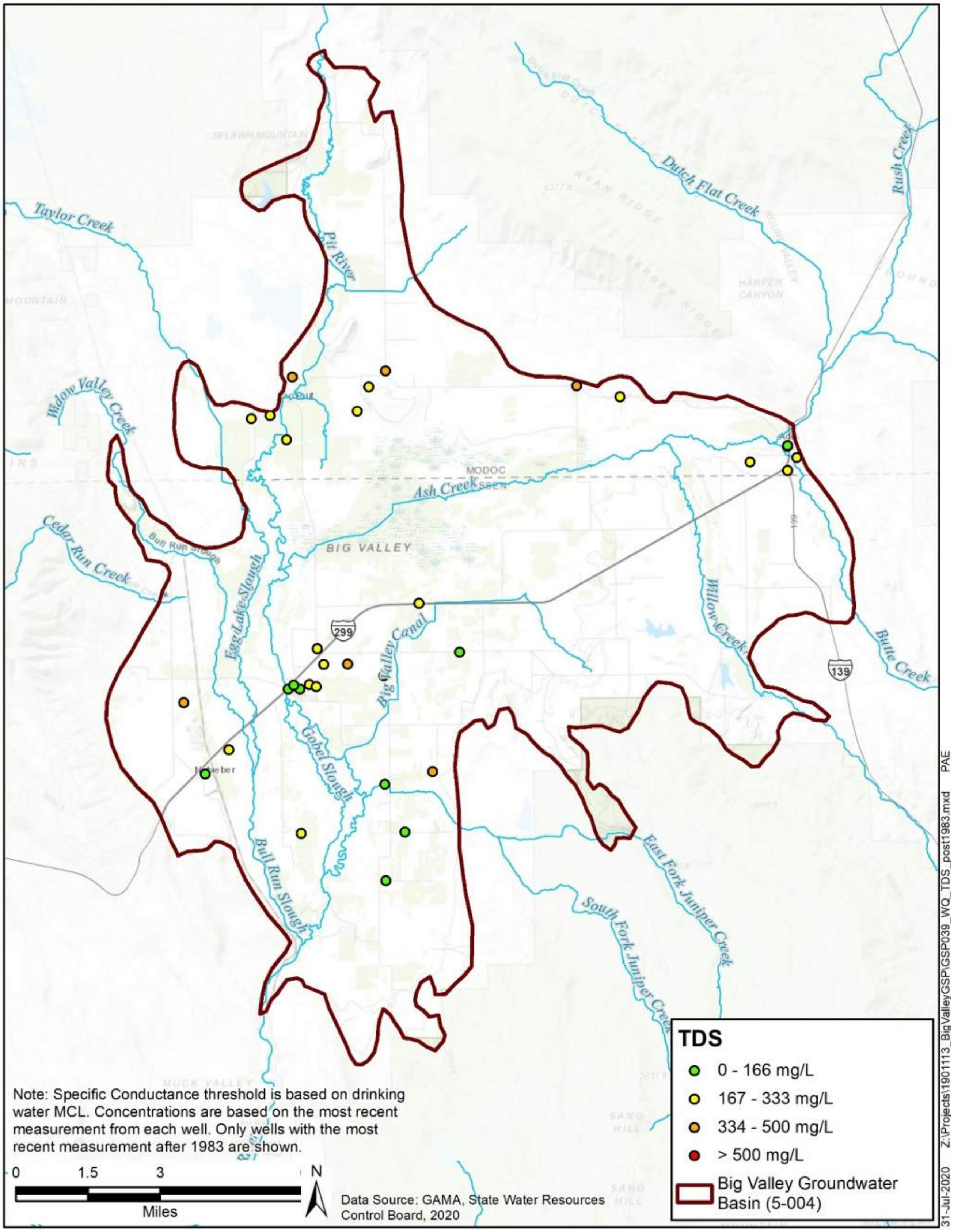


Figure 5-14 Distribution of Elevated TDS Concentrations

5.4.2 Groundwater Contamination Sites and Plumes

To determine the location of potential groundwater contamination sites and plumes, the State Water Board's GeoTracker website was consulted. GeoTracker catalogs known groundwater contamination sites and waste disposal sites~~.~~ (State Water Board 2020b~~)~~). A search of GeoTracker identified ten sites where groundwater could potentially be contaminated. These sites are in the vicinity of Bieber and Nubieber as listed in **Table 5-4** and shown on **Figure 5-15**. The sites include leaking underground storage tanks (LUSTs), cleanup program sites and a land disposal ~~sites~~site. Half of the sites are open and subject to on-going regulatory requirements. The contaminants are listed in **Table 5-4**, which also gives a summary of the case history.

Most of the contaminants originated at LUST sites leaking petroleum hydrocarbons which are light non-aqueous phase liquids (LNAPLs). LNAPLs are less dense than water and their solubility is quite low, meaning that if they reach groundwater, they float on top and generally do not migrate into the deeper portions of the aquifer. Moreover, many of the constituents can be degraded by naturally occurring bacteria in soil and groundwater so the hydrocarbons do not migrate far from the LUST sites. However, MTBE[40], TBA[41] and fuel oxygenates are more soluble in water. Two LUST sites and the landfill site are subject to long-term monitoring while a fourth site is ready for case closure.

The Bieber Landfill is subject to on-going semi-annual monitoring of groundwater levels and groundwater quality at four shallow wells. This monitoring is required by the RWQCB (Order No. R5-2007-0175), after the formal closure of the landfill in the early 2000s. Trace concentrations of several organic constituents[42] have been detected at MW-1, the closest downgradient well to the site, but rarely at the other three wells. Higher concentrations of inorganic constituents (e.g., TDS, SC, others) are also present at MW-1. During 2019, the landfill was also required to analyze groundwater samples from MW-1, MW-2 and MW-4 for per/polyfluoroalkyl substances (PFAS), which are an emerging group of contaminants that are being studied for their effect on human health and may be subject to very low regulatory criteria (parts per trillion). Fifteen of 28 PFASs were detected at MW-1 and nine of 28 PFASs were detected at MW-4 (none at MW-2). The State Water Board/RWQCB evaluation of these data is still pending.

[40] Methyl tert-butyl ether (MTBE) is a fuel additive that was used starting in 1979 and was banned in California after 2002. MTBE is sparingly soluble in water and has a primary MCL of 13 ug/l for human health and a secondary MCL of 5 ug/l for aesthetics.

[41] tert-Butyl alcohol (TBA) is also a fuel additive and is used to produce MTBE. TBA does not have a drinking water MCL in California.

[42] 1,1-dichoroethane, 1,4-dichlorobenzene, cis-1,2-dichloroethylene, benzene, chlorobenzene, MTBE, 2,4,5-trichlorophenoxyacetic acid

Table 5-4 Known Potential Groundwater Contamination Sites in the BVGB

GeoTracker ID	Latitude	Longitude	Case Type	Status	Last Regulatory Acitivity	Case Begin Date	Potential Contaminants of Concern	Site Summary
T10000003882	41.12050	-121.14605	LUST Cleanup Site	Open - Assessment & Interim Remedial Action	04/16/20	10/17/11	Benzene, Diesel, Ethylbenzene, Total Petroleum Hydrocarbons (TPH), Xylene	The case was opened following an unauthorized release from an UST(s). Tank removal and further site assessment, including installation of 8 monitoring wells, led to remedial actions. Periodic groundwater monitoring started in October 2013 and has been ongoing though March 2020.
T0603593601	41.13230	-121.13070	LUST Cleanup Site	Open - Remediation	07/29/20	03/22/00	Gasoline	Active gas station with groundwater impacts. Full-scale remediation *via* groundwater extraction and treatment began in September 2013 and was shut down in April 2017 because it was determined that it was no longer an effective remedy to treat soil and groundwater. At the time of system shutdown, the influent MTBE concentration was 5,650 micrograms per liter which exceeds the Low-Threat Closure Policy criteria. Additionally, high levels of TPHg and sheen/free product are present. A soil vapor extraction system operated for a limited time in 2016/2017 but was not effective. In April 2018, it was determined that active remediation is not a cost-effective path to closure given low permeability of site soils. Staff suggested incorporating institutional controls (IC) and risk-based cleanup objectives instead of active remediation of soil and groundwater. The IC approach was dependent on the submittal of several documents related to soil management, deed restriction and risk modeling plus annual groundwater sampling. This information has not been provided and the RWQCB sent an Order for this information.
T0603500006	41.12241	-121.14128	LUST Cleanup Site	Completed - Case Closed	01/04/00	06/28/99	Diesel	A 2000-gallon UST was removed, and limited contaminated soil was present in the excavation. Petroleum hydrocarbons were not found in the uppermost groundwater. These findings led to the closure of the case.
L10005078943	41.12941	-121.14169	Land Disposal Site	Open - Closed facility with Monitoring*	06/26/20	06/30/08	Higher levels of Inorganic constituents, organic chemicals (synthetic), per/polyfluoroalkyl substances	Disposal activities at Bieber Landfill occurred from the early 1950s until 1994. The landfill was closed during the early 2000s. While active, the site received residential, commercial and industrial non-hazardous solid waste. Formerly an unlined burn dump, the site was converted to cut-and-cover landfill operation in 1974. Landfill refuse is estimated to occupy less than 13 acres of the 20-acre site. Wastes are estimated to be approximately 10-15 feet thick. The Class III landfill was closed in accordance with Title 27 of the California Code of Regulations. A transfer station was established at the site for the transportation of waste to another landfill. Groundwater levels and quality are monitored twice per year at 4 wells.
T0603500003	41.12124	-121.14061	LUST Cleanup Site	Completed - Case Closed	09/13/94	07/31/91	Heating Oil / Fuel Oil	A 1000-gallon UST was removed, and contaminated soil was present beneath the tank, which led to installation of nine soils borings and 3 monitoring wells. Contaminated soil was removed but an adjacent building limited the extent of the excavation so contaminated soil remains under the building. Hydrocarbons were initially found in 1 well but not in subsequent sampling. The RWQCB concurred with a request to close the investigation.
T10000003101	41.13151	-121.13658	Cleanup Program Site	Open - Assessment & Interim Remedial Action	07/22/20	04/03/07	Benzene, Toluene, Xylene, MTBE / TBA / Other Fuel Oxygenates, Gasoline, Other Petroleum	A diesel leak was found in association with an industrial chipper. Corrective action included excavation of diesel-impacted soil, removing contaminated water and groundwater monitoring. Results of soil and groundwater sampling indicate low concentrations of TPHg and BTEX and that there is no offsite migration. Staff have determined that the case is ready for closure, pending decommissioning of the site monitoring wells.
SL0603581829	41.09251	-121.17904	Cleanup Program Site	Completed - Case Closed	09/01/05	01/08/05	Petroleum - Diesel fuels, Petroleum - Other	Contaminated soil excavated and transported to Forward Landfill for disposal. Contaminated groundwater (7,000 gallons) extracted with vacuum truck for disposal.
T0603500002	41.12188	-121.13546	LUST Cleanup Site	Completed - Case Closed	07/17/06	10/20/86	Gasoline / diesel	Three USTs were removed, and contaminated soil was present beneath the tank, which led to installation of nine monitoring wells and three remediation wells. Natural attenuation of the hydrocarbon impact was acceptable to the RWQCB due to the limited, well-defined extent of the impact and the limited and declining impact to groundwater. The RWQCB concurred with a request to close the site.
T0603500004	41.12134	-121.13547	LUST Cleanup Site	Completed - Case Closed	03/12/99	06/12/97	Diesel	A 5000-gallon UST was removed and very low levels of petroluem hydrocarbons were detected in the soil, which was allowed to be spread onsite and the case was closed.
T10000002713	41.11993	-121.14271	Cleanup Program Site	Open - Site Assessment	12/30/16	03/10/10	Other Petroleum	The site is an old bulk plant which was built in the 1930's and handled gasoline and diesel. During a routine inspection in March 2010, evidence of petroleum spills were identified at the loading dock area. A follow-up inspection was conducted in April 2010. The ASTs and loading dock were removed but additional contamination was noted under the removed structures. Furthermore, a shallow excavation contained standing water with a sheen. Due to the potential impacts to shallow groundwater, the Regional Water Board became the lead agency in December 2010. Additional information was requested in December 2016. A response is not evident.

*This terminology indicates that the landfill is closed (no new material being disposed), but the site is open with regard to ongoing groundwater monitoring.
Source: GeoTracker (State Water Board 2020b)
MTBE = Methyl tert-butyl ether; TBA = tert-Butyl alcohol

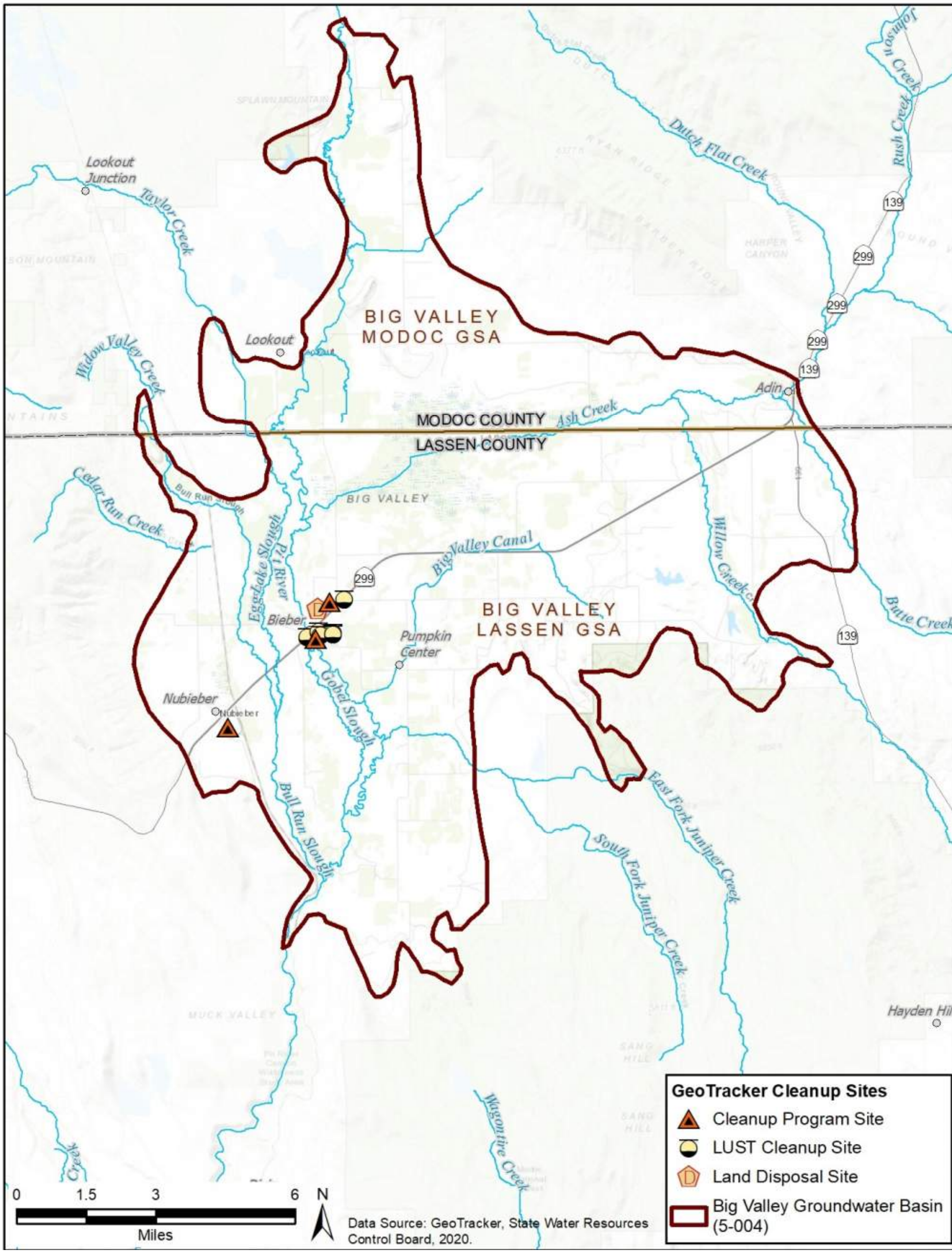


Figure 5-15 Location of Known Potential Groundwater Contamination Sites

5.5 Subsidence

Vertical displacement of the land surface (subsidence) is comprised of two components: 1) elastic displacement which fluctuates according to various cycles (daily, seasonally and annually) due to temporary changes in hydrostatic pressure (e.g., atmospheric pressure and changes in groundwater levels) and 2) inelastic displacement or permanent subsidence which can occur from a variety of natural and human-caused phenomena. Lowering of groundwater levels can cause prolonged and/or extreme decrease in the hydrostatic pressure of the aquifer. This decrease in pressure can allow the aquifer to compress, primarily within fine-grained beds (clays). Inelastic subsidence cannot be restored after the hydrostatic pressure increases. Other causes of inelastic subsidence include natural geologic processes (e.g., faulting) and the oxidation of organic rich (peat) soils as well as human~~-caused processes~~ activities such as mining and grading of land surfaces.

Subsidence can be measured by a variety of methods, including:

- Regular measurements of any vertical space between the ground surface and the concrete pad surrounding a well. If space is present and increasing over time, subsidence may be occurring at that location. If a space is not present, subsidence may not be occurring, or the well is not deep enough to show that subsidence is occurring because the well and ~~groundwater~~ground are subsiding together.
- Terrestrial (ground-based) surveys of paved roads and benchmarks.
- Global Positioning Survey (GPS) of benchmarks. GPS uses a constellation of satellites to measure the 3-dimensional position of a benchmark. The longer the time that the GPS is left to collect measurements, the higher the precision. Big Valley has one continuously operating GPS (CGPS) station near Adin.
- Monitoring of specially constructed "extensometer" wells. There are no extensometers in the BVGB.
- Use of InSAR, which is microwave-based satellite technology that has been used to evaluate ground surface elevation and deformation since the early 1990s. InSAR can document changes in ground elevation between successive passes of the satellite. Between 2015 and 2019, InSAR was used to evaluate subsidence throughout California, including Big Valley.

Subsidence was recognized as an important consideration in the 2007 LCGMP (Brown and Caldwell 2007) but was not identified as an issue for Big Valley specifically. The analysis in the LCGMP was based on indirect observations (groundwater levels) and anecdotal information. This section presents additional data that has become available since the development of the LCGMP.

5.5.1 Continuous GPS Station P347

A CGPS station (P347) was installed at the CalTrans yard near Adin in September 2007. The station is part of the Plate Boundary Observatory which is measuring 3-dimensional changes in the Earth surface due to the movement of tectonic plates (e.g., Pacific and North American plates).

Figure 5-16 is a plot of the vertical displacement at P347 and shows a slight decline (0.6 inch) over the first 11 years of operation, based on the annual mean values (large black open circles). Daily values (blue dots) show substantial variation, as much as an inch, but more typically only 0.1 inch on average.

This scattering of daily values around the annual mean provides an indication of the elastic nature of the displacement. The overall decline of 0.6 inch is an indication of inelastic displacement has occurred over an 11-year period, which equates to a rate of -0.05 inch per year at this location near Adin.

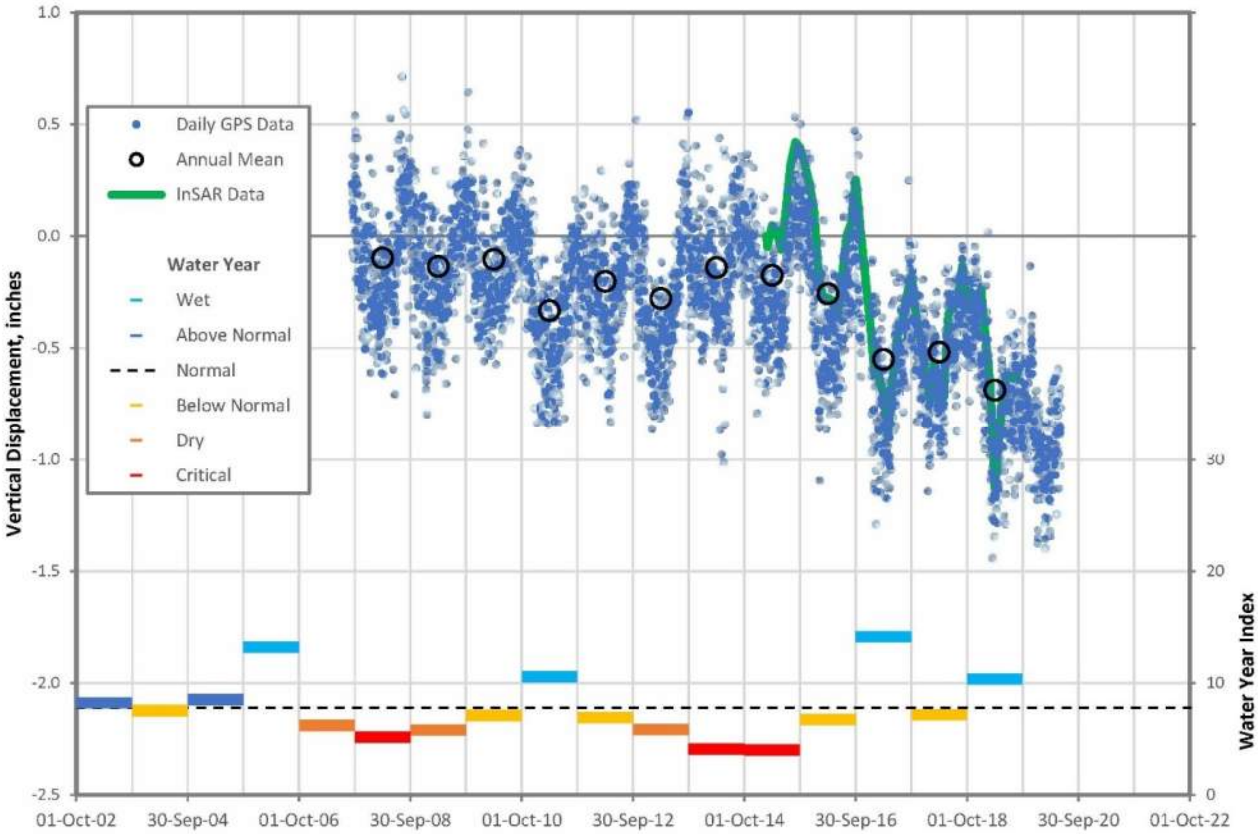


Figure 5-16 Vertical Displacement at CGPS P347

5.5.2 Interferometric Synthetic Aperture Radar

Figure 5-17 is a map of InSAR data made available by DWR for the 4.3-year period between June 2015 and September 2019. The majority of Big Valley was addressed by this InSAR survey although the survey excludes some areas (shown in white on **Figure 5-17**) including much of the Big Swamp (ACWA), areas along the Pit River near Lookout and south of Bieber. The accuracy of this type of InSAR data in California has been calculated at 18mm (0.7 inches) at a 95% confidence level~~.~~ (Towill 2021~~)~~). Most of the survey shows downward displacement between 0 and -1 inch throughout Big Valley. This small displacement is close to the level of accuracy of the data, but if true is likely due to natural geologic activities due to its widespread nature.

Two localized areas of subsidence exceeding -1.5 inches are apparent from this data, one in the east-central portion of the Basin north of Highway 299 and one in the southern portion of the Basin between the Pit River and Bull Run Slough. Maximum downward displacement in the Basin is -3.3 inches, over the 4.3-year period. Some of the downward displacement in the Basin may be due to ~~re-grading~~laser leveling of fields, particularly for production of wild rice.

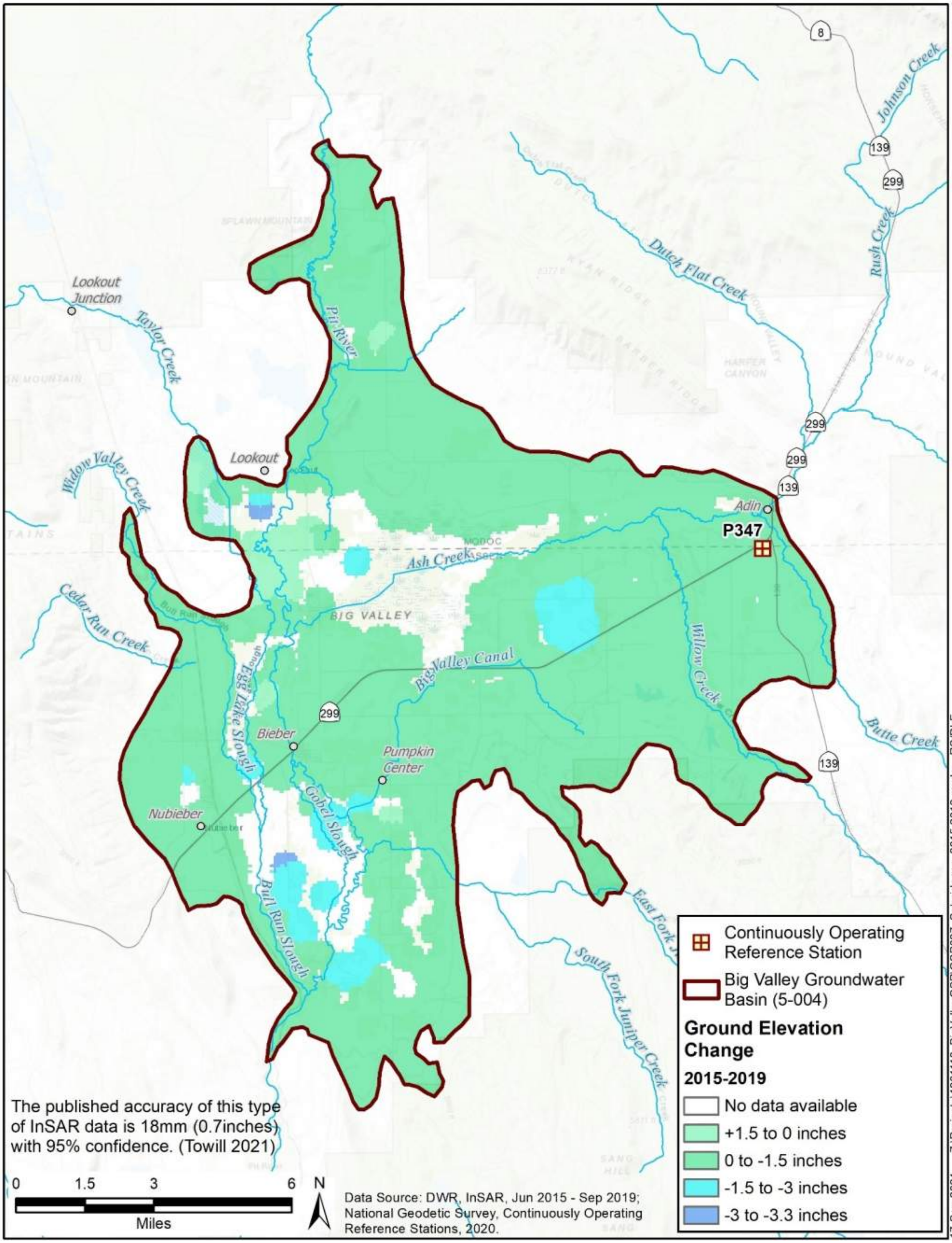


Figure 5-17 InSAR Change in Ground Elevation 2015 to 2019

5.6 Interconnected Surface Water

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" (DWR 2016c). For the principal aquifer to be interconnected to surface water streams, groundwater levels need to be near ground surface. As a first determination of where surface water *may* be interconnected, **Figure 5-18** shows the major[43]~~, perennial~~[44] streams in the Basin which have groundwater levels near ground surface, depth to water less than ~~20~~15 feet based on spring 2015 groundwater contours. These ~~are designated as~~ areas ~~with *potentially*~~*may* have the potential to be interconnected with surface water.

Interconnected streams can be gaining (groundwater flowing toward the stream) or losing (groundwater flowing away from the stream). ~~The flow directions~~Preliminary data from the ~~groundwater contours can indicate whether the stream might be gaining or losing, as shown on **Figure 5-18**. In addition,~~ shallow monitoring well clusters[45] give an indication the direction of shallow groundwater flow adjacent to streams in two locations in the Basin as shown by the black arrows on **Figure 5-18**.

Section §354.16(f) of the regulations require an estimate of the "quantity and timing of depletions of [interconnected surface water] systems, utilizing…best available information". The existence and quantity cannot be determined with any reasonable level of accuracy using empirical data, so the best available information is presented in Chapter 6 – Water Budget. The timing of depletions also cannot be determined with existing data.

5.7 Groundwater-Dependent Ecosystems

SGMA requires GSPs to identify Groundwater Dependent Ecosystems (GDEs) but does not explicitly state the requirements that warrant a GDE designation. SGMA defines a GDE as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface~~".~~." (DWR 2016c~~)~~). GDEs are considered a beneficial use of groundwater.

The most comprehensive and readily accessible data to identify GDEs is referred to as the NCCAG[46] dataset. Upon inspection of the data~~ there are~~[47], many inaccuracies ~~in the data~~were noted. The abstract of the dataset documentation reads:

> The Natural Communities dataset is a compilation of 48 publicly available State and federal agency datasets that map vegetation, wetlands, springs, and seeps in California. A working group comprised of DWR, the California

[43] Named streams from the National Hydrography Dataset [NHD] (USGS 2020a)

~~[44] With year-round or nearly year-round flow, indicating it is not completely depleted.~~

[45] The clusters are sets of 3 wells drilled in close proximity to each other for the purpose of determining shallow groundwater flow direction and gradient. At the time of writing this draft chapter, 2 clusters have enough data to determine flow direction, ~~1~~one cluster near Adin and ~~1~~one cluster near Lookout. **Appendix 5C** contains data collected at the ~~2~~two clusters and their flow directions

[46] Natural communities commonly associated with groundwater

[47] By local landowners and local experts familiar with the Basin and its ecological communities.

Department of Fish and Wildlife (CDFW), and The Nature Conservancy (TNC) reviewed the compiled dataset and conducted a screening process to exclude vegetation and wetland types less likely to be associated with

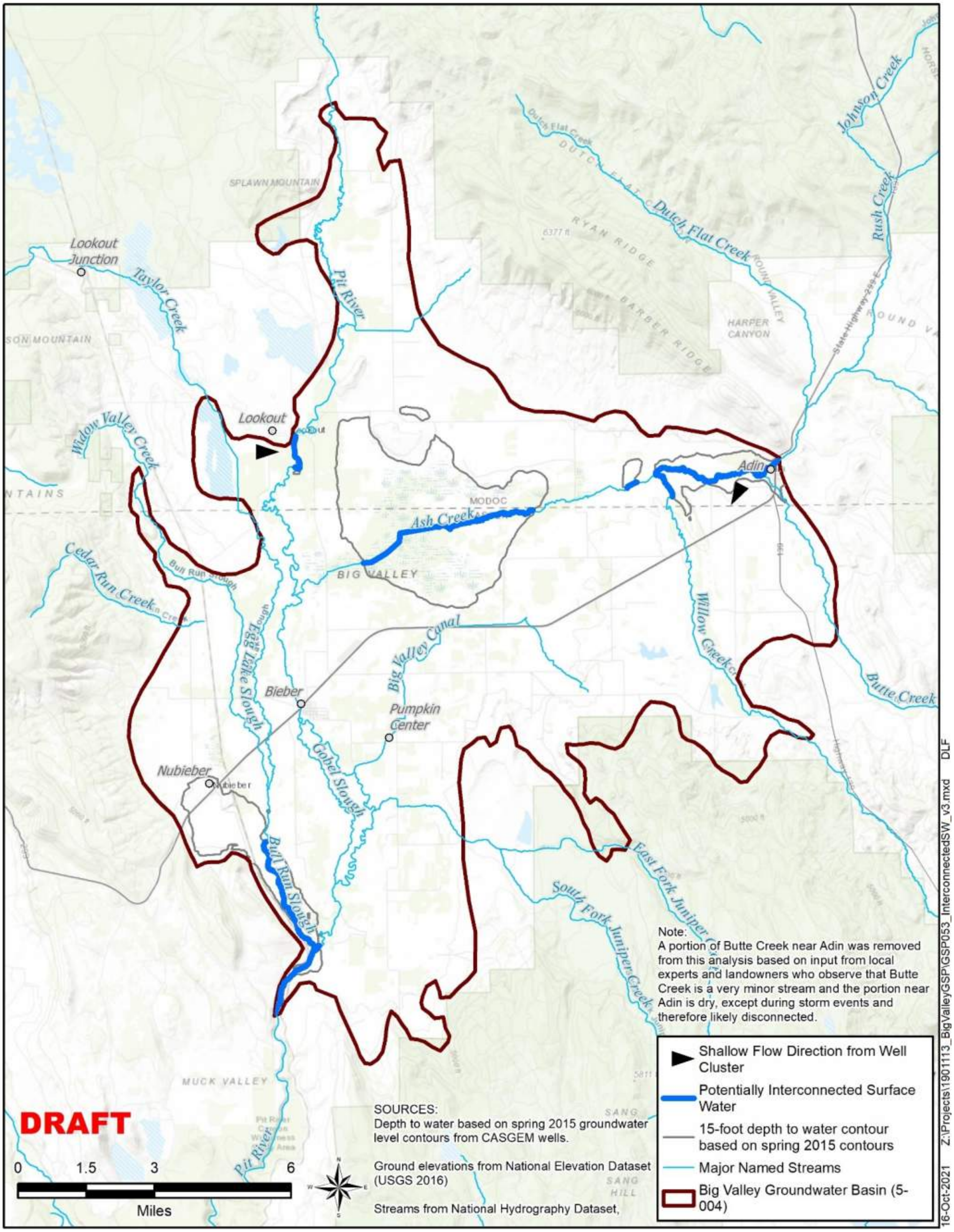


Figure 5-18 Potentially Interconnected Surface Water

> groundwater and retain types commonly associated with groundwater, based on criteria described in Klausmeyer et al. (2018).
>
> Two habitat classes are included in the Natural Communities dataset: (1) wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions; and (2) vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes).
>
> The data included in the Natural Communities dataset do not represent DWRs determination of a GDE. However, the Natural Communities dataset can be used by GSAs as a starting point when approaching the task of identifying GDEs within a groundwater basin. (DWR 2018a)

The NCCAG geospatial data (DWR 2018a) is separated into two categories: wetlands and vegetation, respectively.

The Wetlands area is subdivided into two primary habitats present in Big Valley: palustrine[48] and riverine[49]. Palustrine is the dominant habitat at 96 percent of the total wetland area while riverine is present at 4 percent and ~~can be seen~~occurs along river courses. Sixteen springs account for a very small ~~areal component~~area. Most of the springs are in Lassen County (13) although numerous springs are located outside the BVGB boundary.

The Vegetation area ~~(11,500 total acres)~~ is subdivided ~~further~~ into two primary habitats, based on the plant species. Wet Meadows was the largest primary habitat at 59 percent of the vegetation area but did not include a dominant species. Willow was the second largest habitat at 41 percent of the vegetation area.

For the NCCAG areas to be designated as actual GDEs, the groundwater level needs to be close enough to the ground surface that it would support the vegetation. For determining potential GDEs, *fall* 2015[50] depth to water is used, because mid-summer months are the critical limiting factor for plant communities. Furthermore, if groundwater moisture isn't available later in the summer, then the groundwater dependent communities don't have an advantage over communities that are typically not associated with groundwater such as sagebrush, juniper and bunchgrass (Lile 2021).

The depth to water that could potentially be accessed by GDEs depends on the rooting depth of the vegetation. ~~Plant roots can extend up to 30 feet or more (TNC 2020), and 30 has been used by other GSPs as the threshold for GDEs.~~ An assessment of native plants ~~present~~ in the BVGB found that maximum rooting depths of species present is 10 feet as shown in **Table 5-5**. Access to groundwater by plant roots extends above the water table ~~as~~because the groundwater ~~seeps~~is drawn upward to fill soil pores~~. This~~, and this zone is known as the capillary fringe ~~and can extend at least a few~~. The thickness of

[48] Palustrine are freshwater wetlands, such as marshes, swamps and bogs, not associated with flowing water ~~such as marshes, swamps and bogs.~~ (Cowardin et al. 2013~~)~~).

[49] Riverine are freshwater wetlands located in or near a flowing stream~~.~~ (Cowardin et al. 2013).

[50] 2015 is used because it is the baseline for SGMA.

the capillary fringe extends upward several feet~~ or potentially much more,~~ depending on the soil type. ~~Therefore, for the purposes of delineating GDEs, only those areas in the NCCAG datasets that are in areas with groundwater less than 20 feet are classified as potential GDEs. **Figure 5-18** shows the spring 2015 20-foot depth to water contours.~~

Table 5-5 Big Valley Common Plant Species Rooting Depths

Species	Rooting Depth
Carex spp.	Up to 5 feet
Alfalfa	9 feet
Aspen	10 feet and less
Willow	2-10 feet
Elderberry	10 feet and less
Saltgrass	2 feet
Sources: CNPS 2020, TNC 2020, Snell 2020	

As a conservative estimate, a capillary fringe of 10 feet is used. In order for plants to access the water and thrive, not just barely touch, there needs to be significant overlap (of, say 5 feet) between the rooting depth and the capillary fringe (Lile 2021). Furthermore, while roots may extend to a deep level, documentation on maximum depth to water for some of the deep-rooting species in **Table 5-5** to thrive is on the order of 2-3 meters (6-9 feet) (Pezeshki and Shields 2006, Springer et. al. 1999). Therefore, as a conservative estimate for the purposes of delineating GDEs, only those areas in the NCCAG datasets that are in areas with fall 2015 groundwater less than 15 feet are classified as potential GDEs.

Figure 5-19 shows the area with potential GDEs~~. This map~~, which is a preliminary assessment and needs to be ground-truthed. Moreover, the data ~~is~~are inaccurate in many places. ~~These potential GDEs need to be ground-truthed. Since a large portion of the potential GDE areas are in the ACWA, the GSAs will seek assistance from CDFW to perform such an assessment.~~

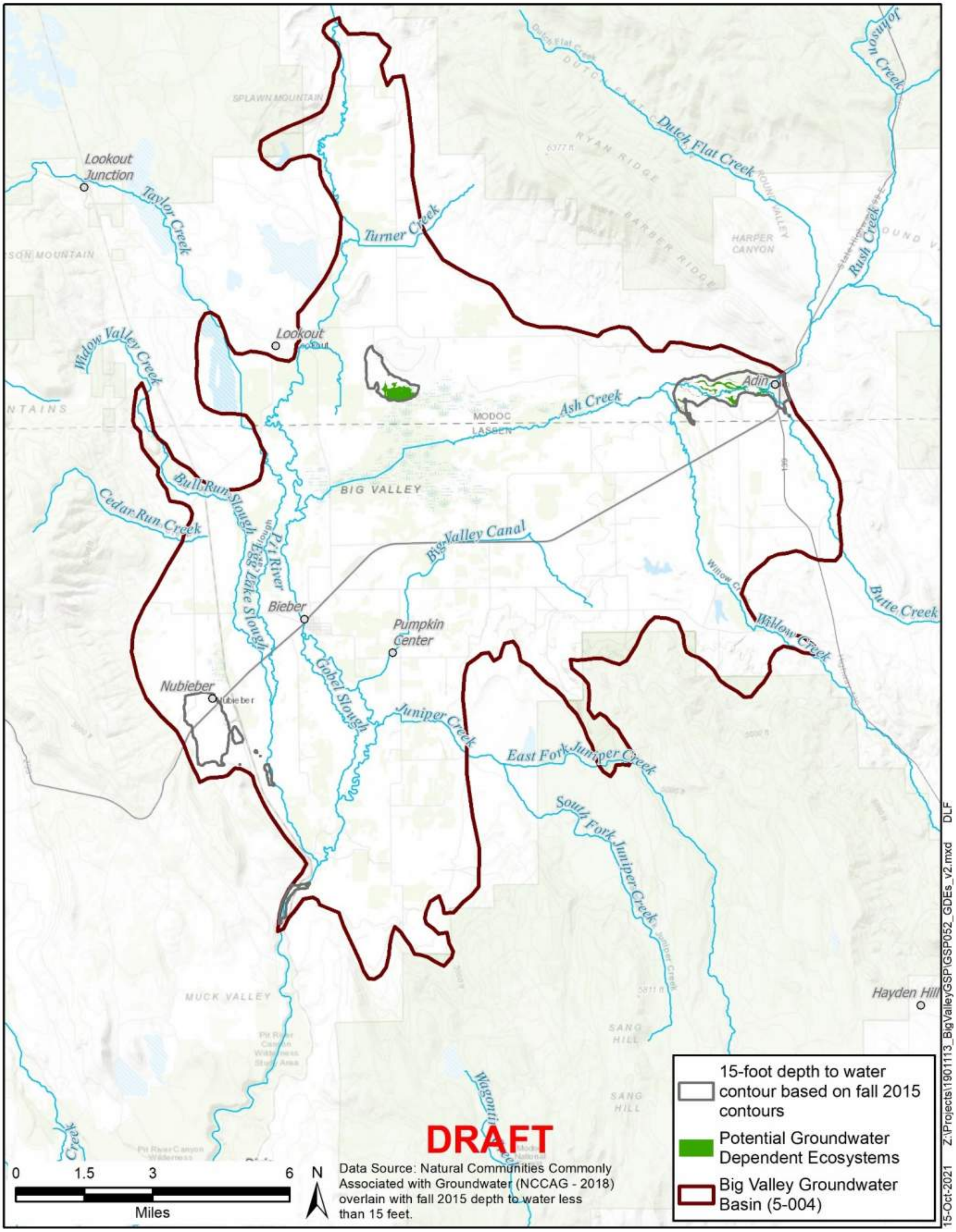


Figure 5-19 Potential Groundwater Dependent Ecosystems

6. Water Budget § 354.18

The hydrologic cycle describes how water is moved on the earth among the oceans, atmosphere, land, surface water bodies and groundwater bodies. **Figure 6-1** ~~shows~~is a depiction of the hydrologic cycle.

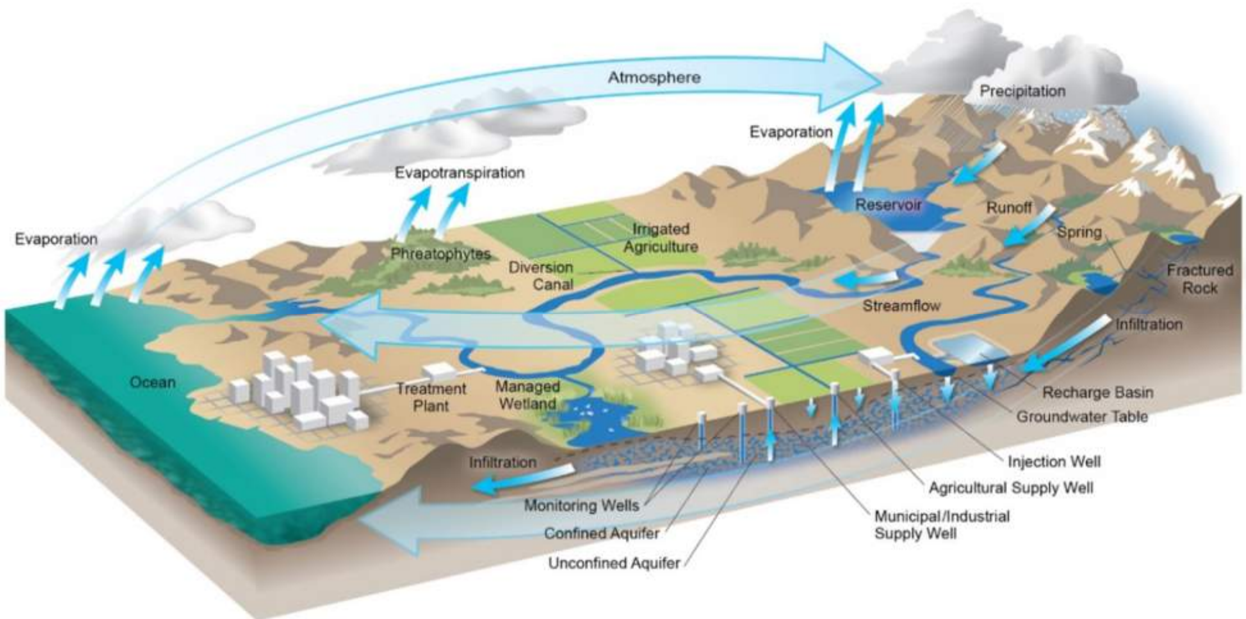


Figure 6-1 Hydrologic Cycle

A water budget accounts for the movement of water among the four major systems in Big Valley: atmospheric, land surface, surface water, and groundwater. The BVGB consists of the latter three systems (land surface, surface water and groundwater) as shown by the black outline on **Figure 6-2**. This figure ~~demonstrates~~shows the exchange between the systems and identifies the specific components of the water budget~~ and exchange between the systems~~. The systems and the flow arrows are color coded. Inflows to the BVGB are shown with blue arrows and outflows from the BVGB are shown with orange arrows. Flows between the systems are shown with green arrows and flows within a system are shown in purple. The land system, surface water system and groundwater system are green, blue and brown respectively.

Like a checking account, a water budget helps the GSA and stakeholders better understand the deposits and withdrawals and identify what conditions result in positive and negative balances. It should be noted that, while the development of a water budget is required by the GSP regulations, the regulations don't require actions based directly on the water budget. Actions are only required based on outcomes related to the six sustainability indicators: groundwater levels, groundwater storage, water quality, subsidence, seawater intrusion and surface water depletions. Therefore, a water budget should be viewed as a tool to develop a common understanding of the Basin and a basis for making decisions to achieve sustainability and avoid undesirable results with the sustainability indicators.

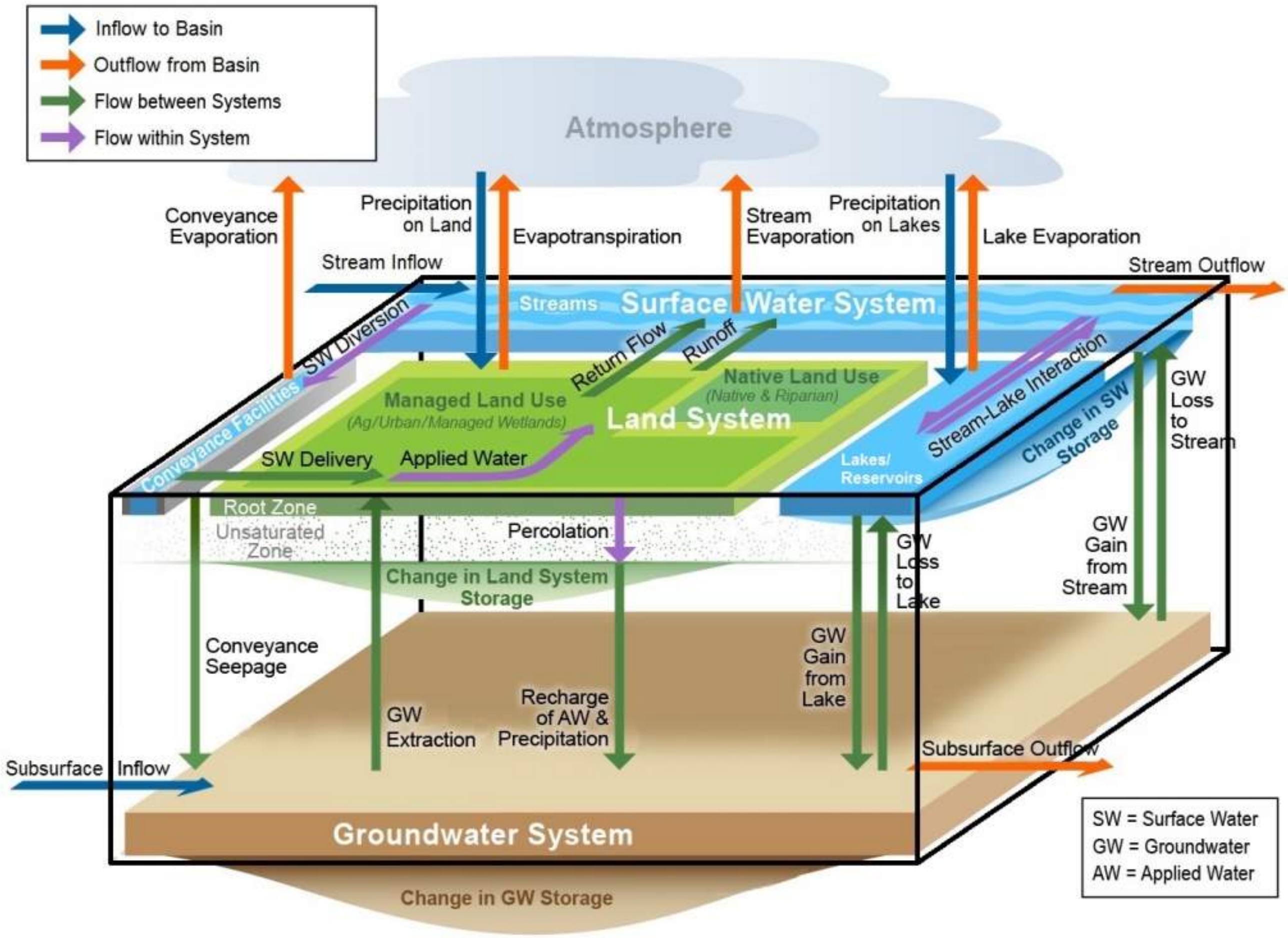


Figure 6-2 Water Budget Components and Systems

6.1 Water Budget Data Sources

Each component shown in **Figure 6-2** was estimated using readily available data and assembled into a budget spreadsheet. Many groundwater basins in California utilize a numerical groundwater model, such as MODFLOW[51] or IWFM[52] to calculate the water budget. These models require a specialized hydrogeologist to run them and the methodology by which the water budget is calculated is not readily apparent to the lay person. For the BVGB, a non-modeling (spreadsheet) approach was used so that future iterations of the water budget could be performed by a wider range of hydrology professionals (potentially reducing future GSP implementation costs) and so that the calculations of the specific components could be understood by a broader range of people.

In concept, each component ~~could be~~is quantified precisely and accurately, and the resultant budget ~~could come out~~is balanced. In practice, most of the components can only be roughly estimated and in many cases not at all. Therefore, much of the work to balance the water budget is adjusting some of the

[51] Modular Finite-Difference Groundwater Flow model, developed by USGS.
[52] Integrated Water Flow Model, developed by DWR.

unknown or roughly estimated parameters within acceptable ranges until the budget is balanced and all components ~~of the budget~~ are deemed reasonable.

As such, the water budget calculations presented ~~here~~herein are not unique and the precision of the ~~components estimated through the use of the water budget~~component estimates are within an order of magnitude. Estimation of nearly all components involves assumptions and, with more Basin-specific data, the accuracy and precision of many of the components are improved. Additional and improved data ~~that is obtained results~~will result in a budget that more closely reflects the Basin conditions and allows the GSAs to make more informed decisions to sustainably maintain groundwater resources. **Appendix 6A** show the components of the water budget, their data source(s), assumptions and relative level of precision.

Major data sources include the PRISM[53] model (NACSE 2020) for precipitation, CIMIS (DWR 2020c) for evapotranspiration data, the National Water Information System (USGS 2020b) for surface water flows and DWR land use surveys (DWR 2020d).

6.2 Historical Water Budget

The historic water budget presented in this section covers 1984 to 2018. This period was chosen because it represents an average set of climatic conditions. **Figure 6-3** shows the annual precipitation and year type for the period. The criteria for year types were critical dry below 70 percent of average precipitation, dry between 70 and 85 percent of average precipitation, normal between 85 and 115 percent of average precipitation and wet years greater than 115 percent of average precipitation.

[53] PRISM stands for Parameter-elevation Regression on Independent Slopes Model and is provided by the Northwest Alliance for Computational Science and Engineering from Oregon State University. This model provides location-specific, historical precipitation values on monthly and annual time scales. Precipitation was evaluated at Bieber.

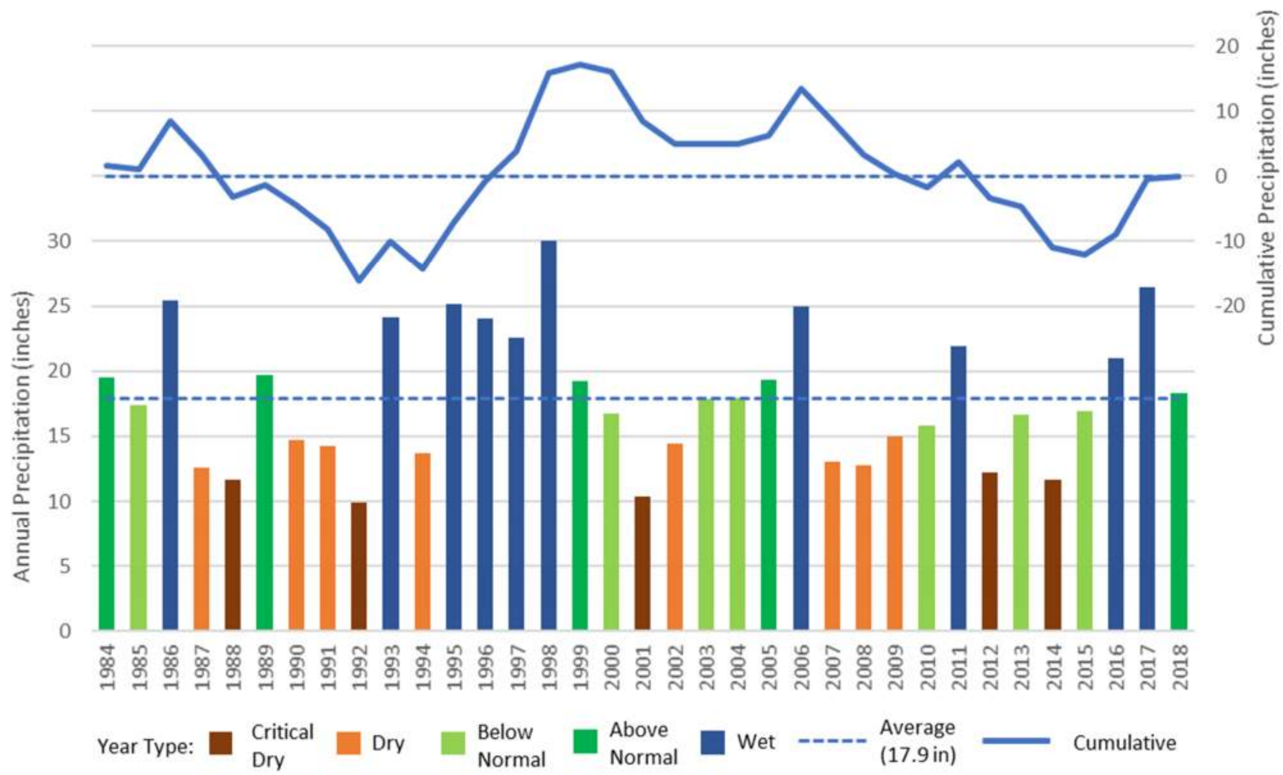
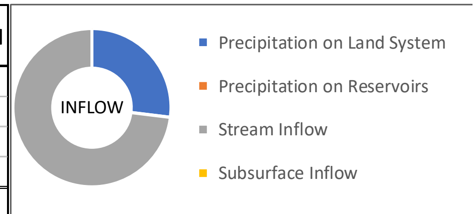


Figure 6-3 Annual and Cumulative Precipitation and Water Year Types 1984 to 2018

The budget was developed using this precipitation and other climate data (evapotranspiration) along with stream flow to estimate the inflows (credits) and outflows (debits) to the total BVGB. The budget was balanced by assuming that the land and surface water systems remain nearly in balance from year to year and allowing the groundwater system to vary. **Figure 6-4** shows the average annual values for the overall water budget. The detailed water budget for each year is included in **Appendix 6B**. **Appendix 6C** shows graphically how the water budget varies over time.

item	Flow Type	Origin/ Destination	Component	Estimated
	TOTAL BASIN WATER BUDGET			**Acre-Feet**
(1)	Inflow	Into Basin	Precipitation on Land System	136,800
(14)	Inflow	Into Basin	Precipitation on Reservoirs	500
(13)	Inflow	Into Basin	Stream Inflow	371,100
(27)	Inflow	Into Basin	Subsurface Inflow	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*508,400*
(5)	Outflow	Out of Basin	Evapotranspiration	154,000
(24)	Outflow	Out of Basin	Stream Evaporation	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	700
(19)	Outflow	Out of Basin	Conveyance Evaporation	-
(18)	Outflow	Out of Basin	Stream Outflow	358,500
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*513,600*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(5,000)



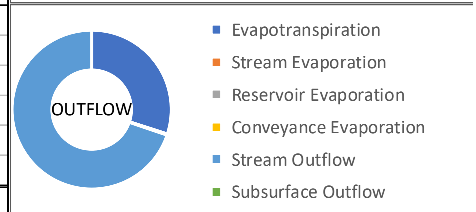


Figure 6-4 Average Total Basin Water Budget 1984-2018 (Historic)[54]

The evapotranspiration value was calculated using land use data (crop and wetland acreages) from DWR for 2014 and land use was assumed to be constant throughout the water budget period.

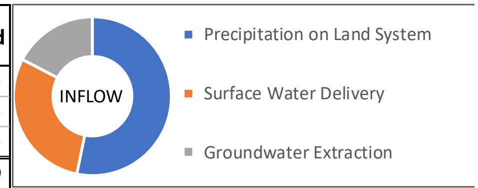
Using the evapotranspiration for irrigated lands, the amount of irrigation from surface water and groundwater was determined using 85 percent irrigation efficiency (NRCS 2020) and a respective 35 to 65 percent split between surface water and groundwater. This surface water – groundwater split was determined from input received from local landowners, an assessment of surface water rights (areas without surface water rights were assumed to use 100% groundwater), well drilling records (areas without wells drilled were assumed to use 100% surface water) and an assessment of aerial imagery to see if water source could be determined. For the evapotranspiration associated with the ACWA, the ~~habitat~~ecosystem largely relies on surface water and very shallow subsurface[55] water~~ that may be interconnected with Ash Creek~~. This surface water delivery[56] was enhanced by implementation of a "pond and plug" project in 2012 to keep the water table higher and broader throughout ACWA. The ACWA also has three wells that extract groundwater from the deeper aquifers ~~and~~which is applied in portions of the habitat during dry months (fall). These areas with groundwater~~ enhanced habitat areas~~ use are indicated by the light blue areas within ACWA. Based on the limited area and time groundwater is used to support the habitat, 98 percent of the evapotranspiration for ACWA is estimated to come from surface water and 2 percent from groundwater. **Figure 3-6** shows the lands with applied water and their water source based on this assessment.

Stakeholders have noted that despite the efforts to improve estimates of water source and some input from local residents, **Figure 3-6** still contains significant inaccuracies and further refinement of this dataset is needed.

The average annual water ~~budget~~budgets for the three systems (land, surface water and groundwater) are shown on **Figure 6-5**, **Figure 6-6** and **Figure 6-7**. The detailed water budget for each year is included in **Appendix 6B**. **Appendix 6C** shows graphically how the system water budgets vary over time.

[54] To re-emphasize, these are rough estimates and better and more accurate data ~~is~~are needed.
[55] Within about the top 10 feet that plant roots can access.
[56] For the purposes of the water budget, water from Ash Creek is considered "delivered" to the wetland areas.

item	Flow Type	Origin/ Destination	Component	Estimated
	LAND SYSTEM			**Acre-Feet**
(1)	Inflow	Into Basin	Precipitation on Land System	136,800
(2)	Inflow	Between Systems	Surface Water Delivery	75,800
(3)	Inflow	Between Systems	Groundwater Extraction	44,600
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*257,000*
(5)	Outflow	Out of Basin	Evapotranspiration	154,000
(6)	Outflow	Between Systems	Runoff	83,400
(7)	Outflow	Between Systems	Return Flow	5,000
(8)	Outflow	Between Systems	Recharge of Applied Water	13,100
(9)	Outflow	Between Systems	Recharge of Precipitation	1,600
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*257,000*
(12)	Storage Change	(4)-(11)	Change in Land System Storage	-



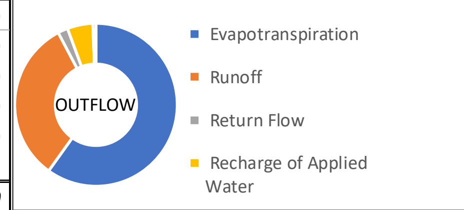
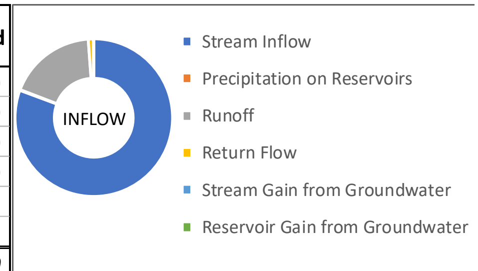


Figure 6-5 Average Land System Water Budget 1984-2018 (Historic)

item	Flow Type	Origin/ Destination	Component	Estimated
	SURFACE WATER SYSTEM			**Acre-Feet**
(13)	Inflow	Into Basin	Stream Inflow	371,100
(14)	Inflow	Into Basin	Precipitation on Reservoirs	500
(6)	Inflow	Between Systems	Runoff	83,400
(7)	Inflow	Between Systems	Return Flow	5,000
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-
(16)	Inflow	Between Systems	Reservoir Gain from Groundwater	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*460,000*
(18)	Outflow	Out of Basin	Stream Outflow	358,500
(19)	Outflow	Out of Basin	Conveyance Evaporation	50
(20)	Outflow	Between Systems	Conveyance Seepage	30
(2)	Outflow	Between Systems	Surface Water Delivery	75,800
(21)	Outflow	Between Systems	Stream Loss to Groundwater	24,000
(22)	Outflow	Between Systems	Reservoir Loss to Groundwater	600
(23)	Outflow	Out of Basin	Reservoir Evaporation	700
(24)	Outflow	Out of Basin	Stream Evaporation	400
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*460,000*
(26)	Storage Change	(17)-(25)	Change in Surface Water Storage	-



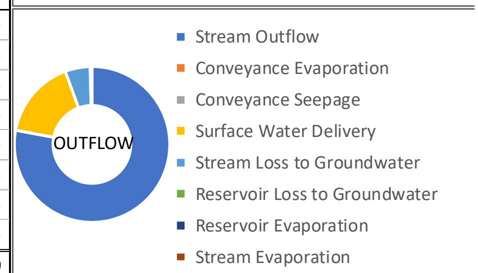


Figure 6-6 Average Surface Water System Water Budget 1984-2018 (Historic)

item	GROUNDWATER SYSTEM Flow Type	Origin/ Destination	Component	Acre-Feet Estimated
(8)	Inflow	Between Systems	Recharge of Applied Water	13,100
(9)	Inflow	Between Systems	Recharge of Precipitation	1,600
(10)	Inflow	Between Systems	Managed Aquifer Recharge	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	24,000
(22)	Inflow	Between Systems	Groundwater Gain from Reservoir	600
(20)	Inflow	Between Systems	Conveyance Seepage	30
(27)	Inflow	Into Basin	Subsurface Inflow	1
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*39,300*
(3)	Outflow	Between Systems	Groundwater Extraction	44,600
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-
(16)	Outflow	Between Systems	Groundwater Loss to Reservoir	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*44,600*
(31)	Storage Change	(28)-(30)	Change in Groundwater Storage	(5,000)

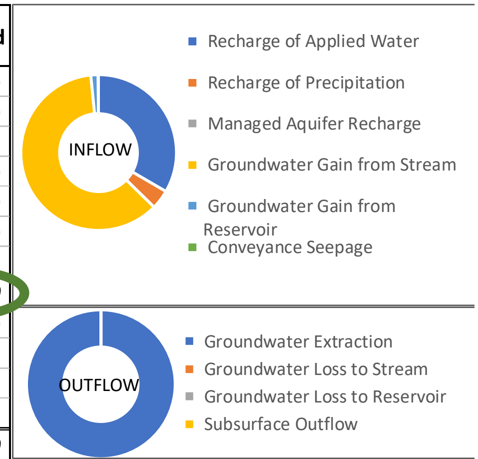


Figure 6-7 Average Groundwater System Water Budget 1984 to 2018 (Historic)

With the land system and surface water system assumed to be in balance, the groundwater system varies and reflects the change in water stored in the Basin. This change in storage is shown in **Figure 6-8** and is analogous to the change in storage presented in Chapter 5 – Groundwater Conditions which used groundwater contours to calculate the change. These two approaches show similar trends, but the magnitude of the changes differs slightly, with the groundwater contours showing a maximum cumulative overdraft (2015) of about ~~120~~116,000 AF and the water budget indicating about ~~190~~183,000 AF. This difference may indicate that the water budget overdraft may be slightly over estimated or that the average specific yield of the Basin is higher.

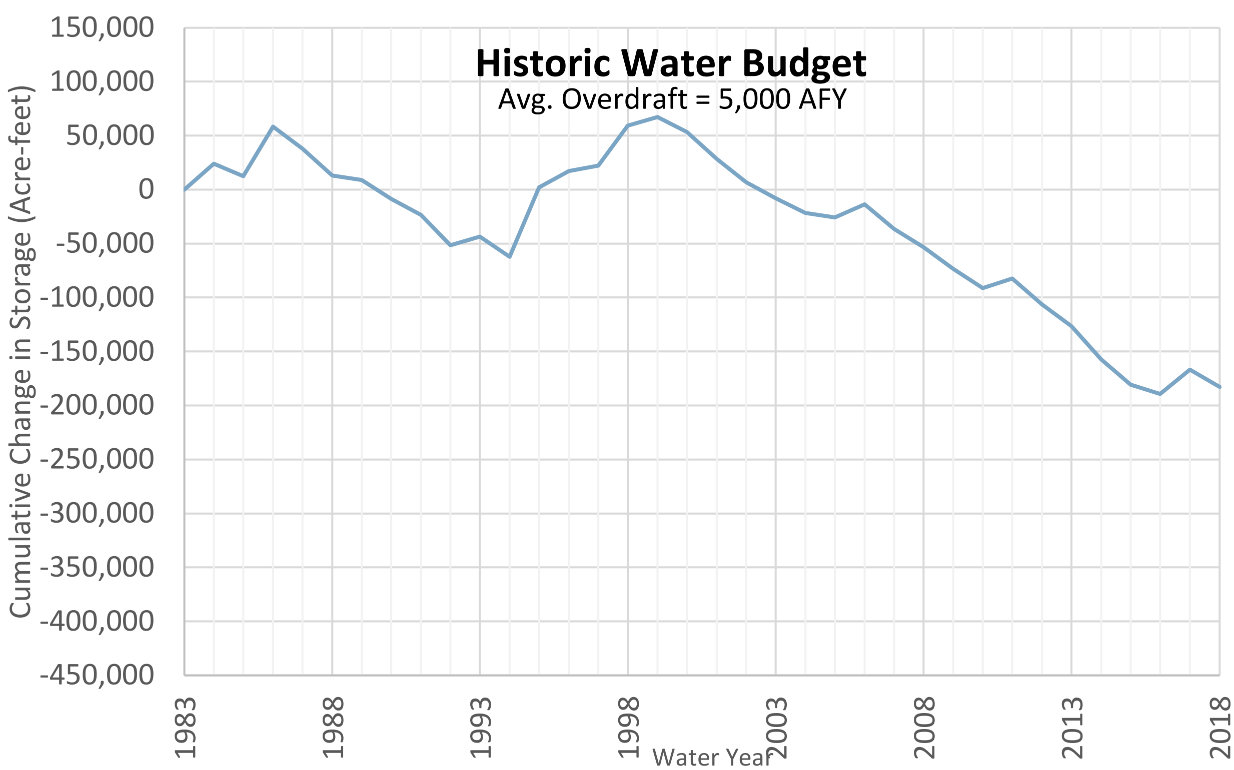


Figure 6-8 Cumulative Groundwater Change in Storage 1984 to 2018 (Historic)

The GSP regulations require an estimate of the sustainable yield[57] for the Basin~~.~~ (§354.18(b)(7)). This requirement is interpreted as the average annual inflow to the groundwater system, which for the 34-year period of the historic water budget is approximately 39,~~400~~300 AF, as indicated on item 28 of **Figure 6-7** (circled in green) for the groundwater system. The estimate of annual average groundwater use is approximately 44,600 AFY.

The regulations also require a quantification of overdraft[58]~~.~~ (§354.18(b)(5)). For the water budget period of 1984 to 2018, overdraft is estimated at approximately 5,~~200~~000 AFY, shown as the average annual groundwater system change in storage, circled in red on **Figure 6-7** (item 31).

6.3 Current Water Budget

The current water budget is demonstrated by ~~looking at WY 2018, which is the most recent year of the historic~~estimating future water budget~~.~~ holding current conditions, land use and water use. The projection described in section 6.4.1 below holds these values constant and therefore represents both the current and projected..

6.4 Projected Water Budget

As required by the GSP Regulations, the projected water budget is developed using at least 50 years of historic climate data (precipitation, evapotranspiration and streamflow) along with estimates of future land and water use. The climate data from 1962 to 2011 was used as an estimate of future climate baseline conditions.

6.4.1 Projection Baseline

The baseline projected water budget uses the most recent estimates of population and land use and keeps them constant. **Figure 6-9** shows the average annual future water budget. Long-term overdraft is projected to be about 2,~~100~~000 AFY, which is less than the overdraft for the historic water budget because it uses a longer, wetter time-period for its projections. **Figure 6-10** shows the projected cumulative change in groundwater storage.

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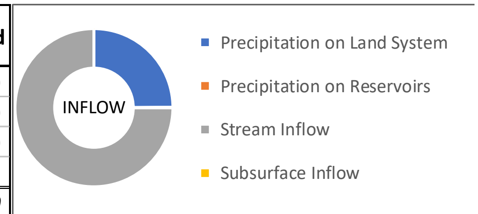
[57] The state defines sustainable yield as, "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result." (CWC §10721(w))

[58] DWR defines overdraft as "the condition of a groundwater basin or Subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions." (DWR 2016b)

item	Flow Type	Origin/ Destination	Component	Estimated
	TOTAL BASIN WATER BUDGET			**Acre-Feet**
(1)	Inflow	Into Basin	Precipitation on Land System	143,200
(14)	Inflow	Into Basin	Precipitation on Reservoirs	500
(13)	Inflow	Into Basin	Stream Inflow	430,200
(27)	Inflow	Into Basin	Subsurface Inflow	1
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*574,000*
(5)	Outflow	Out of Basin	Evapotranspiration	156,900
(24)	Outflow	Out of Basin	Stream Evaporation	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	700
(19)	Outflow	Out of Basin	Conveyance Evaporation	50
(18)	Outflow	Out of Basin	Stream Outflow	418,000
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*576,000*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(2,000)



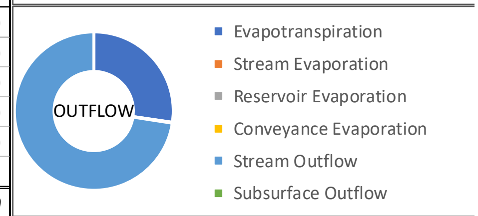


Figure 6-9 Average Projected Total Basin Water Budget 2019-2068 (Future Baseline)

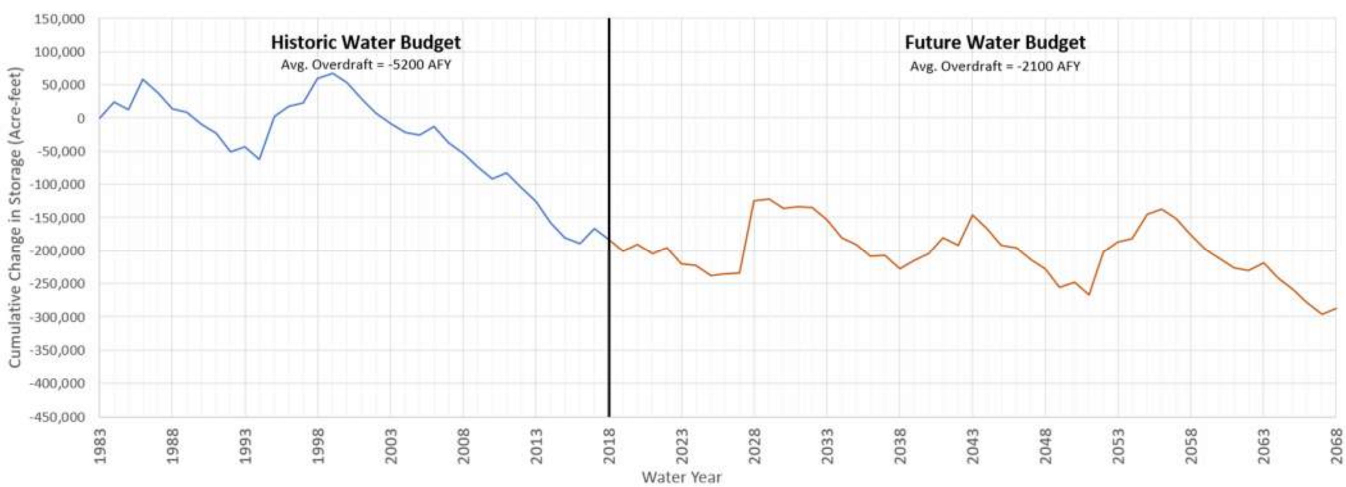
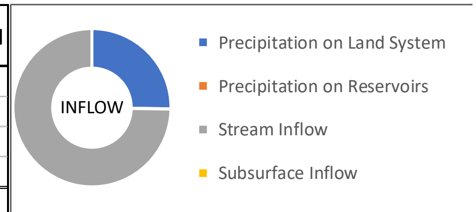


Figure 6-10 Cumulative Groundwater Change in Storage 1984 to 2068 (Future Baseline)

6.4.2 Projection with Climate Change

The SGMA regulations require an analysis of future conditions based on a potential change in climate. DWR provides location-specific change factors for precipitation, evapotranspiration and streamflow based on climate change models. While there is variability in the climate change models, if the models are correct, they indicate that the future climate in Big Valley will be wetter and warmer, resulting in more precipitation and more of that precipitation falling in the form of rain rather than snow. The change factors were applied to the baseline water budget and are shown in **Figure 6-11** and **Figure 6-12**. Land use was assumed to be constant, with conditions the same as DWR's 2014 land use survey. Future conditions with climate change projections indicate that the Basin may be nearly in balance, with overdraft of only about ~~600~~1000 AFY.

item	Flow Type	Origin/ Destination	Component	Estimated
	TOTAL BASIN WATER BUDGET			**Acre-Feet**
(1)	Inflow	Into Basin	Precipitation on Land System	152,200
(14)	Inflow	Into Basin	Precipitation on Reservoirs	600
(13)	Inflow	Into Basin	Stream Inflow	450,400
(27)	Inflow	Into Basin	Subsurface Inflow	-
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*603,000*
(5)	Outflow	Out of Basin	Evapotranspiration	165,800
(24)	Outflow	Out of Basin	Stream Evaporation	400
(23)	Outflow	Out of Basin	Reservoir Evaporation	800
(19)	Outflow	Out of Basin	Conveyance Evaporation	-
(18)	Outflow	Out of Basin	Stream Outflow	436,700
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*604,000*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(1,000)



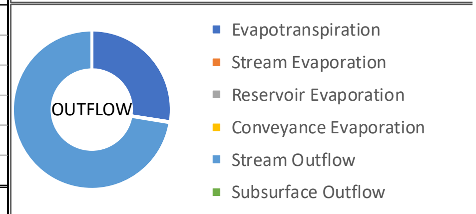


Figure 6-11 Projected Total Basin Water Budget 2019-2068 (Future with Climate Change)

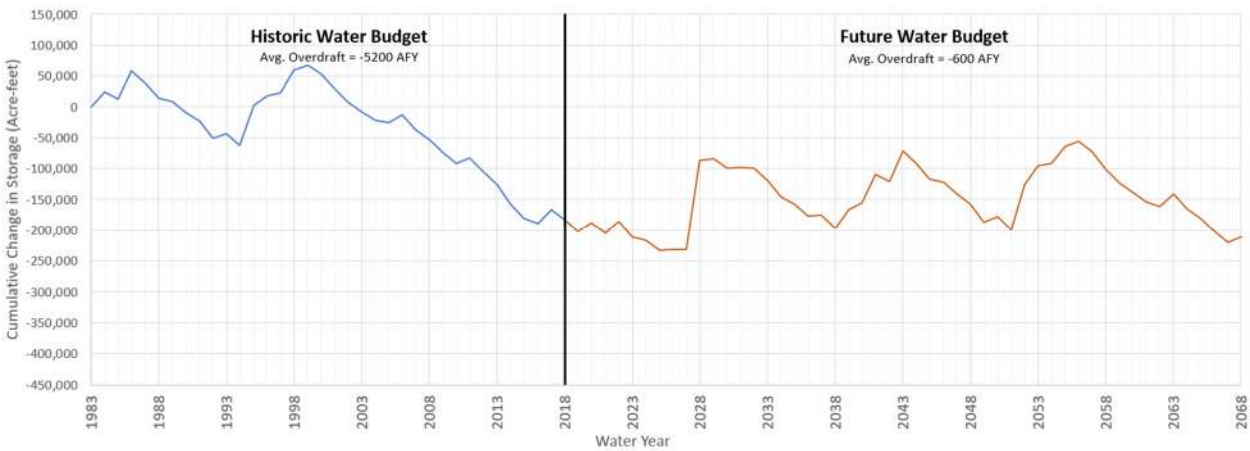


Figure 6-12 Cumulative Groundwater Change in Storage 1984 to 2068 (Future with Climate Change)

7. Sustainable Management Criteria § 354.20

This chapter describes criteria and conditions that constitute sustainable groundwater management for the BVGB, also known as Sustainable Management Criteria (or SMC). Below are descriptions of key terms used in the GSP Regulations and described in this chapter:

- **Sustainability goal:** This is a qualitative, narrative description of the GSP's objective and desired conditions for the BVGB and how these conditions will be achieved. The Regulations require that the goal should, "culminate in the absence of undesirable results within 20 years" (§ 354.22).
- **Undesirable result:** This is a description of the condition(s) that constitute "significant and unreasonable" effects (results) for each of the 6 sustainability indicators:
  - Chronic lowering of *groundwater levels*
  - Reduction in *groundwater storage*
  - *Seawater intrusion* – Not applicable to BVGB
  - Degraded *water quality*
  - Land *subsidence*
  - Depletion of *interconnected surface water*
- **Minimum threshold (MT):** Numeric values that define when conditions have become undesirable ("significant and unreasonable"). Minimum thresholds are established for representative monitoring sites. Undesirable results are defined by minimum threshold exceedance(s) and define when the Basin conditions are unsustainable (i.e., out of compliance with SGMA).
- **Measurable objective (MO):** Numeric values that reflect the desired groundwater conditions at a particular monitoring site. MOs must be set for the same monitoring sites as the MTs and are not subject to enforcement.
- **Interim milestones (IMs):** Numeric values for every 5 years between the GSP adoption and sustainability (20 years, 2042) that indicate how the Basin will reach the MO (if levels are below the MO). IMs are optional criteria and not subject to enforcement.

~~**Figure 7-1** shows the relationship of the sustainability goal, undesirable results and minimum thresholds.~~ **Figure 7-1** shows the relationship of the MT, MO and IMs. In addition to these regulatory requirements, some GSAs in other basins have developed "action levels", applicable when levels are above the MT but below the MO, for each well to indicate where and when to focus projects and management actions. This GSP also has action levels that are described in this chapter.

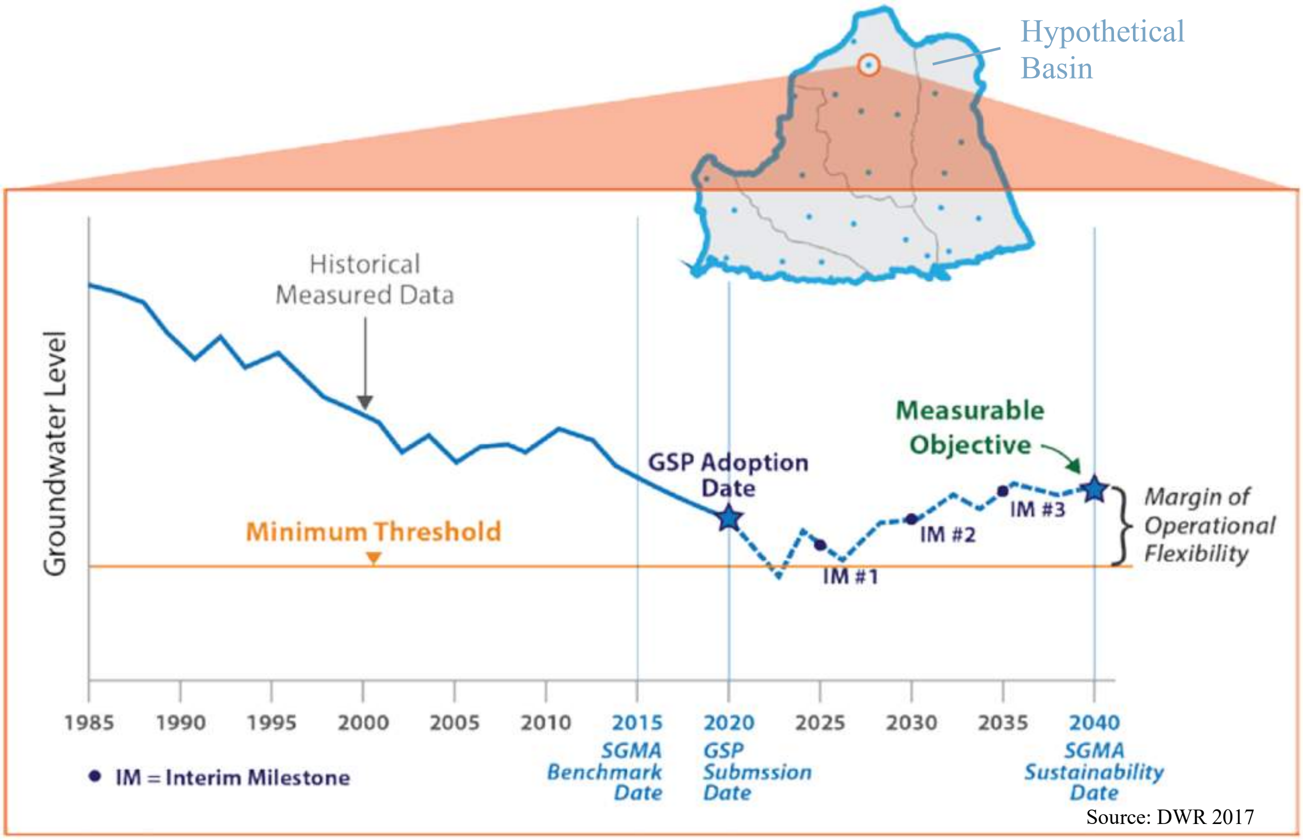


Figure 7-1 Relationship among the MTs, MOs and IMs for a hypothetical basin

7.1 Process for Establishing SMCs

The SMCs detailed in this chapter were developed by the GSAs through consultation with the BVAC. The sustainability goal was developed by an ad hoc committee and presented to the larger BVAC, GSA staff and the public for review and comment. The BVAC also formed ad hoc committees for each sustainability indicator and evaluated the data and information presented in Chapters 1-6. In consultation with GSA staff, each committee determined whether significant and unreasonable effects for each sustainability indicator have occurred historically and the likelihood of significant and unreasonable effects occurring in the future. The sections below reflect the guidance given to the GSAs and consultants by the ad hoc committees.

7.2 Sustainability Goal

The sustainability goal was presented in Chapter 1 and is reiterated here:

> The sustainability goal for the Big Valley Groundwater Basin is to maintain a locally governed, economically feasible, sustainable groundwater basin and surrounding watershed for existing and future legal beneficial uses with a concentration on agriculture. Sustainable management will be conducted in context with the unique culture of the basin, character of the community, quality of life of the Big Valley residents and the vested right of agricultural pursuits through the continued use of groundwater and surface water.

7.3 Undesirable Results

Undesirable results must be described for each sustainability indicator. To comply with §354.26 of the Regulations, the narrative for each applicable indicator includes:

- *Description* of the "significant and unreasonable" conditions that are undesirable
- Potential *causes* of the undesirable results
- *Criteria* used to define when and where the effects are undesirable
- Potential *effects* on the beneficial uses and users of groundwater, on land uses and property interests

Sustainability indicators that have not experienced undesirable results and are unlikely to do so in the future describe the justification for non-applicability of that Sustainability Indicator.

7.3.1 Groundwater levels

For this section, it is necessary to understand that it is natural (and expected) that groundwater levels will rise and fall during a particular year and over the course of many years. Chapters 4 through 6 describe the nature of groundwater levels throughout the Basin and how levels have changed over time. These chapters conclude that many areas of the Basin have seen no significant change. Other areas saw a lowering of levels in the late 1980's and early 1990's, recovery during the wet period of the late 1990's and lowering water levels since 2000. Groundwater usage has only seen minor increases since 2000, therefore the declines are more related to climatic conditions than to a lack of stewardship of the resource. As illustrated in **Figure 5-4**, water levels in 12 wells have shown stable (less than 1 foot of change) or rising water levels and 9 wells have shown declining trends with only three of those wells declining by more than 2 feet per year.

This context is given both to set the stage for discussion of undesirable results and to illustrate that water levels overall have not declined significantly. This re-emphasizes the point raised in Section 1.3 that the GSAs believe the Basin should be ranked as low priority. As mentioned previously, the GSAs also believe its ranking of medium priority is due in large part to the DWR's scoring of all basins with water level declines with a fixed number of points rather than considering the severity of declines. Big Valley has seen only minor declines in comparison to the widespread decline of hundreds of feet experienced elsewhere in the state. The Basin has demonstrated that it can recover during wet climatic cycles (e.g., late 1990's) as shown in **Figure 5-7**. There have not been widespread reports of issues or concerns regarding groundwater levels from the residents of the Basin (whether agricultural producers or domestic users or others). The GSAs contend that Big Valley's medium priority ranking is based on unscientific concerns raised by DWR based on isolated wells that experienced limited decline during a below average climatic cycle.

Therefore, undesirable results have not occurred in the past and the measurable objective established in this section is set at the fall 2015 groundwater level for each well in the monitoring network (*see* Chapter 8 – Monitoring Networks). Fall 2015 is the most recent measurement prior to the adoption of this GSP and is generally the lowest groundwater level throughout the period of record. Since these levels are ~~assumed to be~~ economically feasible for agricultural uses, this level is a reasonable proxy for the desired conditions.

Description

This section describes undesirable results for groundwater levels by defining significant and unreasonable impacts on beneficial uses. As described in Section 1.1 and emphasized in the Sustainability Goal, agricultural production is of paramount importance due to its economic, cultural and environmental benefits. For agricultural pursuits to be viable, growers need a large margin of operational flexibility (*refer to* **Figure 7-1**) so that crops can be irrigated even during dry years. Accordingly, and consistent with the goal, 140 feet below the 2015 groundwater level was established as the minimum threshold.

Consistent with the Sustainability Goal, significant and unreasonable lowering of groundwater levels is defined as the level where the energy cost to lift groundwater exceeds the economic value of the water for agriculture[59]. Through discussions in BVAC ad hoc committee meetings among committee members, local well driller (Conner 2021) and the Lassen County Farm Advisor (Lile 2021) a depth of 140 feet below fall 2015 levels was determined to be the depth at which groundwater pumping becomes economically unfeasible for agricultural use.

The increase in horsepower required to pump from a well approaching the MT would result in an increased cost of $15 per acre foot of water using Surprise Valley Electric (SVE) rates and $30 per acre foot using Pacific Gas and Electric (PG&E) rates (Conner 2021). Calculated on a per ton basis, the increased cost of 140-foot water level decline translates to about $6.50 per ton using SVE power and $13 per ton with PG&E. (*see* **Appendix 7A**).

Total operating costs for a typical grass hay farm in the intermountain area are estimated to be $119 per ton. Total cash costs, not counting land and depreciation are estimated at $138 per ton of hay produced (Orloff et al 2016). Considering hay prices have been in the $200 per ton range (U.S. Department of Agriculture [USDA], Agricultural Marketing Service), the potential increase in required pumping power reduces return over cost by 10 to 20 percent.

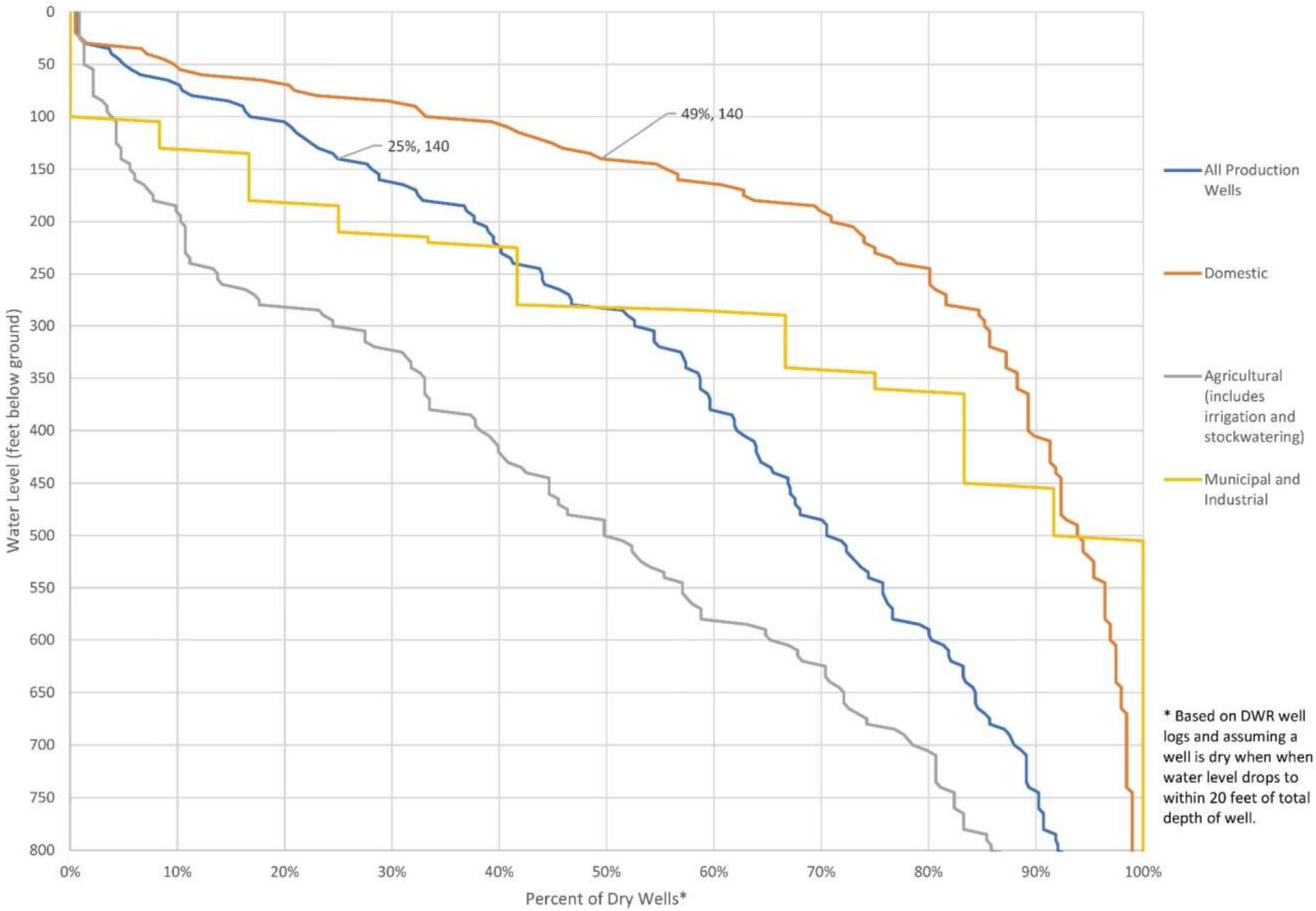
To produce grain hay pumping costs are less because less water is required. Because the relative value of grain hay, approximately $120 per ton, is also much less, the overall impact to economic returns is equal if not greater. Thus, the agricultural production economic threshold for well levels is determined to be 140 feet below the fall 2015 baseline.

While the viability of agriculture is of paramount importance, it is acknowledged that if water levels approach the MT, some wells in the Basin may go dry. **Figure 7-2** shows an assessment of the depths of wells throughout the Basin based on DWR well logs[60]. While this dataset has inaccuracies, it gives a sense of the impact of lowering water levels on the different well types and indicates that lowering of water levels throughout the Basin to the MT could result in a significant percentage of wells going dry. Many of the shallower wells are likely the oldest wells in the Basin and may be unused or abandoned.

Figure 7-3 shows that domestic well density is not evenly distributed throughout the Basin and that representative wells are located near the areas of highest domestic well density.

It is also acknowledged that utilizing the margin of operational flexibility by agriculture could have impacts on users of surface water if it is determined to be interconnected. This potentially includes

[59] The Lassen County General Plan identifies this.
[60] This is an inaccurate dataset, but the best well data available to the GSAs.



6399
6400 **Figure 7-2 Analysis of Wells That Could Potentially Go Dry at Different Depths**

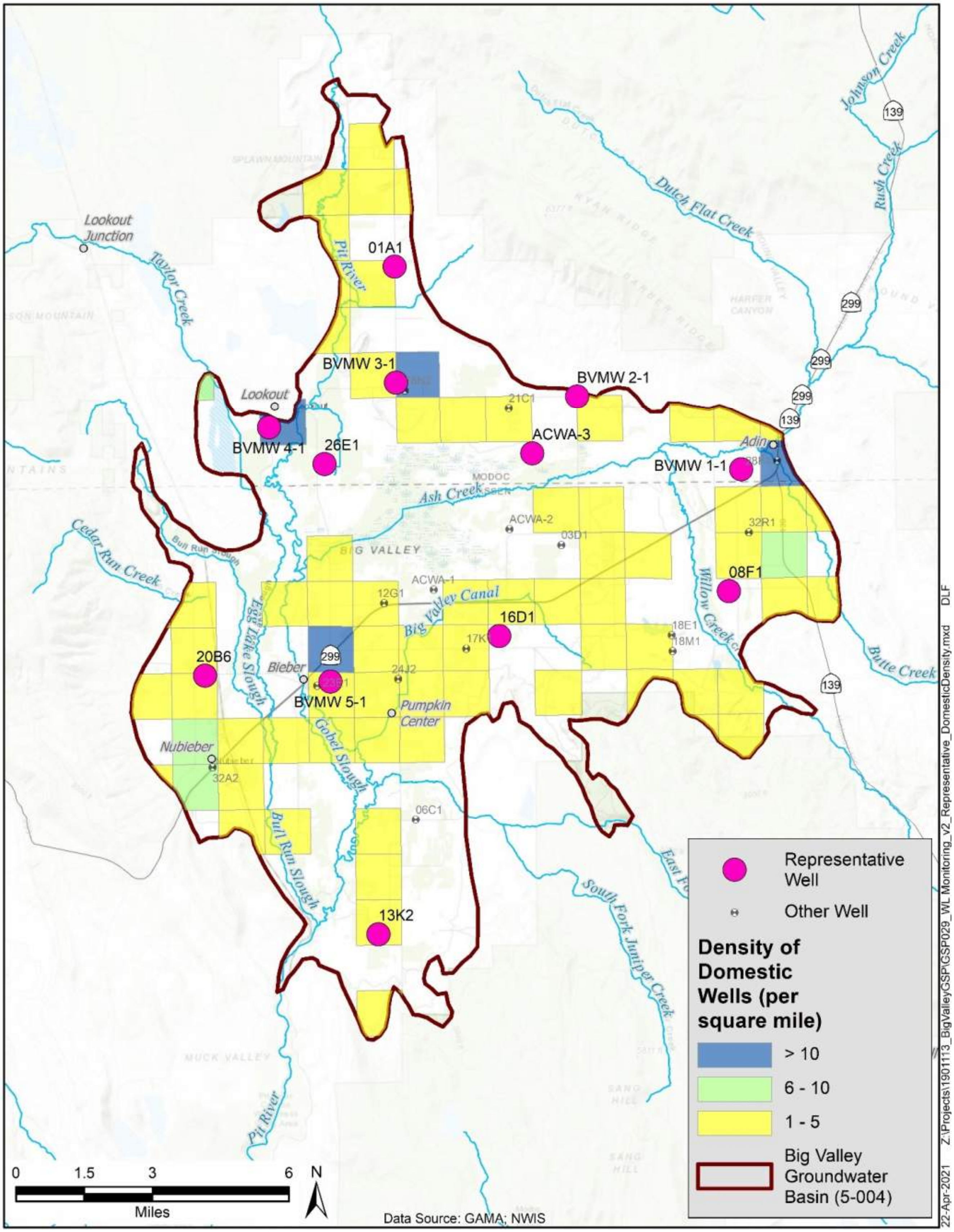


Figure 7-3 Domestic Well Density and Representative Groundwater Level Wells

groundwater dependent ecosystems and surface water rights holders. Discussion of this effect is discussed in Section 7.3.6 – Interconnected Surface Water, below.

Causes

Long term sustainability of groundwater is achieved when pumping and recharge are measured and balanced over multiple wet and dry cycles. When the groundwater pumping exceeds recharge, groundwater levels may decline. Similarly, when recharge exceeds pumping, groundwater levels may rise. Lower than average precipitation and snowpack over the last 20 years has resulted in declining groundwater levels in some parts of the Basin. A similar period of declining water levels occurred in the late 1980’s through the middle of the 1990’s. In the late 1990’s, several years in a row of above average precipitation caused groundwater levels to fully recover. Future wet periods, enhanced recharge, increased storage and addressing data gaps will likely cause groundwater levels to experience a similar recovery and maintain balance within the Basin.

Criteria

The undesirable result criterion for the groundwater level sustainability indicator occurs when the groundwater level in one-third of the representative monitoring wells drop below their minimum threshold for 5 consecutive years.

In addition to the above definition of undesirable result it is recognized that, although groundwater levels naturally fluctuate, some actions may be justified even before levels fall below the minimum threshold at a particular representative well. Thus, the GSAs are defining an “action level” to identify areas within the Basin where management actions and projects are needed (*see* Chapter 9 – Projects and Management Actions). The definition of the term “Action Level” is also at the discretion of the GSAs. “Action Levels” and the associated protocol are defined as follows:

“Action Level”: When monitoring within the established monitoring network identifies the following ground water level trends, targeted projects or management actions may be considered, at the discretion of the GSAs when any of the following occur:

- 1/3 of the representative monitoring wells in the Basin decline below the measurable objective (e.g., the fall 2015 baseline levels) for 5 consecutive years.
- Water levels at a 1/3 of the representative wells decline 3 times the average historic decline that well experienced between 2000 and 2018 as shown in **Appendix 5A**.
- Water levels at 1/3 of the representative wells decline more than 5 feet in 1 year.

Effects

As discussed above, if groundwater levels were to fall below the minimum threshold, pumping costs would render agricultural pursuits in the affected areas unviable. Without agriculture, the unique culture, character of the community and quality of life for Big Valley residents would be drastically changed. Reductions in agriculture would also affect wildlife who use irrigated lands as habitat, breeding grounds and feeding grounds.

Low water levels could cause wells to go dry, requiring deepening, redrilling, or developing a new water source. However, the long-term costs of agriculture becoming unviable causing reduced property values and tax revenue outweigh the short-term costs of investing in deeper wells or alternative water supplies. The potential effect would be offset by a shallow well mitigation program, which would apply to wells that have gone dry because water levels have fallen below the measurable objective. Substandard (e.g., hand-dug wells) would not qualify for mitigation. Mitigation would rely on a "good neighbor" practice already demonstrated in the Basin and would leverage any state or federal funding that may be secured. For example, the USDA Rural Development has offered low interest loans to drill new or replace existing wells. Additionally, prior to the first 5-year update, a program will be developed (*see* Chapter 9 – Projects and Management Actions) to cover a portion of the cost if new residential wells must be drilled because groundwater levels drop below the measurable objective. Any such program would apply to legally established wells and would be dependent on state and federal funding. Criteria will likely include well depth, screen interval, age of the well, distribution of declining wells (e.g., is it isolated) and other factors.

7.3.2 Groundwater Storage

The discussion and analysis regarding groundwater levels is directly related to groundwater storage. The groundwater levels for the fall 2015 measurement for each of the wells in the monitoring network (*see* Chapter 8 – Monitoring Network) is established as the measurable objective for groundwater storage (identical to the groundwater level measurable objective). The measurable objective is established at this level for storage for the same reasons discussed in the groundwater levels section. In summary, through public outreach, coordination with the BVAC and analysis of available data, the GSAs have determined that groundwater storage has not reached significant and unreasonable levels historically. Like the groundwater levels minimum threshold, the minimum threshold for groundwater storage is the same as for groundwater levels. The minimum threshold is set at this level for the same reasons discussed in the groundwater levels section.

Chapter 5 contains estimates of groundwater storage from 1983 to 2018 using groundwater contours from each year and an assumption that the definable bottom of the groundwater basin is 1,200 feet bgs. During this period, storage has fluctuated between a high of about 5,390,000 AF in fall 1983 (and 1999) to a low of 5,214,000 AF in fall 2015.

Description

Like groundwater levels, significant and unreasonable reduction in groundwater storage is defined as a level that results in the energy cost to lift the groundwater exceeding the economic value of the water for agriculture or a significant number of domestic wells are affected.

Justification of Groundwater Elevations as a Proxy

Again, the use of groundwater elevations as a substitute metric for groundwater storage is appropriate because change in storage is directly correlated to changes in groundwater elevation.

Causes

Long-term sustainability of groundwater is achieved when pumping and recharge are measured and balanced over multiple wet and dry cycles. When the groundwater pumping exceeds recharge, groundwater levels may decline. Similarly, when recharge exceeds pumping, groundwater levels may rise. Lower than average precipitation and snowpack over the last 20 years has resulted in declining groundwater levels in some parts of the Basin. A similar period of declining water levels occurred in the late 1980's through the middle of the 1990's. In the late 1990's, several years in a row of above average precipitation caused groundwater levels to fully recover. Future wet periods, enhanced recharge, increased storage and addressing data gaps will likely cause groundwater storage to experience a similar recovery and maintain balance within the Basin.

Criteria

As said, the measurable objective and the minimum threshold for groundwater levels and groundwater storage is the same. The monitoring network described in Chapter 8 – Monitoring Networks is also the same for both groundwater levels and storage. As such, the GSAs will use the voluntary and discretionary “Action Level” protocol described in the groundwater level section as a technique to improve management of groundwater when groundwater storage is below the measurable objective but above the minimum threshold.

Effects

Please *refer to* the “Effects” discussion in the groundwater levels section of this chapter, as the content in both sections is the same.

7.3.3 Seawater Intrusion

§354.26(d) of the GSP Regulations states that “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.”

The BVGB is not located near an ocean and ground surface elevations are over 4000 feet above msl. Seawater intrusion is not present and is not likely to occur. Therefore, SMCs are not required for seawater intrusion as per §354.26(d) cited above.

7.3.4 Water Quality

As described in Chapter 5 – Groundwater Conditions, the groundwater quality conditions in the Basin are over all excellent (DWR 1963, Reclamation 1979). After a review of the best available data on water quality in the Basin, it was concluded that all the constituents which were elevated above suitable thresholds are naturally occurring. There has been no identifiable increase in the level of concentrations over time, and several constituents have indications of improvement in recent decades compared to concentrations in the 1950’s and 1960’s (e.g., Arsenic and Manganese **Figures 5-8** and **5-10**).

While the water quality is considered excellent in the Basin, water quality is an important issue to both agricultural and domestic users within the Basin and they are working in coordination to retain the existence of excellent water quality. The multitude of programs which regulate water quality is listed in Section 3.5.

In addition, Big Valley residents are voluntarily participating and coordinating in activities that will ensure continued excellent quality water in the Basin. Over the last 15 years, landowners have drilled stock watering wells as part of the EQIP program to protect water quality in streams. In 2018, the Upper Pit River Watershed IRWMP 2017 Update was completed. This document conducted a thorough analysis of the entire Pit River Watershed and found no water quality issues within the BVGB. Agricultural users are also proactively managing water quality *via* partnerships with agencies such as the NRCS to implement on site programs which are designed to improve water quality as detailed in Chapter 9 – Projects and Management Actions. As described in Section 1.1 – Introduction, agricultural users primarily grow low impact crops with no till methods and little application of fertilizer or pesticides. Domestic water users are also assisting in maintaining good water quality within the Basin through community action. Through the civic process, Big Valley residents were engaged in the development of the Modoc and Lassen County ordinances to deter unlicensed outdoor marijuana growers and the unpermitted use of pesticides and rodenticides which may make their way into the groundwater and surface water. The domestic water users are also actively seeking to assist in code enforcement and reduce the amount of harmful debris within the Big Valley communities that may cause water quality issues. Public outreach through the offices of Public Health, Environmental Health and the Regional Recycling Group Recycle Used Oil and Filter Campaign will assist in maintaining excellent water quality. These outreach efforts are further discussed in Chapter 9 – Projects and Management Actions.

Due to the existence of excellent water quality in the Basin, significant amount of existing water quality monitoring, generally low impact land uses and a robust effort to conduct conservation efforts by agricultural and domestic users, per §354.26(d), SMCs were not established for water quality because Undesirable Results are not present and not likely to occur. At the 5-year updates of this GSP, data from various existing programs, including the RWQCB sites, public supply wells (regulated by the Division of Drinking Water) and electrical conductivity transducers installed by the GSAs at three wells (BVMW 1-2, 4-1 and 5-1) will be assessed to determine if degradation trends are occurring in the principal aquifer. In addition, water quality impacts resulting from projects and management actions will be evaluated during their planning and implementation. At the 5-year update, SMCs will be considered only if the trends indicate that undesirable results are likely to occur in the subsequent 5 years.

7.3.5 Land Subsidence

As detailed in Section 5.5, little to no measurable subsidence is occurring in the Basin. Furthermore, causes of micro-subsidence identified by the InSAR data presented in Section 5.5 are likely due to either agricultural land leveling operations or natural geologic activity. The specific identified areas of subsidence are considered acceptable and necessary agricultural operations to promote efficient irrigation. Similar situations may occur throughout the Basin and if identified through InSAR will be investigated. As detailed in Chapter 5, very minor areas of land subsidence have been observed in the Basin by the Continuous Global Positioning System site near Adin (CGPS P347, -0.6 inch over 11 years) and by the InSAR data provided by DWR (maximum of -3.3 inches over 4 years). The cause of these downward displacements has not been determined conclusively, but due to the widespread nature is likely natural and unavoidable due to the movement of Tectonic plates.

Given the lack of significant subsidence and the fact that some subsidence is acceptable to stakeholders in the absence of impacts on infrastructure (roadways, railroads, conveyance canals and wells among others), no undesirable results have occurred and none are likely to occur. Therefore, per §354.26(d), SMCs were not established for subsidence. At the 5-year updates of this GSP, data from GPS P347 and InSAR data provided by DWR will be assessed for notable subsidence trends that can be correlated with groundwater pumping. SMCs and undesirable results for subsidence will be established at the 5-year update only if trends indicate significant and unreasonable subsidence is likely to occur in the subsequent 5 years.

7.3.6 Interconnected Surface Water

The rivers and streams of the Basin are an important and vital resource for all interested parties. The agricultural industry has an extensive history of surface water use in the Basin and has operated for over a century. Many of the surface water rights on farms and ranches are pre-1914 water rights. All surface water flowing in the Basin during irrigation season is fully allocated. For all interested parties, there is need for better tracking of surface water allocations.

Section 5.6 ~~– Interconnected Surface Water~~ presents the available information related to interconnected surface water. It is nearly impossible to quantify surface water depletion impact based on flow alone, even in an area where there is good data, such as pumping quantity, deep aquifer groundwater elevation, precipitation and surface flow. Many of these criteria are current data gaps in the Basin, particularly the variation in precipitation and flow across the Basin. Uncertainty in the amount of surface water entering the Basin and the unpredictability of weather patterns has already been established and will continue to be a barrier. Pumping data in the Basin is also a data gap as there is no current monitoring system which annually measures the amount of water pumped. The connection between upland recharge areas and the unique volcanic geologic features surrounding the Basin are mostly unknown and make understanding the connectivity of surface and groundwater very difficult if not impossible.

Furthermore, the number of wells located next to streams and the river in the Basin are not quantified. While Chapter 5 – Groundwater Conditions details the streams in Big Valley which *may* be interconnected by a "…continuous saturated zone to the underlying aquifer and the overlying surface water…" (DWR 2016c), however, there is currently no evidence to support interconnected surface water. Therefore, there is a lack of evidence for interconnection of streams. **Figure 5-18** overlays the general direction(s) of groundwater flow around the Basin in relation to the major ~~perennial~~ streams. Also shown is the general direction of flow determined from the newly constructed well clusters near Adin and Lookout. The remaining clusters were constructed later and do not yet have a sufficient period of data to determine flow directions with certainty. The newly constructed monitoring wells will continue to gather data on whether there is any evidence of interconnected surface water.

Chapter 4 – Hydrogeological Conceptual Model, identified data gaps related to the effect of Ash Creek, Pit River and smaller streams on recharge. These data gaps may partially be filled once adequate data from the five monitoring well clusters are collected. Scientific research related to groundwater and surface water will improve over time. As this science is made available, the GSAs will work to locate funding for improved data depending on available staffing and financial resources.

SMCs were not established for interconnected surface water because there is insufficient evidence to determine ~~if~~that Undesirable Results are present or likely to occur. At the 5-year updates of this GSP, data from newly established well clusters, new and historic stream gages and the monitoring network detailed in Chapter 9 – Projects and Management Actions, will be assessed to determine if undesirable trends are occurring in the principal aquifer. At the 5-year update, SMCs will be considered only if the trends indicate that undesirable results are likely to occur in the subsequent 5 years.

7.4 Management Areas

Management areas are not being established for this GSP.

8. Monitoring Networks § 354.34

8.1 Monitoring Objectives

This chapter describes the monitoring networks necessary to implement the BVGB GSP. The monitoring objectives under this GSP are twofold:

- to characterize groundwater and related conditions to evaluate the Basin's short-term, seasonal and long-term trends related to the six sustainability indicators
- to provide the information necessary for annual reports, including water levels and updates to the water budget[61]

The sections below describe the different types of monitoring required to meet the above objectives, including groundwater levels, groundwater quality, subsidence, streamflow, climate and land use. Each type of monitoring relies on existing programs not governed by the GSAs and therefore the monitoring networks described in this chapter are subject to change if the outside agencies modify or discontinue their monitoring. The monitoring networks will generally be adjusted to the availability of data collected and provided by the outside agencies.

8.2 Monitoring Network

8.2.1 Groundwater Levels

Monitoring of groundwater levels is necessary to meet several needs based on the above stated objectives of the monitoring networks, including:

- Representative monitoring for groundwater levels
- The groundwater contours required for annual reports
- Shallow groundwater monitoring to help define potential interconnection of groundwater aquifers with surface water bodies

Table 8-1 lists existing wells that have been used for groundwater monitoring along with the newly constructed dedicated monitoring wells. The table indicates which wells are used for each of the three groundwater level monitoring networks. A more detailed table with elements required under §352.4(c) is included in **Appendix 8A**. Further details for each well and water level hydrographs are included in **Appendix 5A**. **Appendix 8B** contains the As-Built Drawings for the dedicated monitoring wells, also required by §352.4(c). The locations of the wells are shown on **Figure 8-1**.

[61] Water levels are needed to generate hydrographs, contours and an estimate of change in storage as required for the annual report. Also required for the annual reports are estimates of groundwater pumping, surface water use, and total water use which can be estimated from the water budget.

Table 8-1 Big Valley Groundwater Basin Water Level Monitoring Network

					Depth to Water (feet bgs)		Groundwater Elevation (feet msl)				
Well Name	Well Use	Well Depth (feet bgs)	Screen[1] Interval (feet bgs)	Representative Well[2]	Measurable Objective[3]	Minimum Threshold[4]	Measurable Objective[3]	Minimum Threshold[4]	Contour Well	Shallow Well	Monitoring Frequency
01A1	Stockwatering	300	40 - 300	X	148	288	4035	3895	X		biannual
03D1	Irrigation	280	50 - 280						X		biannual
06C1	Irrigation	400	20 - 400						X		biannual
08F1	Other	217	26 - 217	X	32	172	4222	4082	X		biannual
12G1	Residential	116	--								biannual
13K2	Irrigation	260	20 - 260	X	66	206	4062	3922	X		biannual
16D1	Irrigation	491	100 - 491	X	93	233	4079	3939	X		biannual
17K1	Residential	180	30 - 180						X		biannual
18E1	Irrigation	520	21 - 520						X		biannual
18M1	Irrigation	525	40 - 525								biannual
18N2	Residential	250	40 - 250								biannual
20B6	Residential	183	41 - 183	X	41	181	4085	3945	X		biannual
21C1	Irrigation	300	30 - 300						X		biannual
22G1	Residential	260	115 - 260								biannual
23E1	Residential	84	28 - 84								biannual
24J2	Irrigation	192	1 - 192						X		biannual
26E1	Irrigation	400	20 - 400	X	20	160	4114	3974	X	X	biannual
28F1	Residential	73	--								biannual
32A2	Other	49	--						X		biannual
32R1	Irrigation	--	--						X		biannual
ACWA-1	Irrigation	780	60 - 780						X		biannual
ACWA-2	Irrigation	800	50 - 800						X		biannual
ACWA-3	Irrigation	720	60 - 720	X	23	163	4136	3996	X	X	biannual
BVMW 1-1	Observation	265	175 - 265	X	53	193	4162	4022	X		continuous[5]
BVMW 1-2	Observation	52	32 - 52							X	continuous[5]
BVMW 1-3	Observation	50	30 - 50							X	continuous[5]
BVMW 1-4	Observation	49	29 - 49							X	continuous[5]
BVMW 2-1	Observation	250	210 - 250	X	22	162	4194	4054	X		continuous[5]
BVMW 2-2	Observation	70	50 - 70							X	continuous[5]
BVMW 2-3	Observation	70	50 - 70							X	continuous[5]
BVMW 2-4	Observation	60	40 - 60							X	continuous[5]
BVMW 3-1	Observation	185	135 - 185	X	18	158	4146	4006	X		continuous[5]
BVMW 3-2	Observation	40	25 - 40							X	continuous[5]
BVMW 3-3	Observation	50	25 - 50							X	continuous[5]
BVMW 3-4	Observation	50	25 - 50							X	continuous[5]
BVMW 4-1	Observation	425	385 - 415	X	65	205	4088	3948	X		continuous[5]
BVMW 4-2	Observation	74	54 - 74							X	continuous[5]
BVMW 4-3	Observation	80	60 - 80							X	continuous[5]
BVMW 4-4	Observation	93	73 - 93							X	continuous[5]
BVMW 5-1	Observation	540	485 - 535	X	47	187	4082	3942	X		continuous[5]
BVMW 5-2	Observation	115	65 - 115							X	continuous[5]
BVMW 5-3	Observation	85	65 - 85							X	continuous[5]
BVMW 5-4	Observation	90	70 - 90							X	continuous[5]

Notes:

-- = information not available

feet bgs = feet below ground surface (depth to water)

feet msl = feet above mean sea level (groundwater elevation NAVD88)

water year = October 1 to September 30

[1] For the purposes of this GSP, the terms "screen" or "perforation" encompases any interval that allows water to enter the well from the aquifer, including casing perforations, well screens, or open hole.

[2] Respresentative wells for Water Levels and Groundwater Storage

[3] Measurable objective is set at the Fall 2015 water level or at the lowest water level measured for wells that don't have a Fall 2015 measurement

[4] Minimum threshold is set at 140 feet below the measurable objective

[5] Continuous measurements are currently available due to the water level transducers installed in the wells. Less frequent monitoring may be appropriate in the future once the period of record of these wells is longer and interconnection of surface and groundwater is better understood.

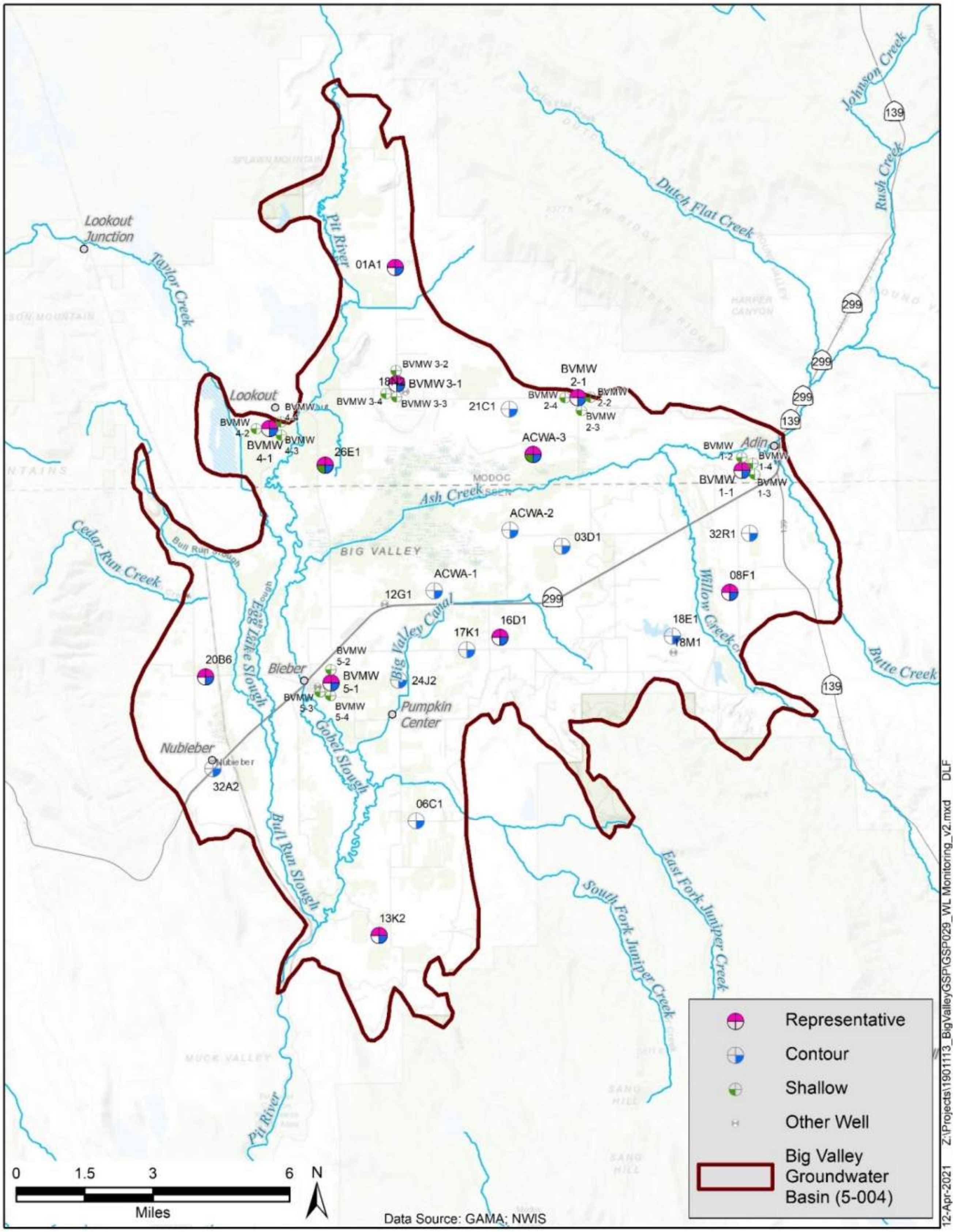


Figure 8-1 Water Level Monitoring Networks

GSP Regulation §352.4 states that monitoring sites that do not conform to DWR BMPs, "…shall be identified and the nature of the divergence from [BMPs] described." DWR's BMP (DWR 2016e) states that wells should be dedicated to groundwater monitoring. In addition, §354.34 indicates that wells in the monitoring network should have "depth-discrete[62] perforated intervals." Many of the historic wells listed in **Table 8-1** diverge from these standards and the explanation of their suitability for monitoring is described below.

Previous groundwater level monitoring in the Basin has relied on existing domestic and irrigation wells that often have pumps in them used for irrigation, stockwatering, or domestic uses. The intent of groundwater level monitoring is to capture static (non-pumping) water levels. However, historic monitoring is performed before and after the irrigation season, March or April for spring measurements and October for fall measurements[63]. Since these measurements are taken at a time when large-scale groundwater use is typically not active, using production wells is acceptable in the absence of dedicated monitoring wells. DWR staff who monitor the wells will indicate if the well (or a nearby well) is pumping in order to be considered when assessing water level measurements.

In addition to the well use considerations, most of the historic wells do not have depth-discrete screen intervals[64], as the typical well construction practice in the Basin has been to use long (100 feet up to 800 feet) screens, perforations, or open hole below about 30 to 40 feet of blank well casing. This construction practice is designed to maximize well yield. The use of such long-screen wells is acceptable for monitoring in Big Valley because multiple principal aquifers have not been defined in the Basin and therefore these long intervals do not cross defined principal aquifers. Since most wells are constructed with this practice, water levels in these long-screen wells should be indicative of the aquifer as a whole and less likely to be affected by perched water or isolated portions of the aquifer that may not be interconnected over large areas.

8.2.1.1 Representative Groundwater Levels and Storage Monitoring Network

The representative monitoring network includes all wells that have been assigned sustainable management criteria (minimum thresholds and measurable objectives). DWR does not give strict guidance on the number or density of wells appropriate for representative monitoring. ~~Their~~DWR's BMP document cites sources that recommend well densities ranging from 0.2 to 10 wells per 100 square miles (DWR 2016e). Through consultation with the BVAC, 12 wells were selected for representative monitoring of the Basin (which has an area of about 144 square ~~mile Basin,~~miles), a density of 8.3 wells per 100 square miles.

Extensive discussion and consideration were performed by the GSAs and local stakeholders to determine an appropriate water level monitoring network. Based on the comprehensive review of the wells, the network was selected based on:

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[62] "Depth-discrete" means that the screens, perforations, or open hole is relatively short (typically less than about 20 feet).

[63] Local stakeholders have advocated for future measurements to occur in mid-March and late-October to ensure they are taken before and after the irrigation season.

[64] Screens in this context includes perforated casing, well screens, or open hole, all of which allow water to flow into the well.

- Spatial distribution throughout the Basin to represent agricultural pumping areas
- Areas with a high density of domestic wells
- An existing monitoring record (where available) to track long-term trends
- Access for long-term future monitoring
- Well depth (greater than the MT)
- Wells dedicated to monitoring where available

Table 8-1 shows the MOs and MTs for the 12 representative wells. As stated in Chapter 7 – Sustainable Management Criteria, MOs are set at the fall 2015 water level. MTs are shown in **Table 8-1** to protect agricultural beneficial use

8.2.1.2 Groundwater Contour Monitoring Network.

The GSP Regulations (§356.2) require that annual reports include groundwater contours for the previous year (spring and fall) as well as an estimate of change in groundwater storage. Historic groundwater storage changes were estimated in Chapter 5 – Groundwater Conditions, using groundwater contours contained in **Appendix 5B**. Therefore, for annual reports to be comparable to historic conditions, the wells used for groundwater contouring should be the same, or nearly the same as those used for the historic contours. Five wells that were used in the historic contours are not included in the groundwater contour monitoring network (18M1, 18N2, 22G1, 23E1 and 28F1), because they were either replaced by a new dedicated monitoring well or there was another well close by that makes the measurement unnecessary. **Table 8-1** lists the groundwater contour monitoring network and **Figure 8-1** shows their locations.

8.2.1.3 Shallow Groundwater Monitoring Network

Chapter 5 – Groundwater Conditions, discusses interconnected surface water and describes the perennial streams in the BVGB. As described in Chapter 7 – Sustainable Management Criteria, there is currently no conclusive evidence for interconnection of streams with the groundwater aquifer and all summer flows are 100 percent allocated based on existing surface water rights. Therefore, measurable objectives, minimum thresholds and a representative monitoring network for interconnected surface water have not been established. Monitoring will be assessed at the 5-year update. Through consultation with the BVAC, a shallow monitoring network has been established that includes the shallow wells from each of the five monitoring well clusters. These clusters were designed to measure the magnitude and direction of shallow groundwater flow and are equipped with water level transducers that collect continuous (15-minute interval) water level measurements so that potential correlations with streamflow gages can be assessed. Well 26E1 was also added to the shallow network due to its position between the two major streams (Pit River and Ash Creek), its shallow screen depth (20 feet bgs) and its lack of a pump. Well number ACWA-3 was also selected for the shallow network due to its location on the ACWA within the northern portion of the Ash Creek wetlands associated with Big Swamp and the possible groundwater dependent ecosystems shown in **Figure 5-19**. **Table 8-1** lists the shallow groundwater monitoring network and **Figure 8-1** shows the well locations.

8.2.1.4 Monitoring Protocols and Data Reporting Standards

Currently, DWR measures groundwater levels at 21 wells in Big Valley. The expectation of the GSAs is that DWR will also monitor levels at the dedicated monitoring wells and download the transducer data from these wells. Transducer data will be corrected for barometric fluctuations using data from two barometric probes installed at two of the clusters. Water level data will be made available on the state's SGMA Data Viewer website for use by the GSAs in their annual reports and GSP updates. DWR's water level monitoring protocols are documented in their Monitoring Protocols, Standards and Sites BMP. (DWR 2016b). Portions of the BMP relevant to water levels are included in **Appendix 8C**.

8.2.1.5 Data Gaps in the Water Level Monitoring Network

Data gaps are identified in this section using guidelines in SGMA Regulations and BMP published by DWR on monitoring networks (DWR, 2016e). **Table 8-2** summarizes the suggested attributes of a groundwater level monitoring network from the BMP in comparison to the current network and identifies data gaps. No data gaps exist except the area near well 06C1, shown on **Figure 8-1**.

8.2.2 Groundwater Quality

Chapter 5 describes water quality conditions as overall excellent, and the few constituents that are infrequently elevated in Big Valley are all naturally occurring. Therefore, measurable objectives, minimum thresholds and a representative monitoring network have not been established. Monitoring will be assessed at the 5-year update. To make such an assessment, the GSAs will rely on existing programs, described in Chapter 7. Focus will be on the water quality reported for wells regulated by the State Water Board's DDW. DDW wells are shown on **Figure 8-2** and are in Bieber and Adin, with one well in the western portion of the Basin. In addition to data from DDW, the GSAs have installed three transducers to measure electrical conductivity (EC) at wells BVMW 1-1, 4-1 and 5-1, shown on **Figure 8-2**. These transducers increase the distribution of the monitoring network around the Basin and with increased frequency of measurement will allow the GSAs to better understand temporal trends that may not be apparent from infrequent DDW measurements. The EC transducers may be able to put anomalous[65] measurements from DDW into better context. **Table 8-3** lists the groundwater quality monitoring sites and their details.

[65] Anomalous measurements are those that are out of the norm or deviate from what would be expected. The source of the deviation from the norm should be noted and if errors are identified, the measurement(s) removed from the dataset based on professional judgment. At a minimum, anomalous measurements are marked as questionable, and the potential source(s) of the deviation documented.

Table 8-2 Summary of Best Management Practices, Groundwater Level Monitoring Well Network and Data Gaps

Best Management Practice (DWR, 2016d)	Current Monitoring Network	Data Gap
Groundwater level data will be collected from each principal aquifer in the Basin.	12 representative wells	None. There is a single principal aquifer and therefore all wells monitor the aquifer.
Groundwater level data must be sufficient to produce seasonal maps of groundwater elevations throughout the Basin that clearly identify changes in groundwater flow direction and gradient (Spatial Density).	22 contour wells	21 of the 22 proposed contour wells are currently monitored. Well 06C1 was monitored up until WY 2016. This well fills an important spatial area in the southern part of the Basin. To fill the data gap, the well could be re-activated, a new willing well owner found, or a dedicated monitoring well constructed in the area.
Groundwater levels will be collected during the middle of October and March for comparative reporting purposes, although more frequent monitoring may be required (Frequency).	All proposed monitoring network wells, except 06C1 are measured biannually, with the dedicated monitoring wells collecting continuous (15-minute) measurements	None. Current DWR monitoring occurs in March or April and in October for seasonal high (spring) and low (fall) respectively.
Data must be sufficient for mapping groundwater depressions, recharge areas and along margins of basins where groundwater flow is known to enter or leave a basin.	Groundwater depressions are present in the east-central part of the Basin near 03D1 and in the southern portion of the Basin near Well 06D1 and Well 13K2	03D1 defines the east-central depression. To ensure adequate definition of the southern depression, well 06C1 could be re-activated, a new, willing well owner found, or a dedicated monitoring well constructed in the area.
Well density must be adequate to determine changes in storage.	22 contour wells	Filling of data gap near 06C1.
Data must be able to demonstrate the interconnectivity between shallow groundwater and surface water bodies, where appropriate.	17 shallow wells, including 5 clusters of 3 shallow wells each	None.
Data must be able to map the effects of management actions, i.e., managed aquifer recharge.	22 contour wells and 17 shallow wells	None. Once projects and management actions are defined, monitoring specific to those projects and management actions will be identified.
Data must be able to demonstrate conditions near Basin boundaries; agencies may consider coordinating monitoring efforts with adjacent basins to provide consistent data across Basin boundaries. Agencies may consider characterization and continued impacts of internal hydraulic boundary conditions, such as faults, disconformities, or other internal boundary types.	22 contour wells and 17 shallow wells	None. There are no direct boundaries with adjacent Basins. Inflow/outflow from Basin addressed above.
Data must be able to characterize conditions and monitor adverse impacts to beneficial uses and users identified within the Basin.	12 representative wells	None

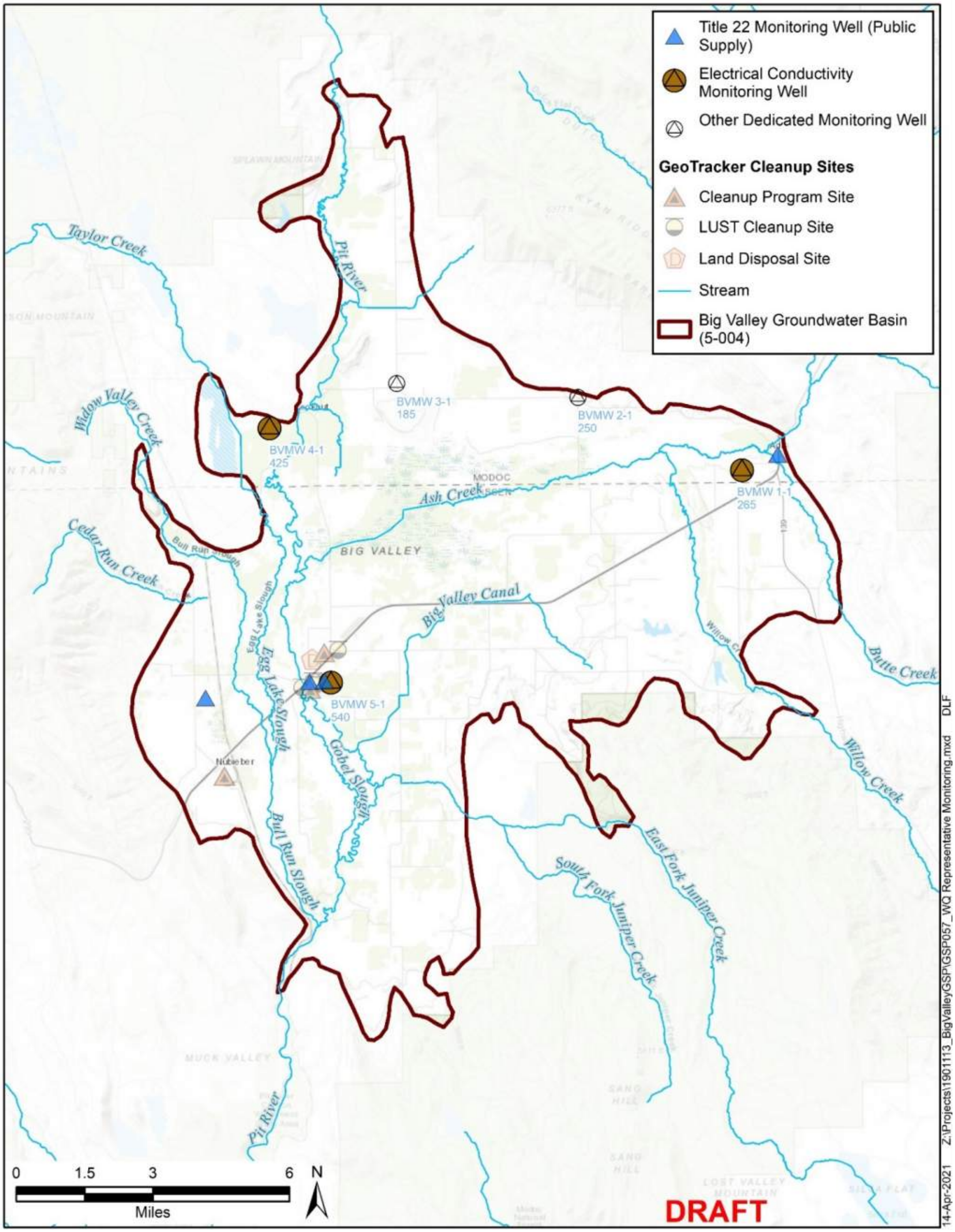


Figure 8-2 Water Quality Monitoring Network

Table 8-3 Big Valley Groundwater Basin Water Quality Monitoring Network

Well Name	SWRCB Public Source Code	DWR Site Code	Well Use	Well Depth (feet bgs)	Open Hole	Screen[1] Interval (feet bgs)	Constituents
Bieber Town Well 1	1810003-001		Public Supply	200	yes	62 - 200	Title 22
Bieber Town Well 2	1810003-002		Public Supply	240	no	60 - 240	Title 22
Adin Ranger Station Well 3	2500547-003		Public Supply	--	--	--	Title 22
Intermountain Conservation Camp Well 1	1810801-001		Public Supply	--	--	--	Title 22
BVMW 1-1		411880N1209599W001	Observation	265	no	175 - 265	Electrical conductivity
BVMW 3-1		412029N1211587W001	Observation	185	no	135 - 185	Electrical conductivity
BVMW 5-1		411219N1211339W001	Observation	540	no	485 - 535	Electrical conductivity

Notes:
-- = information not available
feet bgs = feet below ground surface (depth to water)
[1] For the purposes of this GSP, the terms "screen" or "perforation" encompases any interval that allows water to enter the well from the aquifer, including casing perforations, well screens, or open hole.

8.2.2.1 Monitoring Protocols and Data Reporting Standards

While DWR provides guidance on protocols and standards for water quality in their BMP (DWR 2016f), these don't generally apply to the Big Valley water quality monitoring network. For the DDW wells, monitoring protocols used by the parties responsible for collecting and analyzing samples will be relied upon. DDW and other data regulated by the State Water Board is made available on their GAMA GIS website. At the 5-year update, the GSAs will obtain and analyze the available data. The measurements for EC transducers are made in situ with no samples collected or analyzed in a laboratory.

8.2.2.2 Data Gaps in the Water Quality Monitoring Network

Table 8-4 summarizes the recommendations for groundwater quality monitoring from DWR's BMPs, the current network and data gaps. There are no data gaps in the water quality monitoring network.

8.2.3 Land Subsidence

As described in Chapter 5 - Groundwater Conditions and Chapter 7 – Sustainable Management Criteria, no significant land subsidence has occurred in the BVGB and no significant subsidence is likely to occur. Therefore, MOs, MTs and a representative monitoring network have not been established. This assessment was made based on a CGPS station near Adin (P347) and InSAR data provided by DWR. Future assessment of subsidence at the 5-year GSP update will rely on data provided by NOAA who operates Well P347 and updated InSAR data provided by DWR. The data will be assessed to determine if significant subsidence is occurring and the source of that subsidence.

Table 8-4 Summary of Groundwater Quality Monitoring, Best Management Practices and Data Gaps

Best Management Practices (DWR, 2016a)	Current Network	Data Gap
Monitor groundwater quality data from each principal aquifer in the Basin that is currently, or may be in the future, impacted by degraded water quality. The spatial distribution must be adequate to map or supplement mapping of known contaminants. Monitoring should occur based upon professional opinion, but generally correlate to the seasonal high and low groundwater level, or more frequent as appropriate.	4 public supply wells and 3 monitoring wells with EC transducers.	None. Most known contaminants are located in Bieber and Nubieber. Monitoring at wells in Bieber and in BVMW 5-1 have not shown contaminants but monitoring there would indicate if they become present.
Collect groundwater quality data from each principal aquifer in the Basin that is currently, or may be in the future, impacted by degraded water quality. Agencies should use existing water quality monitoring data to the greatest degree possible. For example, these could include ILRP, GAMA, existing RWQCB monitoring and remediation programs and drinking water source assessment programs.	4 public supply wells and 3 monitoring wells with EC transducers.	None.
Define the three-dimensional extent of any existing degraded water quality impact.	No degraded water quality impacts are present.	None.
Data should be sufficient for mapping movement of degraded water quality.	No degraded water quality impacts are present.	None.
Data should be sufficient to assess groundwater quality impacts to beneficial uses and users.	No degraded water quality impacts are present.	None.
Data should be adequate to evaluate whether management activities are contributing to water quality degradation.	None. Projects and management activities that are implemented will assess potential water quality impacts.	None.

8.2.3.1 Monitoring Protocols and Data Reporting Standards

Since the monitoring network relies on NOAA and DWR-provided data, the monitoring protocols and reporting standards for those organizations apply.

8.2.3.2 Data Gaps in the Subsidence Monitoring Network

Since InSAR data is contiguous across the Basin, there are no spatial data gaps. If subsidence is indicated by future InSAR datasets, there may be a need to field verify those areas to determine if field leveling has occurred or there is another reason or cause for the subsidence. Additional field validation could potentially be made by re-surveying monuments in the Basin, including those installed at the new monitoring wells.

8.2.4 Monitoring to Support Water Budget

8.2.4.1 Streamflow and Climate

Streamflow and climate data are needed to update the water budget. Current monitoring sites are shown on **Figure 8-3**. Modoc County has been working to improve water budget estimates and is proposing to add a stream gage on the Pit River just north of the BVGB, shown on **Figure 8-3**, which will be maintained by the state. Data gaps for smaller streams, such as inflow from Roberts Reservoir, Taylor Creek and Juniper Creek are proposed to be filled by investigating SB-88 stream diversion records submitted to the State Water Board.

8.2.4.2 Land Use

Land use data is needed for updates to the water budget. Since 2014, DWR has provided land use mapping using remote sensing processed by DWR's LandIQ mapping resource. DWR has provided these datasets for 2014, 2016 and 2018[66]. The GSAs will rely on DWR continuing to provide this land use data to generate annual updates to the water budget. The most recent land use data available will be used to generate the evapotranspiration estimates. Current research is being performed to develop the relationship between evapotranspiration (ET) and applied water. This research indicates that crops in this area are typically irrigated less than indicated by the assumptions made by multiplying ETo by crop coefficients.

[66] Landowners in the Basin have pointed out that these datasets are inaccurate, but they represent the best available information.

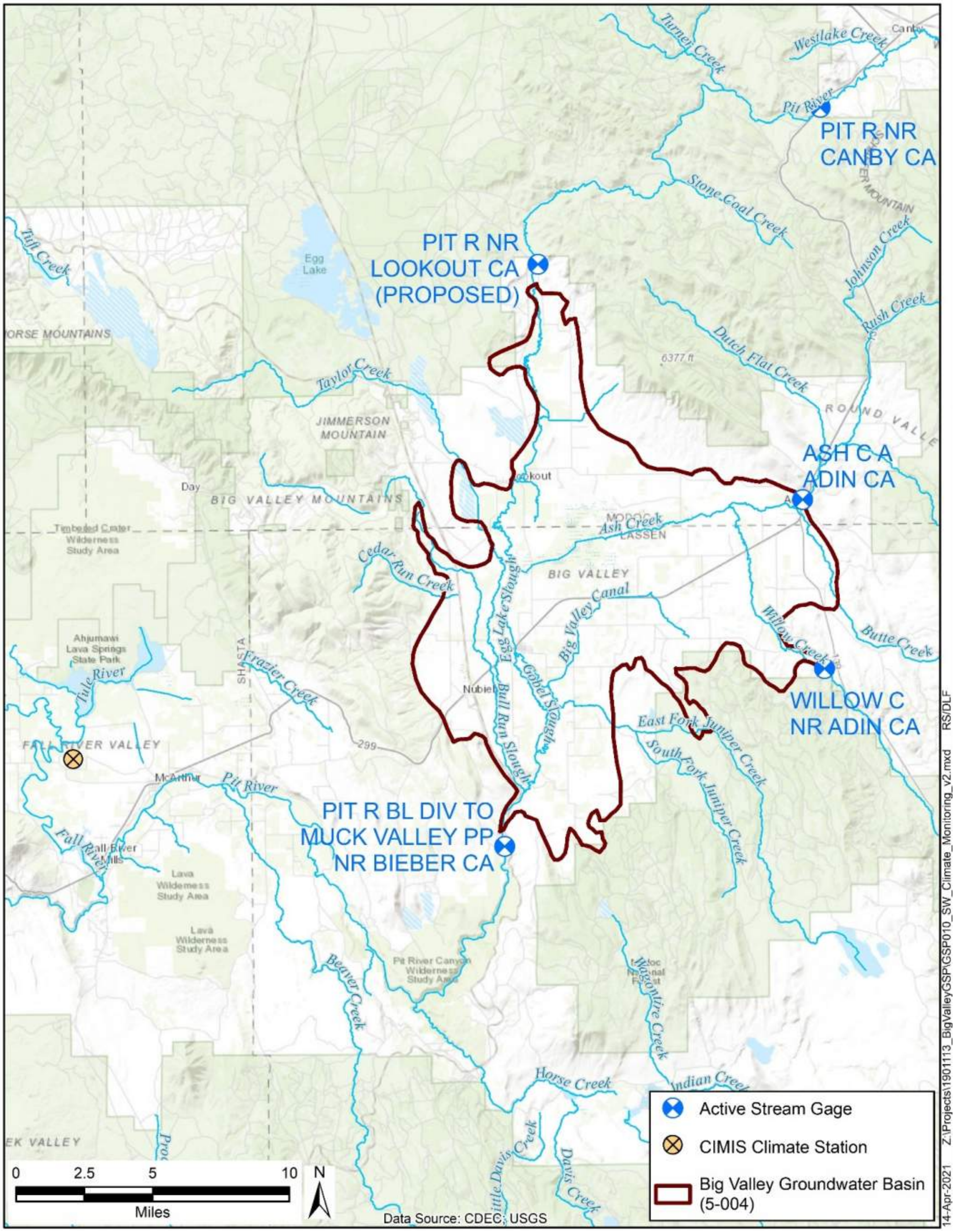


Figure 8-3 Surface Water and Climate Monitoring Network

9. Projects and Management Actions §354.44

Through an extensive planning and public outreach process, the GSAs have identified an array of projects and management measures that may be implemented to meet sustainability objectives in the BVGB. Additionally, numerous state and federal programs are available in the Basin to help meet the sustainability goals. Some of the projects can be implemented immediately while others will take significantly more time for necessary planning and environmental review, navigation of regulatory processes and implementation. The Big Valley Basin is relatively small, and while recharge does occur within the Basin itself, significant recharge comes from the extensive uplands surrounding the Basin. Projects will be located within the greater Big Valley watershed boundary shown in **Figure 9-1**.

Although the Big Valley area is extremely rural and economically disadvantaged, and resource capacity is limited, there are several local, state and federal agencies that can assist in project development.

Project implementation will also be impacted by funding acquisition. **Table 9-1** lists current state and local funding sources that can be targeted to support project planning and implementation.

With a proactive approach to identify projects for increased recharge and conservation in the Big Valley Basin and surrounding watershed, it is envisioned that the GSAs will be successful in remaining a sustainable groundwater basin. With the possible exception of a large surface water storage project such as Allen Camp Dam, the projects and management measures describe in this chapter are expected to work in combination and should be considered as a whole rather than dependent on any single strategy. Should sustainability not be realized, additional projects and management actions will be considered and developed as appropriate. A timeline for projects can be found in **Table 9-2**~~ and additional~~. The Regulations require details ~~fulfilling state requirements~~about each project to satisfy§354.44. Most of those details can be found in **Table 9-3**. One of the items not included in **Table 9-3** is §354.44(b)(7) is a description of the legal authority required for each project. The GSAs have the legal authority to coordinate and/or implement each of the projects described based on their authority under SGMA and state law. Some of these projects include aspects that will be implemented on private and public land. In those cases, permission and authority to implement the project will be obtained from the land owner.

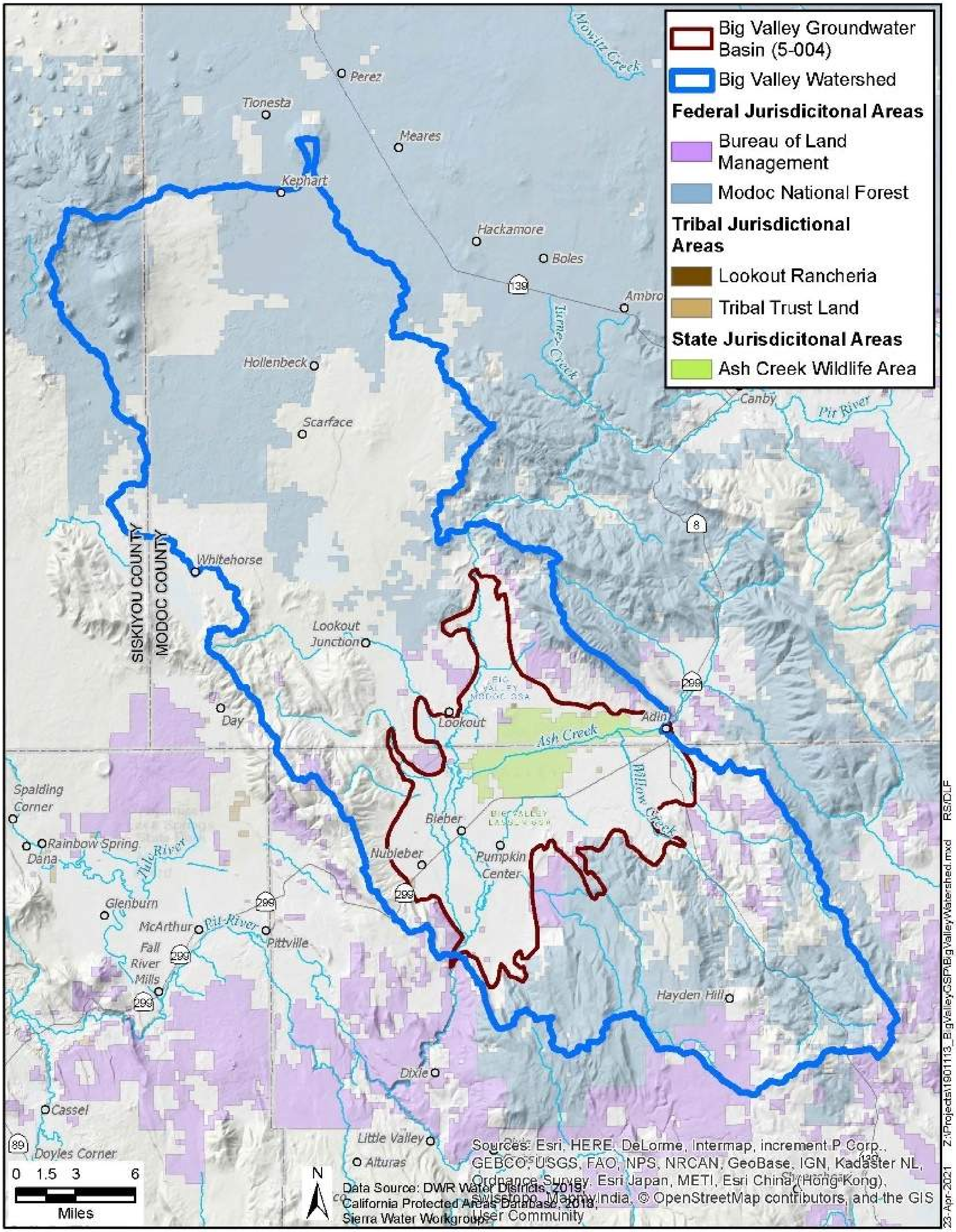


Figure 9-1 Big Valley Watershed Boundary

Table 9-1 Available Funding Supporting Water Conservation

Funding Program Title	Managing Agency	Description of Funding
Wetlands Reserve Program, Crop Reserve Program, Environmental Quality Improvement Program	NRCS (website)	Cost share funding for wide array of soil, water and wildlife conservation practices. Funding priorities developed locally.
Conservation Innovation Grants	NRCS (website)	Supports development of new tools, approaches, practices and technologies to further conservation on private lands.
Partners for Fish and Wildlife Program	US Fish and Wildlife Service (website)	Private land meadow, forest, or rangeland restoration, conservation easement.
State Water Efficiency and Enhancement Program (SWEEP)	California Dept of Food and Agriculture (CDFA) (website)	Supports implementation of water saving irrigation systems.
Healthy Soils Program	CDFA (website)	Supporting management and conservation practices for enhancing soil health (which includes water holding capacity).
Farmer/Rancher and/or Professional + Producer grants	Western Sustainable Agriculture Research and Education (website)	Farmer-driven innovations in agricultural sustainability including profitability, stewardship and quality of life.
Alternative Manure Management Program (AMMP) (link)	CDFA (website)	Financial assistance for non-digester manure management.
Sustainable Groundwater Management	DWR (website)	Planning and implementation grants supporting sustainable groundwater management. Disadvantaged communities and economically distressed areas.
State Forest Health Program	CAL FIRE (website)	Improve forest health throughout California.
USDA for household well deepening	USDA Rural Development (website)	No interest loan up to $11K to improve existing domestic wells.

Table 9-2 Projects and Potential Implementation Timeline

No.	Category	Description	Estimated Time for Potential Implementation (years)		
			0-2	2-8	>8
1	9.1 Recharge Projects	AgMAR	X	X	X
2		Drainage and Basin Recharge	X	X	X
3		Ag Injection Wells			X
4	9.2 Research and Data Development	Stream Gages	X		
5		Refined Water Budget	X	X	
6		Agro-Climate Station	X		
7		Voluntary Installation of Well Meters	X	X	
8		Adaptive Management	X	X	X
9		Mapping and Land Use	X	X	
10	9.3 Increased Storage Capacity	Expanding Existing Reservoirs		X	
11		Allan Camp Dam			X
12	9.4 Improved Hydrologic Function	Forest Thinning and Management	X	X	X
13		Juniper Removal	X	X	X
14		Stream and Meadow Restoration	X	X	X
15	9.5 Water Conservation	Irrigation Efficiency	X	X	
16		Landscaping and Domestic Water Conservation	X	X	
17		Conservation Projects	X	X	
18	9.6 Education and Outreach	Public Communication	X		
19		Information and Data Sharing	X	X	
20		Fostering Relationships	X		
21		Compiling Efforts	X	X	
22		Educational Workshops	X		

Note: AgMAR = Agricultural Managed Aquifer Recharge

Table 9-3 Required Elements for Projects and Management Actions

Project	Brief description	Circumstances under which the project will be implemented	Public notification process	Permitting and regulatory process	Benefits	Schedule	Estimated cost
9.1 Basin Recharge Projects	Agricultural Managed Aquifer Recharge is the practice of using excess surface water (when available) and applying it to agricultural fields to intentionally recharge groundwater aquifers	AgMAR will be performed during winter months during high surface flows. The nature, frequency and timing of these flows will be evaluated through a ~~Water Availability Analysis FIX LINK (WAA).~~ Water Availability Analysis (WAA).	Notification of available water and success of this projects will be communicated at public GSA meetings. Agreements will be made between the GSAs and interested producers.	Following development of the WAA, an AgMAR permit for surface water diversions can be solicited from the State Water Board. Currently this permitting process can take 6-18+ months and cause significant economic burden to the applicant. An organized application for Basin-wide winter diversions by the GSAs could lessen some of the regulatory burden since they qualify for a streamlined process but a waiver of fees for extremely disadvantaged communities working to improve groundwater recharge may also be needed.	Irrigating every 5-7 days for roughly 10 weeks in the winter/spring would benefit 2-5 AF of water per acre. Previous research has quantified that over 90% of water is recharged to deep aquifers or available in the soil profile with AgMAR. The limitation to this project is available winter for recharge but a project goal of 1,000 acres per year could provide roughly 10,000 AF of water per year benefit.	Water budget planning and permitting will take 6-18 months and possibly more depending on the case load at the department of water resources. After an off-season water budget is completed, permitting can be distributed to the GSAs for winter recharge location selection. AgMAR could start being used at productive scale by 2024 if all processes go smoothly.	The cost to develop the WAA is still being developed but may be covered under existing grants from DWR. The cost of submitting a streamlined permit will also be developed, including fees.
9.2 Research and Data Development	Stream gages are scientific instruments used to collect streamflow and water quality data to decrease scientific uncertainty in order to inform water management decisions. Agri-climate/CIMIS stations are helpful in monitoring for climactic factors such as temperature, humidity, wind speed, etc. and overall help refine estimates of ET in the Basin. Refining the water budget for the Basin will improve the accuracy with which management decisions are made because many of the assumptions used to generate the water budget stem from data gaps that need to be addressed, or other efforts to collect and analyze data submitted through other regulatory programs.	In addition to the continued use of existing stream gages which monitor many of the seasonal streams that contribute inflow to the Big Valley Basin, stream gages may be installed if locations and need are determined. Presently, Modoc County is working to install an additional stream gage where the Pit River enters the Basin. Data from agri-Climate/CIMIS stations may be utilized in order to make water management decisions with regard for climactic factors such as wind, rain etc. Adaptive management will be employed throughout the implementation process to allow for management decisions to reflect the best available data as more information comes available. Employing adaptive management strategies will expand our capacity to conduct research and data development, also. Refining the water budget will be done as more data becomes available through the combination of the data development projects described previously.	All research and data development progress will be shared at public GSA meetings. Data collected from gaging stations will be publicly available.	We will continue to work with DWR to ensure compliance with any relevant laws and to obtain any necessary permits related to stream gage installation and maintenance, as well as for other projects that fall under adaptive management strategies and the water budget.	Decreasing data gaps would decrease reliance on assumptions to govern groundwater management decisions. As more data becomes available, more accurate estimates of evapotranspiration would allow for more precise water budgeting estimates.	Gaging stations being installed where necessary early in the planning process in order to decrease uncertainty related to streamflow. They will be monitored throughout. Adaptive management strategies are anticipated to be employed throughout the GSP development and implementation phases. Refining the water budget is important early on in order to create a GSP that best reflects existing conditions in the Basin and which may be referenced in the future to perform adaptive management.	Funding is available for the development of new gaging stations. Maintenance costs may vary, but 1 estimate projects the annual maintenance cost for a single gage to be around $15,000. Funding for projects related to adaptive management and refining the water budget will be acquired as necessary. Presently, there is funding to maintain or install flow meters on private wells. More funding is likely available for similar projects, such as refining mapping and land use designations within the Basin.

Project	Brief description	Circumstances under which the project will be implemented	Public notification process	Permitting and regulatory process	Benefits	Schedule	Estimated cost
9.3 Increased Surface Water Storage Capacity	Surface water storage may be used to reduce reliance on groundwater by providing an alternative water source. Presently, Robert's Reservoir and several others including the Inverson, Silva and BLM reservoirs mitigate potential overdraft. As water levels in streams and other water courses diminish during the dry months, existing diversions may not adequately meet the needs of users. Expanding the capacity of these reservoirs and possibly constructing new reservoirs such as the Allan Camp Project would allow additional water from snowmelt and storm events to be stored. This would help circumvent reliance on groundwater and would provide reliable supplies of surface water for users.	Projects intended to increase surface water storage will be implemented when it is economically advisable to do so and when they may help mitigate Basin overdraft.	Pursuant to environmental review, these projects will have opportunities for public comment and project documents will be made publicly available whenever appropriate. Both National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) compliance mandate opportunities for public comment.	Permitting for surface water storage projects will be subject to NEPA and CEQA depending on whether the project sites are located on federal or state land respectively.	Increasing the capacity to store surface water by capturing runoff could reduce reliance on groundwater during summer months. Further, increasing surface water storage would improve water security during dry years.	The timeframe for largescale infrastructure projects would likely be upwards of 8 years, as the regulatory and environmental review processes generally require extensive coordination between agencies and stakeholders for planning and compliance.	Large infrastructure projects can be quite expensive. $1 in May 1981 had the same buying power as $2.97 in April 2021. A ballpark estimate of the capital costs for the Allan Camp Project in its entirety would amount to approximately $344,041,830, with the dam and reservoir component amounting to an additional $174,487,500. These figures are Funding may be available from the federal government in the form of loans under the Small Reclamation Projects Act of 1956. The cost associated with expanding existing reservoirs depends on the method employed. Sediment removal typically costs between "$8,000 and $32,000 per acre foot," (Lund 2014) and would be done infrequently. Increasing dam height typically costs between "1,700 to $2,700 per acre foot" (Lund 2014).
9.4 Improved Hydrologic Function and Upland Recharge	Upland forest recharge enhancement occurs in conjunction with vegetation management and forest fuels reduction by increasing snow water content and reducing dense forest canopy and associated evapotranspiration	Upland forest recharge will take place will be enhanced by implementation of forest health and fuels reduction projects within the Big Valley watershed. Such projects are on-going and in varying stages of planning and implantation. Support from GSAs and local, state and federal partners will increase implementation rate and scope. Water availability and recharge enhancement will be realized along with fire/fuels and wildlife habitat benefits.	On federally-managed lands public notification of projects will be conducted under NEPA by the Modoc National Forest or Applegate BLM. State funded projects will follow CEQA public notification process. Opportunities on private land be communicated by GSAs, Pit Resource Conservation District and other state and local entities.	Projects permitting will vary by land ownership. On federal lands: NEPA and applicable federal land policies. On private lands: state forestry rules are applicable and programs such as CAL FIRE's Forest Health Program will help clarify and streamline permitting processes.	Snow water content has been shown to increase by 33 to 44% from a dense conifer canopy to an open area. Surface run-off has also been shown to respond to treatments. Recharge figures are difficult to quantify, but even a modest increase in recharge over 10% of the potential upland recharge area could result several thousand AF of water.	The initial upland forest recharge project "Wagontire Project" is scheduled for implementation in 2022 and is expected completion in a 2- to 4-year window.	Project costs vary by site, but an estimated average is from $500 to $650 per acre.
9.5 Water Conservation Projects	Water conservation and water use efficiency projects would primarily be adopted by growers and homeowners on their private property. Infrastructure improvements, while requiring capital outlay are not subject to permitting or public environmental review.	Project implementation will be voluntary with cost-share incentives. Projects will be implemented on a site-by-site basis and designed for overall production and economic efficiency, along with water use savings.	Notification of opportunity to participate will be through local agricultural organizations, extension outreach meetings and by sponsoring agencies. Broad public notification of individual projects is not required.	Projects in this category such as upgrading irrigation infrastructure, irrigation management techniques, home landscaping, etc. are generally not subject to permitting requirements.	Some practices have been shown to result in efficiency increases in the range of 10% at the field scale. Multiplied over a number of farms, water use savings could be significant.	Irrigation infrastructure and water use efficiency incentives are on-going. UC Cooperative Extension has submitted a grant proposal to SWEEP to initiate an outreach education program in 2022.	Costs vary widely. New irrigation infrastructure on a field scale can exceed $100,000. Soil moisture meters for irrigation scheduling can be in the $100's to $1,000's of dollars per farm. Landscaping and homeowner water efficiency projects in the $100's to $1000's per home.
9.6 Education and Outreach	Education and outreach efforts can drive beneficial changes in patterns of use and protect water resources. Existing efforts employed by the GSAs include outreach about funding opportunities that support water conservation methods, coordinating information sharing efforts and facilitating informational meetings with stakeholder groups.	As an essential part of sustainability, outreach and education will be conducted throughout the development of the GSP, with many opportunities for public engagement.	Public information is available through the Big Valley GSP communication portal, accessible at bigvalleygsp.org. Informational brochures will be distributed to interested parties to make information about the GSP more accessible.	Public engagement is important to the regulatory process of SGMA and other acts that the GSP may be subject to. However, education and outreach are an incredibly important part of meeting the sustainability goals of this GSP, especially as it relates to equity and inclusion.	Public involvement in the GSP development is crucial in attaining sustainability. Research (OECD 2015) has shown that here are many social, economic and environmental benefits to education and outreach efforts in water management. These benefits can vary widely, but generally include increased levels of social cohesion, equity and conflict avoidance, improved water use efficiency and improved water quality.	Ongoing efforts to engage the public in outreach and education programs related to groundwater management are essential as part of the Groundwater Sustainability Plan. The anticipated timeline for outreach and education efforts is indefinite, but it is especially important throughout the planning and implementation process of the GSP.	Costs may vary depending on program type.

9.1 Basin Recharge Projects

Enhancing recharge to get more of the available water into the aquifer is one of the key means to attaining sustainability. Priority is given to the immediate Big Valley watershed, but additional recharge projects will be considered for surrounding upland and upstream areas of the Pit River watershed. A more detailed watershed map is provided in Chapter 3 – Plan Area. For off-season diversion recharge projects to be widely available in the Big Valley Basin, an off-season water availability study must be completed for the Pit River watershed up-river of Big Valley. This would allow growers to be able to obtain a permit for winter flow diversion. This study would include a survey of potential water rights held for off-season use, storage and hydroelectric power. *See* footnote link for a more detailed description of what is needed in this process.[67]

Once this survey is completed and approved by a licensed engineer, permits to divert for available surface water can be solicited from DWR. Currently this permitting process can take 6 to 18+ months and cause significant economic burden to the applicant. An organized application for Basin-wide winter diversions by the GSAs could lessen some of the regulatory burden since they qualify for a streamlined process but a waiver of fees for extremely disadvantaged communities working to improve groundwater recharge is needed. *See* footnote link for a more detailed description of what is needed in this process.[68]

Along with permitting costs, there are also costs to the irrigator in electricity and labor costs to apply water.

9.1.1 Agriculture Managed Aquifer Recharge

One approach to Basin recharge currently being considered is the intentional recharge of groundwater aquifers by spreading water over agricultural fields at times when excess surface water is AgMAR (Kocis & Dahlke, 2017, Dahlke et al. 2018). With significant surface water irrigation and diversions already present in Big Valley, AgMAR is a viable option in the Basin. Much of the current research on AgMAR has been completed on relatively well-drained soils that are not present in Big Valley. Research on Big Valley soils with slow to very slow infiltration rates appears to be initially promising. While recharge of groundwater may be slower in the Basin, it could still be a feasible means for deep water recharge and filling the shallow aquifer and root zone. AgMAR can be utilized for both, increasing recharge and decreasing water application of groundwater during the growing season due to a saturated soil profile. A conservative estimate suggests that 25,000 acres in Big Valley of agricultural and native vegetation lands are accessible to surface water and available for AgMAR. Priority will be given to low infiltration over very low infiltration soils for recharge and areas addressing more critical groundwater levels.

Among the perennial crops, alfalfa is considered a promising candidate for AgMAR for several reasons and significant initial research has been completed throughout California on its feasibility (Dahlke et al. 2018). 80 to 85 percent of the alfalfa in California is irrigated by flood irrigation which in turn could

[67] https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/docs/streamlined_waa_guidance.pdf

[68] https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/streamlined_permits.html

allow for areas where surface water can be utilized for groundwater recharge (Dahlke et. al. 2018). Alfalfa is widely grown in Big Valley and flood irrigation is common. Alfalfa is a nitrogen-fixing plant that seldom receives nitrogen fertilizer, which reduces the risk of leaching excess nitrate to groundwater, one of the main concerns of AgMAR (Putnam and Lin 2016; Walley et al. 1996). Dahlke, H.E., Et. al. 2018 found that winter recharge had no discernible effect on alfalfa yield (first and second cutting) and led to increased crop water availability in the deep soil profile offsetting potential irrigation deficits during the growing season.

Research currently being completed in Big Valley on the feasibility of AgMAR on perennial grass pasture and hay fields looks promising. Although soils in Big Valley have lower infiltration rates, winter recharge rates of 0.2 - 0.5 AF per acre per irrigation between March and April have shown no damage to crops. Soil infiltration rates show 2 to 3.5 inches of infiltration over a 24-hour period to be feasible. Irrigating every 7 to 10 days for six irrigations in the winter/spring would benefit 1 to 2 AF of water per acre into groundwater storage. This is the first AgMAR research completed on grass which is a dominant perennial crop in Big Valley. Given that some forms of applied nitrogen, particularly nitrate, have a propensity for leaching which has presented a challenge in other parts of the state, there has been some concern over nitrogen application and AgMAR. This can easily be addressed with BMPs of applying nitrogen outside of the winter recharge window. This work could also be easily applied to AgMAR feasibility on adjacent rangeland, conservation reserve project (CRP) or NRCS WRP land.

9.1.2 Drainage or Basin Recharge

Using the same principles as used in AgMAR, excess surface water can be diverted into irrigation drainages or canals and recharge basins to percolate into the groundwater table and replenish upper levels of the aquifer. This water is then available to be extracted at a later date for beneficial use. The volume of water recharged is limited by the availability and access to surface water, infiltration rates of the soils, losses to evaporation and available infrastructure.

The total number of feet or miles of irrigation canals or ditches needs to be determined along with the availability of current water storage basins (reservoirs) for recharge. Additional basins may need to be created for the sole purpose of groundwater recharge. Producers wanting to participate in this program would notify the GSA and report diverted water for the purpose of drainage or Basin recharge. The development of a water availability study and permitting as described on in **Table 9-3** also applies to this project. Unlined drainages, canals and basins could recharge up to 90 percent of diverted surface water to the aquifer.

9.1.3 Aquifer Storage and Recovery and Injection Wells

Aquifer storage and recovery (ASR) is the use of a new or existing well to inject and store water underground during wet periods and then extract by the same or other nearly wells to meet demand during dry periods. Increased aquifer storage provides some of the same benefits as new surface storage but can be phased in over time and can be less expensive. From an operations perspective, increased aquifer storage is a practical option since it involves the use of new or existing groundwater wells retrofitted for injection. ASR projects require a permit from the RWQCB and the permitting method is usually the Statewide ASR General Order (General Order)[69] adopted by the State Water Board in 2012.

The General Order requires that the water being injected into aquifer storage meet drinking water standards, so in the case of Big Valley, this will require filtration and chlorination of surface water prior to injection into aquifer storage.

Because pre-treatment of the water source for injection and operation and maintenance of ASR wells is relatively expensive, ASR is typically used when surface spreading *via* basins or flooded fields is not feasible. ASR may be favored in areas of the Basin constrained by land area limitations, unfavorable surface soils or shallow confining layers at or near the ground surface preventing deep percolation of applied water.

In Big Valley, the most likely scenarios in which ASR would be implemented are when under the following conditions:

- Flood MAR projects are not able to stabilize groundwater levels in some location due to the presence of impermeable soils at or new the surface, or
- As mitigation to reverse declining groundwater levels near public or domestic supply wells

ASR would be implemented in phases if the conditions above warrant it. ASR would only be feasible with outside funding assistance through either state or federal grant programs to both cover the capital expenses and assist with the monitoring required for compliance with the ASR General Order. Under these conditions, ASR will be developed in phases as summarized below:

- Phase 1 – Assessment of wells and hydrogeology culminating in a technical report to accompany a notice of intent to inject provided to the regional water quality control board. This phase will identify locations and monitoring during ASR pilot testing.
- Phase 2 – ASR pilot testing following receipt of a Notice of Applicability from the RWQCB. Pilot testing may include a single well test or may involve multiple wells throughout the Basin based on the finding and recommendations in the technical report developed in Phase 1.
- Phase 3 – Implementation including retrofit of existing wells, construction of new wells and operation of these facilities to stabilize or increase aquifer storage.

More information about ASR is available from the U.S. Environmental Protection Agency.[70]

9.2 Research and Data Development

Data gaps are mentioned and detailed throughout the GSP chapters. Continuing to fill these gaps, participate in research and collect data to support the GSP is necessary to support sustainability using the best science available.

[69] https://www.waterboards.ca.gov/water_issues/programs/asr/
[70] https://www.epa.gov/uic/aquifer-recharge-and-aquifer-storage-and-recovery

9.2.1 Additional Stream Gages and Flow Measurement

Several seasonal streams contribute inflow to the Big Valley Basin (**Figure 9-2**). Many of these streams had historical stream gages or have current gages monitored by the USGS and DWR. The Pit River which is a major inflow river and significant contributor of surface water irrigation and recharge in Big Valley has a gage 13 miles from where the Pit River enters Big Valley at the Canby bridge. There are many springs and small tributaries that flow into the Pit River after the Canby bridge as well as irrigated lands water use between Canby and the Big Valley Basin. Modoc County has been working to install an additional stream gage where the Pit River enters the Basin to fill this data gap and provide more current stream flow information for GSP development and water management. There is also funding for additional stream gages if locations of need can be determined. The current and proposed stream gages are in **Figure 9-2**.

9.2.2 Refined Water Budget

Many assumptions were taken to create the Big Valley water budget in Chapter 6 – Water Budget. Some of these assumptions stem from data gaps that need to be addressed and other areas are opportunities to collect and analyze data that is being submitted through other regulatory programs. This section describes a combination of projects that will help improve the accuracy of the water budget and in-turn better inform groundwater management in Big Valley.

There is currently no agri-climate or CIMIS station located in Big Valley. Nearby stations in other basins have helped to create models to determine averages but significant geologic features affecting elevation often make weather patterns unpredictable from nearby basins. These stations have more sensors than typical weather stations including solar radiation, soil temperature, air temperature, wind speed and direction, relative humidity, soil moisture and rain gauging. These measurements can determine accurate ET which is very helpful in creating a more refined water budget for the Basin and help maintain sustainable groundwater conditions. ET is used as a metric for applied water especially when meters on actual applied water are not available. These stations can also help farmers in determining irrigation need and promote water conversation especially early in the growing season.

With an accurate estimate of ET, the next assumption is the relationship between ET and applied water in Big Valley. Since most crops grown in Big Valley are hay crops, irrigation must be stopped when cutting, drying and baling even though ET continues. Pinpointing the relationship between ET and applied water could greatly refine the water budget and amount of irrigation water that is being applied.

An effort to refine mapping and land use designations would further increase the accuracy of estimates related to water use within Big Valley. The water budget's assumptions are primarily derived from existing sources, many of which may need to be updated or expanded upon to reflect current conditions. LandIQ has been a primary tool in estimating irrigated acres, although there is some inaccuracy related to the land classifications which field studies could address.

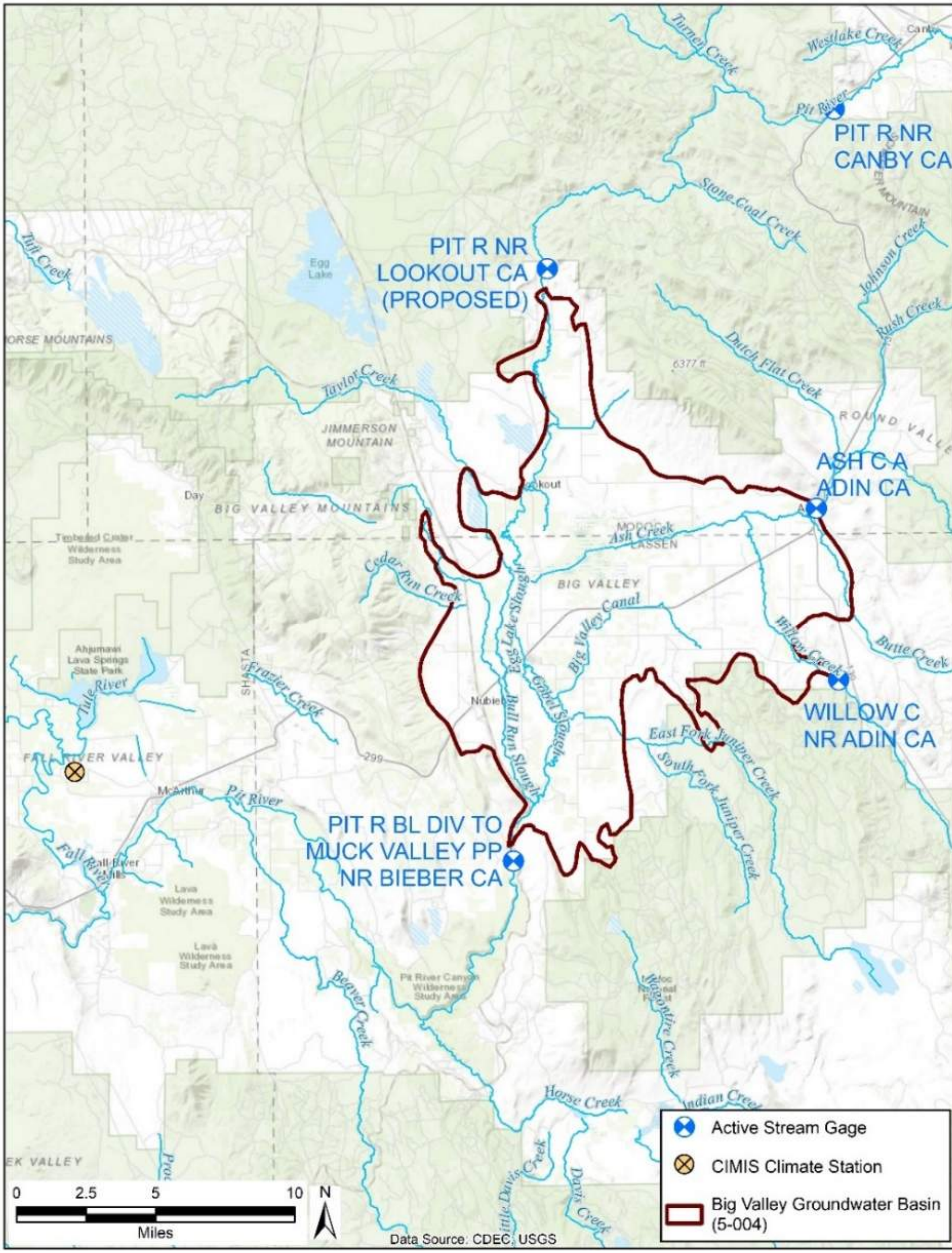


Figure 9-2 Current and Proposed Stream Gages

A voluntary well monitoring program has been available in Big Valley for upwards of 2 decades through the Lassen-Modoc Flood Control and Water Conservation District[71]. Reinvigorating this program by identifying meters that need to be replaced, conducting outreach to add new wells to the program and organizing the historical data fills a data gap and provides critical data to refine the water budget and pinpoint areas of concern. Meters are available for agricultural and domestic water users. Funding from DWR in a grant to Modoc County is currently available to provide well meters to voluntary applicants. Further, it would be beneficial to identify additional monitoring wells to provide unobstructed measurements year-round. Several such wells have been installed at five sites within the Basin and generate monthly data across 15-minute intervals. Expanding on this existing program would further refine the water budget.

Additionally, funding is available to install satellite transducers in key areas throughout the Basin, which would allow for real time monitoring of domestic well levels. Coupled with an increased effort to both verify well numbers and update lists to reflect active *versus* inactive wells, these real time monitoring locations will provide more accurate estimates of domestic groundwater demand and supply within the Basin. Thus, these combined actions will further inform water management strategies to ensure that domestic users' groundwater needs are represented equitably in the water budget.

Collectively, the continuation of applied research efforts will help to better quantify the impacts from those actions and thus help refine the water budget. Such research efforts, which will be discussed in depth in later sections of this chapter, include evaluating the effectiveness of off-season groundwater recharge in hay crop fields and pastures, the impacts of forest thinning projects such as fuels reductions and the removal of invasive junipers on water availability within the watershed, and the extent to which surface water systems, including drainages, canals and reservoirs contribute to recharge within the Basin. Additional research projects to support the water budget will be identified and undertaken as needed, contingent on funding.

9.2.3 Adaptive Management

There are many unknowns and data gaps with respect to groundwater resources in the Big Valley Basin. As a result, estimates and assumptions are currently used in the plan to determine several key variables. To address the lack of necessary information, a significant commitment to the continued monitoring of both ground and surface water is described in this plan. By further developing and enhancing monitoring networks in Big Valley we can gather the data necessary to inform management and set criteria as more information becomes available.

This describes an adaptive management strategy. Adaptive management is an approach to improve natural resource management which focuses on learning by doing. Learning occurs through monitoring, data development, outreach and collaborative interpretation. Then, the adaptation of management criteria and tools is applied to existing practices as critical information becomes available. This approach is very applicable to the BVGB and will serve as a bridge towards sustainability by providing current

[71] Lassen-Modoc County Flood Control and Water Conservation District

site-specific information to inform appropriate SMCs and thresholds as well as the ongoing assessment of projects and management actions in the Basin.

Although it is recognized and proven that the Big Valley Basin does not have the unsustainable conditions seen in other basins around the state, monitoring and filling data gaps from SMCs that were determined to not require thresholds helps us prepare for annual reports and 5-year revisions and make management decisions. These SMCs without identified thresholds include interconnected surface water and groundwater, water quality and subsidence. Additionally, monitoring could aid in the analysis of the relationship between groundwater levels and GDEs.

9.3 Increased Surface Water Storage Capacity

Increasing the capacity to store surface water run-off during winter/spring high-flows could provide significant amounts of water for summer irrigation. An increase in surface water available for irrigation would lessen the reliance on groundwater and thus remain sustainable.

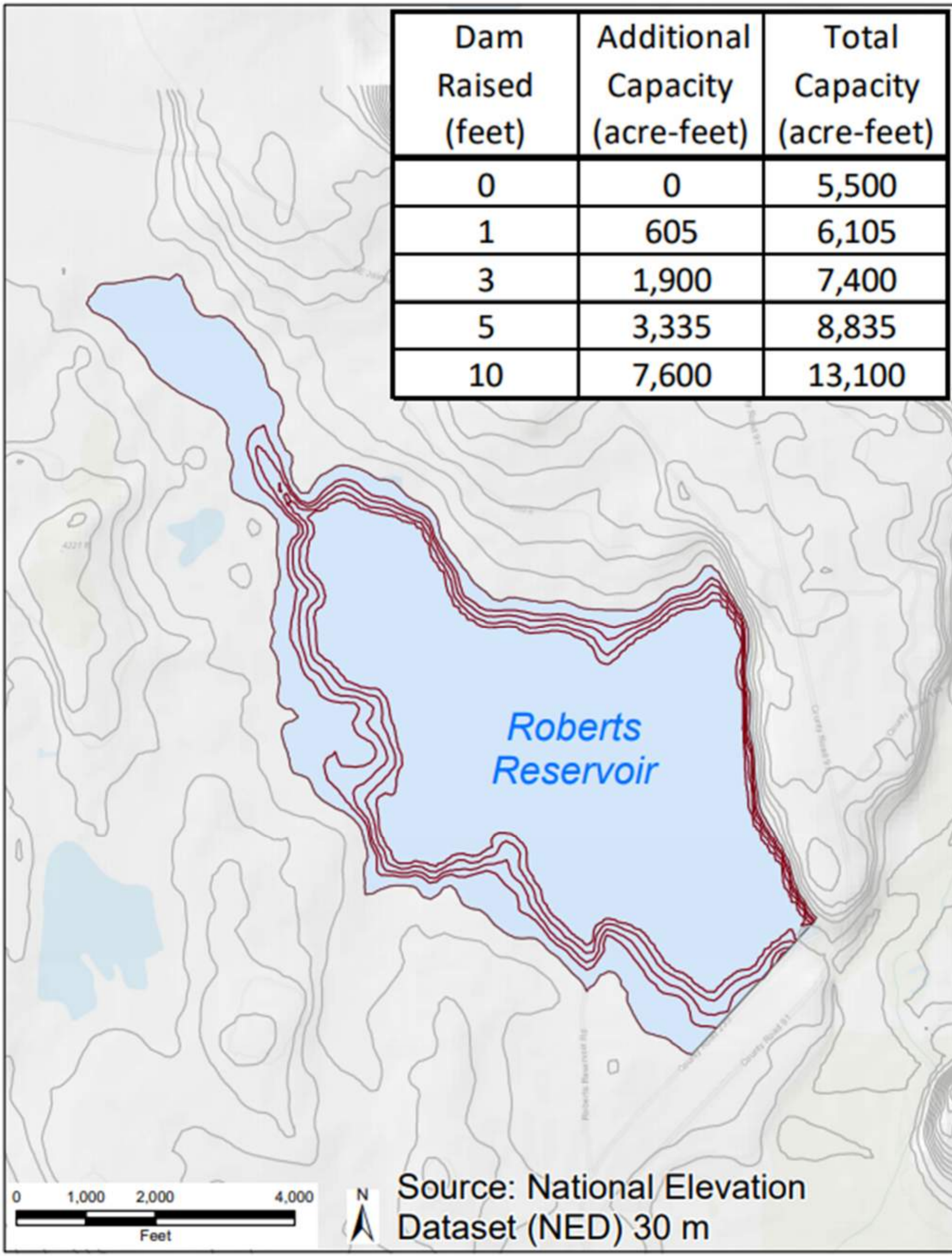
9.3.1 Expanding Existing Reservoirs

Expansion of several existing reservoirs serving Big Valley Basin would increase the capacity of surface water for irrigation and recharge projects as well as help balance the water budget. An increase in water storage would make the Basin more sustainable regarding climate variability and decreases in snowpack while also relieving pressure on groundwater for irrigation in Big Valley. One larger reservoir, Robert’s Reservoir, is located northeast of Lookout and has a current capacity of 5,500 AF. Possible scenarios for raising this reservoir’s dam are shown in **Figure 9-3**. For example, raising Robert’s Reservoir 3 feet would increase capacity 1900 AF, an increase of 35 percent.

Other reservoirs include Iverson, Silva and BLM reservoirs. From an engineering perspective, the base of the Iverson reservoir is much wider than it needed to be at the time it was built. This suggests that the foundation would easily support construction to increase its height.

Expanding current reservoirs may possibly be the most time and cost-effective alternative for expanding surface water storage compared with building new reservoirs, for which navigating the environmental review process and other regulations can be difficult.

All reservoir expansion projects would undergo three phases. The Phase 1 examines the feasibility of the proposed project and planning. Engineering, permitting and project design take place during Phase 2. Phase 3 covers implementation and construction of the proposed project. Reservoir expansion is typically done through either sediment removal or by physically raising the height of the dam. Typically, expanding reservoirs through sediment removal is very costly, between “8,000 and 32,000 dollars per acre foot” (Lund 2014) and would be done very infrequently. Raising dam heights or building new reservoirs is also expensive; an acre foot of storage space generally costs between “1,700 and 2,700 dollars.” (Lund 2014). Depending on funding, sediment removal may be investigated and removed sediment could potentially be repurposed to reinforce existing infrastructure such as the levees that protect Bieber and Lookout from Pit River flood events.



Dam Raised (feet)	Additional Capacity (acre-feet)	Total Capacity (acre-feet)
0	0	5,500
1	605	6,105
3	1,900	7,400
5	3,335	8,835
10	7,600	13,100

Figure 9-3 Robert's Reservoir Scenarios

9.3.2 Allen Camp Dam

The Allen Camp Dam and Reservoir (**Figure 9-4**) was authorized by the Department of the Interior (DOI) as part of the Allen Camp Unit of the Central Valley project in 1976 to regulate flows of the Pit River primarily for irrigation and fish and wildlife purposes, as well as flood control and recreation services. The DOI published a report (DOI 1981) that concluded that based on the existing criteria the proposed project was economically inadvisable, it may be appropriate to conduct a new investigation into the feasibility of this project to reflect the changes to water needs of the community, environment and state that have occurred over the last 40 years.

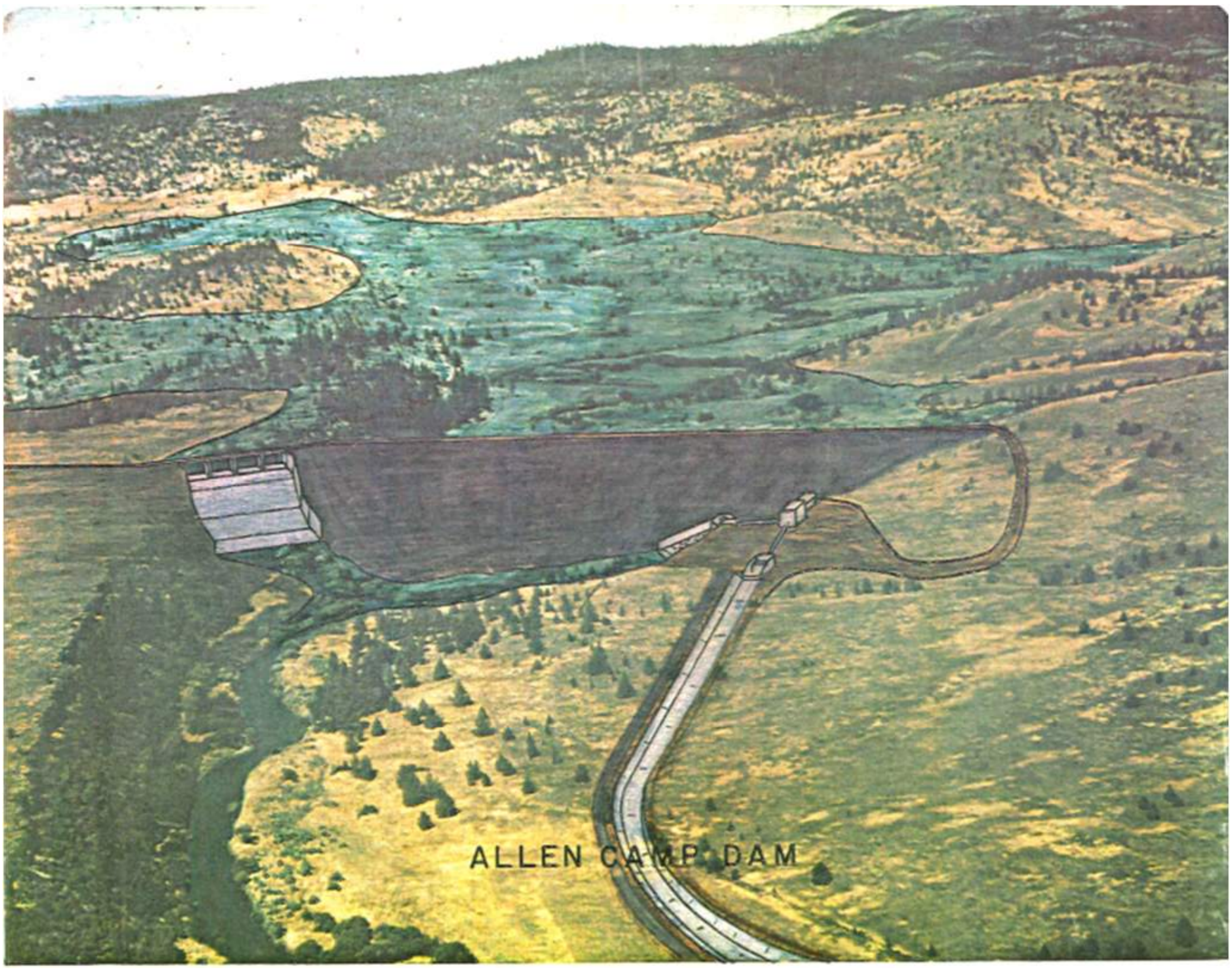


Figure 9-4 Allen Camp Dam Drawing

According to the original feasibility study (DOI 1981) the dam would be located around 11 miles north of the Modoc-Lassen county line, Allen Camp Reservoir would have a 90,000-AF storage capacity, a 18,000-AF surcharge, 2,350 acres of water surface area and a normal year yield of 22,400 AF. The dam would be constructed from earth and rock fill and would measure 103 feet from the streambed. The construction of the various proposed project components would require the acquisition of about 18,240 acres of private land through easements or through fee titles and the withdrawal of roughly 11,845 acres of public land. Most of the land acquired would be allocated for the dam and reservoir project features, a total of 18,015 acres. In the original document, another significant allocation, 11,562 acres, was for the proposed Big Valley National Wildlife Refuge. This addition was intended to offset habitat loss for species such as deer and migratory waterfowl. An updated feasibility study for this project should consider the expansion of the Ash Creek Wildlife Refuge since 1970 as an alternative for this proposed mitigation measure. The remaining land would be partitioned at 355 acres for the Hillside Canal, 148 acres for the lateral distribution system and 5 acres for the Nubieber protective dike.

In 1981, there were 62 ownerships slotted to receive deliveries from this project, accounting for a total 11,700 irrigable acres all of which would benefit from full or supplemental water deliveries. The report stated that the groundwater basin area of the project has a storage capacity of roughly 532,000 AF with a safe yield of 7,000 AFY, with 5,000 AF of that developed. These numbers may have changed over the 40 years that have elapsed since the report was published and should be reviewed under an updated feasibility study. An increasingly variable climate casts uncertainty over water availability, with drier years driving an increased reliance on groundwater supplies. Further, an updated feasibility study might consider how this project could mitigate some of the effects of climate variability and watershed conditions on the BVGB by providing a reliable source of surface water, thereby reducing dependence on groundwater.

9.4 Improved Hydrologic Function and Upland Recharge

9.4.1 Forest Health / Conifer and Juniper Thinning

The watershed surrounding the Big Valley Basin is comprised of approximately 800,000 acres of conifer forest and rangeland (**Figure 9-5**). Management policies have resulted in tree densities that are currently much higher than at the beginning of the 20th century. This includes western juniper and other mixed conifers (Stephens et. al. 2016) (Miller and Tausch 2001).

There are two main mechanisms by which dense junipers and other conifers impact water availability in forested watersheds. First is the interception of snow (primarily) and rain that gets caught in branches and needles and evaporates before ever reaching soil surface and second is the high rate of transpiration due to dense layered canopy and vigorous network of roots (Ryel and Leffler 2011). An excellent summary paper by Smerdon et al (2009) describes linkages between forest health and tree density and groundwater recharge in a variety of landscapes.

Spring snow water content ranged from 33 to 44 percent higher in the aspen and an open meadow snowpack telemetry (SNOTEL[72]) site *versus* adjacent juniper and conifer forest where interception of snowfall was much higher (LaMalfa and Ryel 2008). Averaged over the entire catchment, strategically placed fuel treatments in the wetter central Sierra Nevada (American River) creating a relatively light vegetation decrease (8%), resulted in a 12 percent runoff increase, averaged over wet and dry years. Wildfire, with and without forest treatments, reduced vegetation by 38 and 50 percent and increased

[72] SNOTEL is an automated system of snowpack and related climate sensors operated by the NRCS of the USDA in the Western U.S.

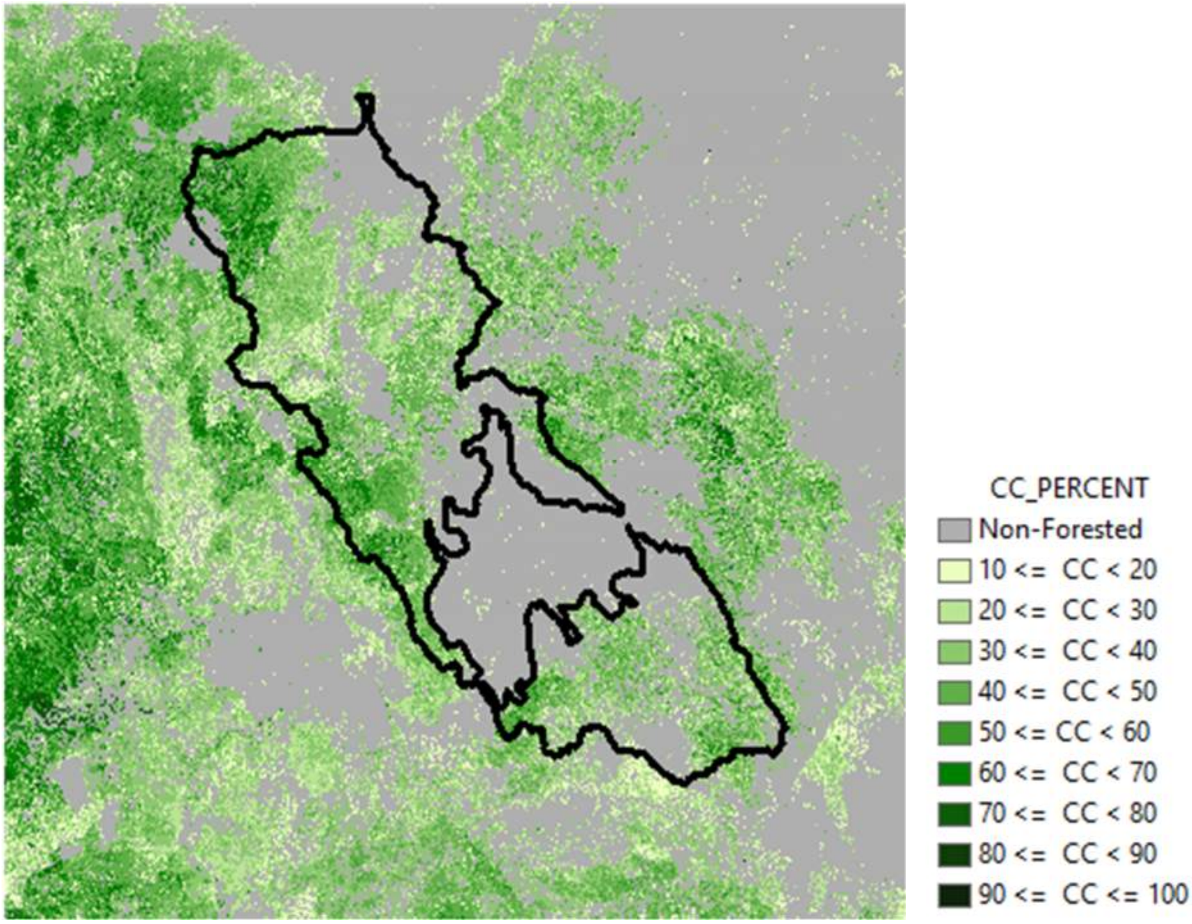


Figure 9-5 Canopy cover percentage of forested areas within the Big Valley watershed

runoff by 55 and 67 percent, respectively. Forest fuel reduction in drier sites in the southern Sierra had less increase in run-off than wetter sites in the central Sierra Nevada Range. (Saska 2019).

A similar increase in water availability has been documented on juniper-invaded rangelands. During the period of maximum water uptake, mature trees used between 45 and 69 times more water than juniper saplings depending on precipitation and, consequently, soil water availability. In summary, 1) juniper water use varies greatly with precipitation and 2) because of the large difference between mature and sapling trees, juniper control results in considerable water savings, even after a 14-year period of juniper regrowth. (Mata-Gonzales et. al. 2021). Paired watershed studies in Oregon have demonstrated increased deep soil moisture, increased spring flow and increased surface water run-off after juniper harvest compared to untreated areas. They have also documented a hydrologic connection between shallow groundwater on juniper sites and a nearby riparian valley. (Ochoa et. al. 2016).

The opportunity to enhance upland watershed recharge is significant as projects are already in planning and implementation stages to reduce fire risk and improved wildlife habitat (Miller 2001) and programs such as CAL FIRE's Forest Health Program support project implementation funding. Forest health projects can be developed and meet multiple resource objectives including hydrologic values. Removal of conifers from meadow edges, drainages and spring areas as well as improving hydrologic function of road crossings, ditches and stream channels (where feasible) will enhance hydrologic and recharge benefits of forest health projects. Given the vast land area surrounding Big Valley, treatment of even a fraction of the land area would result in a significant amount of recharge. This could help mitigate any deficit. Recently, controlled burns and fuels reductions have gained considerable traction as forest management tools and could be utilized for the purposes discussed.

9.4.2 Stream Channel Enhancement and Meadow Restoration

Several meadow restoration techniques exist for the purpose of returning proper hydrologic function to montane and rangeland meadows. Two commonly used in the Big Valley Basin and surrounding uplands include pond and plug and beaver dam analogs. Both techniques result in reconnection of a stream channel with a functioning floodplain and restoration of a degraded meadow's water table up to its historic level. Restoration of the meadow water table results in re-watering of meadow soils and vegetation, with significant effects throughout the restored floodplain for meadow hydrology, wildlife and forage. Restored floodplain connectivity spreads flood flows so that a meadow's natural ability to settle the coarse or fine sediment delivered from steeper stream reaches is restored and natural percolation can occur. When floodplain function is restored, a portion of winter and spring runoff is stored in meadow soils rather than racing down the pre-project gully during the runoff season. Data indicates that release of this stored runoff results in increased stream flow in late spring. (Hunt et. al. 2018)

In mountains of the western U.S., channel incision has drawn down the water table in many meadow floodplains. Increasing climate variability is resulting in earlier melt and reduced snowpack and water resource managers are investing in meadow restoration which can increase springtime storage and summer flows. Between 2012 and 2015, during a record setting drought, a pond and plug restoration in Indian Valley in the Sierra Nevada Mountains was implemented and monitored. Despite sustained drought conditions after restoration, summer base-flow from the meadow increased 5 to12 times. Before restoration, the total summer outflow from the meadow was 5 percent more than the total summer inflow. After restoration, total summer outflow from the meadow was between 35 and 95 percent more than total summer inflow. In the worst year of the drought (2015), when inflow to the meadow ceased for at least one month, summer base-flow was at least five times greater than before restoration. Groundwater levels also rose at four out of five sites near the stream channel. Filling the incised channel and reconnecting the meadow floodplain increased water availability and streamflow, despite unprecedented drought conditions. (Hunt et. al. 2018).

Other studies have also shown that these techniques may increase surface and subsurface storage and groundwater elevations that contribute to channel complexity and residence times. These factors could lead to stronger flow permanence in channels subject to seasonal drying. Increased availability of water and productivity of riparian vegetation can also support human uses in arid regions, such as irrigation and livestock production. (Pilliod et. al. 2018).

9.5 Water Conservation

9.5.1 Irrigation Efficiency

The fundamental objective of an irrigation system is to deliver an optimum amount of water for crop growth during spring, summer and fall growing seasons while temperature and daylength are conducive to plant growth but natural precipitation is lacking. Irrigation water and water application costs comprise the single biggest operational cost associated with alfalfa or grass hay production in the intermountain area accounting for approximately 30 percent of total operating costs (Wilson et. al. 2020) (Orloff et. al. 2016). Increasing the efficiency of crop water use is an economic as well as a conservation minded goal. Farmers in the Big Valley area have been adopting water conservation measures as feasible opportunities arise and will continue to do so. Support for infrastructure, new technology and education outreach will help attain this goal.

Flood, wheel-line and center pivot irrigation systems are all used on Big Valley farms. The best irrigation system depends on water availability, crop, soil type and infrastructure. Commonly, center-pivots are rated as the most efficient systems but there are appropriate uses for all three types. Many advancements in irrigation efficiency have been made and will continue to be developed and implemented. It is critical that implementation is done at a farm-by-farm basis in such a way as to fit specific conditions and production systems. A one-size fits-all application will be neither effective nor economically viable, such as SGMA.

It is important that any irrigation system be well maintained to operate properly. Flood irrigated fields should be appropriately leveled with appropriate width and length of irrigation check to provide for a uniform application of water. Sprinkler systems should be regularly checked for function and be designed with the right nozzle size for available flow and pressure. Systems that can utilize larger diameter nozzles can reduce droplet size and evaporation loss. Length of irrigation set should make use of soil water holding capacity without incurring excessive tailwater. Specialized systems such as Low Energy Sprinkler Application can improve water use efficiency up to 15 percent. Length of irrigation set should make full use of soil water holding capacity without incurring excessive run-off.

To optimize efficiency of water use, the amount and timing of irrigation water applied should closely match the amount of water needed by the crop thus maintaining adequate soil moisture for crop growth while minimizing tail water run-off. Effective use of irrigation technology such as soil moisture sensors, tracking of evapotranspiration, flow meters etc. are available to help farmers manage irrigation timing and length of set to get the most of their irrigation system. While some of these have been applied in Big Valley some are relatively novel.

Genetic selection and the continued improvement of forage crop species has resulted in the increased availability of drought tolerant, heat tolerant, or short-season forage grasses that may provide growers and viable alternatives in certain situations where water availability is otherwise limited. Crop selection is often based on the best fit for particular soil depth, soil texture and water availability in conjunction with value and marketability. Although Big Valley cropping systems are heavily constrained by climate and growing season, on-going forage crop improvement may provide growers with a wider range of species and variety options.

Overall good agronomic practices in terms of soil fertility, weed control, harvest etc. is critical and promotes an efficient use of all resources including water. Finally, as mentioned in other places in this plan, agricultural fields and farms provide important wildlife habitat in the valley. Irrigated lands are an important part of the overall landscape. A good example is that flood irrigated pastures are highly valued by migratory birds particularly in the spring. Emphasis on water efficiency is important but should not become such a single-focused objective that other resource values or farm profitability are ignored.

It should be clear that efficient use of water for irrigated forage crop production is multi-faceted, and several small improvements, strategically together to fit on-farm conditions is the most effective approach. To this end, education outreach *via* U.C. Cooperative Extension, technical support from NRCS, and cost-share and grant programs are all critical to supporting water use efficiency measures. Support and incentive programs that have been used and can be further expanded upon in Big Valley are listed in **Table 9-1** (funding program table).

9.5.2 Landscaping and Domestic Water Conservation

While Big Valley is extremely rural and economically disadvantaged, there are opportunities to enhance water conservation among domestic water users. Particularly regarding domestic landscaping, use of native drought adapted plants, irrigation timers, effective mulch, and rainwater/snow water catchments can reduce water requirements. Low water landscaping can also be integrated with homeowner firesafe planning. Landscaping guides for homeowners can be distributed at public centers and at regional garden supply stores (Hartin et. al. 2014) (California Native Plant Society, 2021).

9.5.3 Illegal Diversions and Groundwater Uses

As detailed in Section 3.3 – Land and Water Use, water use for illegal activities (i.e., unlicensed marijuana growers) occurs in the Basin and surrounding watershed. Lassen and Modoc county staff have limited time and resources to address this issue, but they do utilize high-resolution aerial imagery from an imaging contractor as part of their effort to identify, map and report to the appropriate federal and state agencies responsible for taking enforcement action against the offenders. When county resources are available, staff will continue to work with their imaging contractors to identify and report illegal activities to the Bureau of Cannabis Control, CDFW, State Water Board and the BLM. The GSAs will rely on these agencies to take an aggressive approach in Big Valley with the objective of eradicating the Basin and watershed of illegal groundwater pumping and surface water diversions within the first 5 to 10 year of GSP implementation.

9.6 Public Education and Outreach

The GSAs believe that public education and outreach are an important component of this GSP. Education can change use patterns that promote water conservation and protection of water resources. The GSAs support continued education on preventing illegal dumping, illegal marijuana growers, properly sealing abandoned wells and BMPs. Continued outreach to support the coordination of efforts and information sharing, fostering relationships with relevant agencies and organizations and attending meetings with local and region groups involved in water management is also important. This includes increasing public outreach about funding opportunities and programs that support water conservation methods, increased recharge and mediation opportunities for decreasing water levels. **Table 9-1** lists current state and local funding sources that can be targeted to support project planning and implementation. More information on public outreach and communication can be found in Chapter 11 – Notice and Communications.

Outreach methods that can be expanded include radio public service announcements, cooperator workshops with University of California Cooperative Extension (UCCE) and social media posts informing the public about upcoming meetings and deadlines, BMPs, plan updates, recharge opportunities and updated water conditions. An organized effort to compile recharge and conservation activities would aid GSAs in tracking impacts for future Plan revisions.

10. Implementation Plan

GSP implementation generally consists of five categories of activities:

- GSA Administration and Public Outreach
- Monitoring and Data Management
- Annual Reporting
- Plan Evaluation (5-year updates)
- Projects and Management Actions

This chapter contains discussion of the details for each of these activities, then sets forth a schedule for implementation, estimates costs of implementation and discusses funding alternatives.

10.1 GSA Administration and Public Outreach

The nature of GSA administration is not addressed explicitly in the GSP Emergency Regulations. Much of the work to implement portions of the GSP (e.g., monitoring and projects and management actions) must be performed by outside entities such as DWR and hydrology professionals. However, this work will need to be coordinated by the GSAs and some work will need to be performed by GSA staff.

One category of work that rests on GSA shoulders is public outreach. The level of effort needed from GSA staff depends greatly on the details of public outreach discussed in Chapter 11 – Notice and Communications. In addition to the public outreach performed during GSP development, Regulations (§354.10(d)) require GSAs to develop a communication section of the plan that includes the following:

(1) An explanation of the Agency's decision-making process

(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used

(3) A description of how the Agency encourages the active involvement of diverse social, cultural and economic elements of the population within the basin

(4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions

Chapter 11 will contain the Communications and Engagement Plan, but the requirements of the Regulations are presented here for awareness by GSA staff to refine this chapter and understand the level of effort and expense that will be required for this component of GSP implementation. Decisions will need to be made regarding whether the BVAC continues as a functioning body after completion of the GSP and if the BVAC continues what role they take and how often they meet will determine the level of GSA staff effort to facilitate BVAC meetings and activities.

10.2 GSP Annual Reporting

According to §356.2 of the Regulations, the Big Valley GSAs are required to provide an annual report to DWR by April 1 of each year following the adoption of the GSP. The first annual report will be provided to DWR by April 1, 2022 and will include data for the prior WY, which will be WY 2021 (October 1, 2020 – September 30, 2021). While the WY as defined by DWR isn't ideal for use in Big Valley, the GSAs will assemble data based on DWR's definition as per SGMA statute and regulations. The Annual Report will establish the historic conditions of groundwater within the BVGB, the status of the GSP implementation and the trend towards maintaining sustainability. Unfortunately, while conditions won't differ significantly from when the GSP was developed, the GSAs are still required to submit the annual report to comply with GSP regulations. A general outline is included below:

- General Information
    - Executive Summary
    - Introduction (1 map of Basin)
- Basin Conditions
    - Groundwater Elevations (2 contour maps, 12 hydrographs)
    - Estimated Groundwater Extractions (1 table from water budget)
    - Estimated Surface Water Supply (1 table from water budget)
    - Estimated Total Water Use (1 table from water budget)
    - Estimated Change in Groundwater Storage (2 maps, 1 graph and 1 table)
- GSP Implementation Progress
    - Progress Toward Measurable Objectives
    - Updates on Projects and Management Actions

Another way to organize this requirement and for GSA staff and stakeholders to understand the level of effort and expense involved in developing annual reports is to outline major technical tasks. Much of the effort to develop the annual reports is to take available data collected by outside agencies, generate figures based on that data and then re-submit to DWR. Below is a summary outline of tasks to be performed by GSA staff and/or consultants to develop the annual report:

- Download Water Level Data from state website and generate:
    - Hydrographs for 12 representative wells
    - Assumed Spring and Fall groundwater contours
    - Assumed Groundwater difference contours (e.g., fall 2020 to fall 2021)
- Download water budget data from state websites[73]
    - Run water budget for the WY and generate estimates of:
        - Groundwater extractions
        - Surface water supply

[73] This includes precipitation and reference evapotranspiration (ETo) from CIMIS and streamflow data from CDEC, BVWUA, Brookfield Energy, and other sources.

- Total water use

- Assemble and write annual report, of the estimates and assumptions.
- Upload report and data to state website, of the estimates and assumptions.

10.2.1 General Information

In accordance with §356.2(a), each Annual Report will include, at the front of the report, an executive summary that will summarize the activities and the condition of groundwater levels within the BVGB for the prior year. The executive summary shall also include a map of the BVGB, its GSAs and the monitoring network.

The annual report will include an introduction that will describe the following:

- A description of the BVGB and the two GSAs
- The general conditions of the BVGB for the prior WY (precipitation, surface water allocations, crop demands, municipal demands, etc.)
- Any significant activities or events that would impact the water supply and/or groundwater conditions for the BVGB

10.2.2 Basin Conditions

Included in the annual report will be a discussion of specific local water supply conditions per §356.2(b). This section will provide a description of the water supply conditions for the WY being reported along with a graphical representation of the conditions. A WY shall be defined as the 12-month period starting October 1 through September 30 of the following year. Water supply conditions that will be discussed include:

- Assumed Groundwater Elevations – elevation data from the monitoring network, including hydrographs for the representative wells and groundwater contours for spring and fall.
- Assumed Groundwater Extractions – groundwater pumping estimates and measurements for agricultural, municipal, domestic and industrial[74] pumping generated from the water budget.
- Assumed Surface Water Supply – data from surface water supplies to irrigation demand[75], conveyance losses and groundwater recharge, generated from the water budget.
- Assumed Total Water Use – total water uses by agricultural, municipal, domestic and industrial sectors, generated from the water budget.
- Assumed Change in Groundwater Storage – a determination of the groundwater (volumetric) change, calculated from groundwater difference contours and/or the water budget.

[74] This includes both in-basin industries as well as fire, wildlife, logging, and construction (which use both surface and groundwater).
[75] Summer flows in the BVGB are 100% allocated under existing water rights.

10.2.3 Plan Progress

The annual report also needs to describe the progress of the Plan since the previous report, including progress in maintaining measurable objectives and status of projects and management actions.

10.3 Data Management System

The Regulations require a data management system (DMS), but do not give strict guidance on format or how to develop and maintain the DMS. §352.6 of the Regulations states:

> Each Agency shall develop and maintain a data management system that is capable of storing and reporting information relevant to the development or implementation of the Plan and monitoring of the basin.

The DMS proposed for Big Valley is separated into two categories: data for annual reports and data for GSP updates much of which is taking data already managed by the state and returning it to the state in a new format.

10.3.1 Annual Report DMS

Annual reports require water level data and other data to update the water budget. **Table 10-1** lists the data needed and the sources of those data. The DMS can be stored using common software (Microsoft Excel and ArcGIS) on GSA servers. Water level data will be downloaded from the state website[76] and stored in an Excel hydrograph spreadsheet tool. This tool will store the well information, water level data, WY types and sustainable management criteria (minimum thresholds and measurable objectives). The tool will allow users to generate hydrographs and provide the data needed to generate contours. **Figure 10-1** shows a screenshot of the Excel Water Level Tool for storing water well and water level data and generating hydrographs.

Table 10-1 Annual Report DMS Data Types

Data Type	Collecting Entity	Data Source	DMS Tool
Water Levels	DWR	SGMA Data Viewer	Excel Water Level Tool
Precipitation	DWR	CIMIS	Excel Water Budget Tool
Evapotranspiration	DWR	CIMIS	Excel Water Budget Tool
Streamflow (gages)	USGS/DWR	CDEC	Excel Water Budget Tool
Streamflow (water rights reporting)	State Water Board	eWRIMS	Excel Water Budget Tool
GIS Base Data[1]	GSAs	various	GIS Database

Notes:
[1]Base data includes GIS layers such as the county boundaries, streams, roads, well locations, etc., which generally don't change over time and don't need to be updated.
CDEC = California Data Exchange Center

Water budget data will also be stored in an Excel spreadsheet tool as shown in **Figure 10-2**. Each of these spreadsheet tools has instructions, sheets to store raw data and sheets that perform calculations and generate the needed figures for annual reports or other purposes.

[76] Currently water level data for Big Valley is being managed and stored through DWR's CASGEM system. Once the GSP is completed, the data will be brought into DWR's new SGMA Portal Monitoring Network Module (MNM). Data from either of these systems is available through the SGMA Data Viewer.

Annual reports require maps, which are generated with widely used ArcGIS software. The geographic information system (GIS) data, including base data such as streams, roads and well locations will be organized into a folder structure as shown in **Figure 10-3**. Water level data will be imported into GIS to generate contours for annual reports.

10.3.2 GSP Update DMS

Additional types of data are needed to update the GSP, listed in **Table 10-2**. Much of this additional data is GIS-based and will be stored in the GIS database, shown in **Figure 10-3**. Water quality data will need to be downloaded from the State Water Board's GAMA groundwater system in 2026 to support the 5-year update.

Table 10-2 GSP Update DMS Data Types

Data Type	Collecting Entity	Data Source	DMS Tool
Water Levels	DWR	SGMA Data Viewer	Excel Water Level Tool
Precipitation	DWR	CIMIS	Excel Water Budget Tool
Evapotranspiration	DWR	CIMIS	Excel Water Budget Tool
Streamflow (gages)	USGS/DWR	CDEC	Excel Water Budget Tool
Streamflow (water rights reporting)	State Water Board	eWRIMS	Excel Water Budget Tool
Water Quality	State Water Board	GAMA	Data to be downloaded for 5-year update.
Land Use	DWR	SGMA Data Viewer	GIS Database
Subsidence (InSAR)	DWR	SGMA Data Viewer	GIS Database
GIS Base Data[1]	GSAs	various	GIS Database

Note:
[1] Base data includes GIS layers such as the county boundaries, streams, roads, well locations, etc. which generally don't change over time and won't need to be updated.

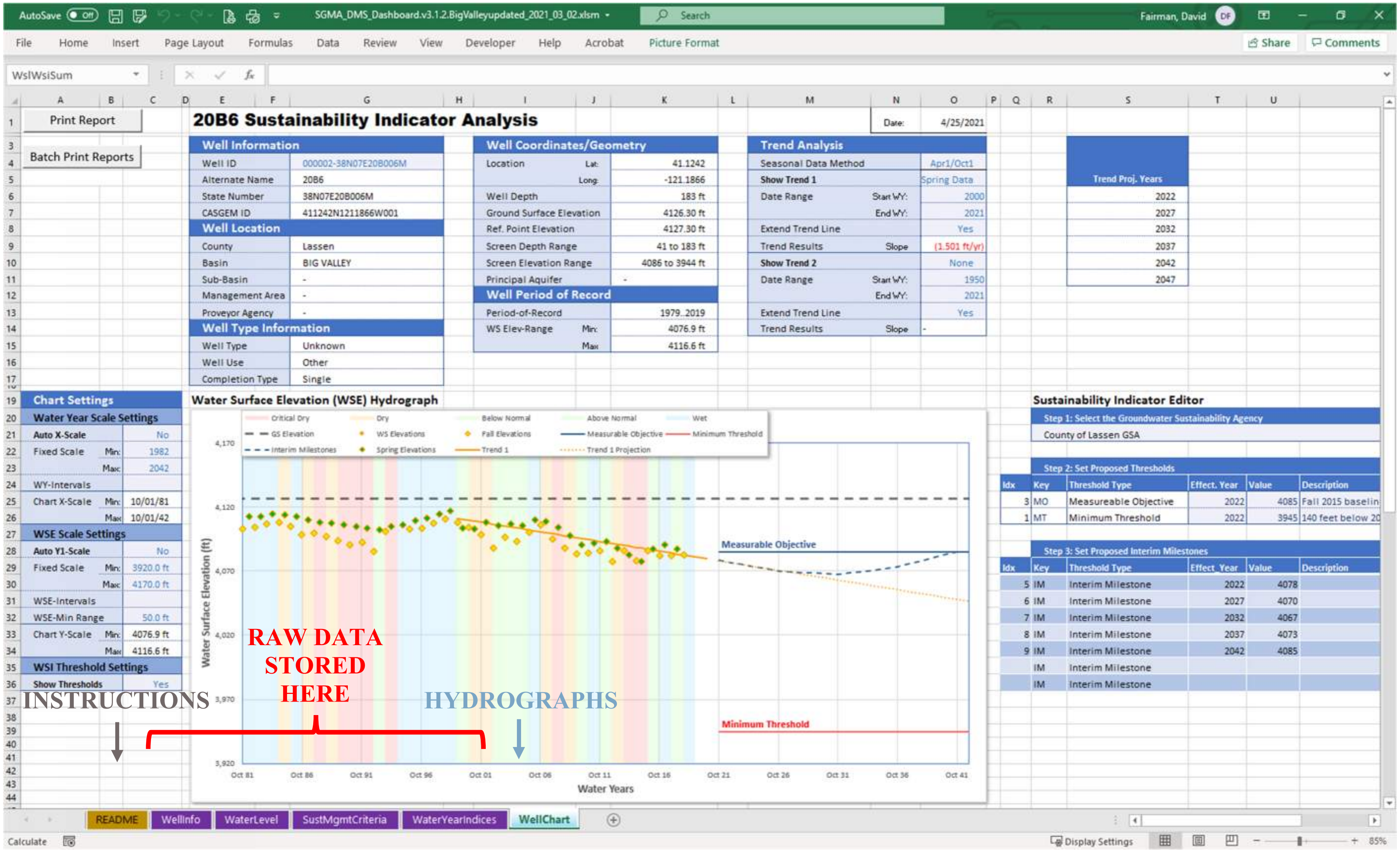
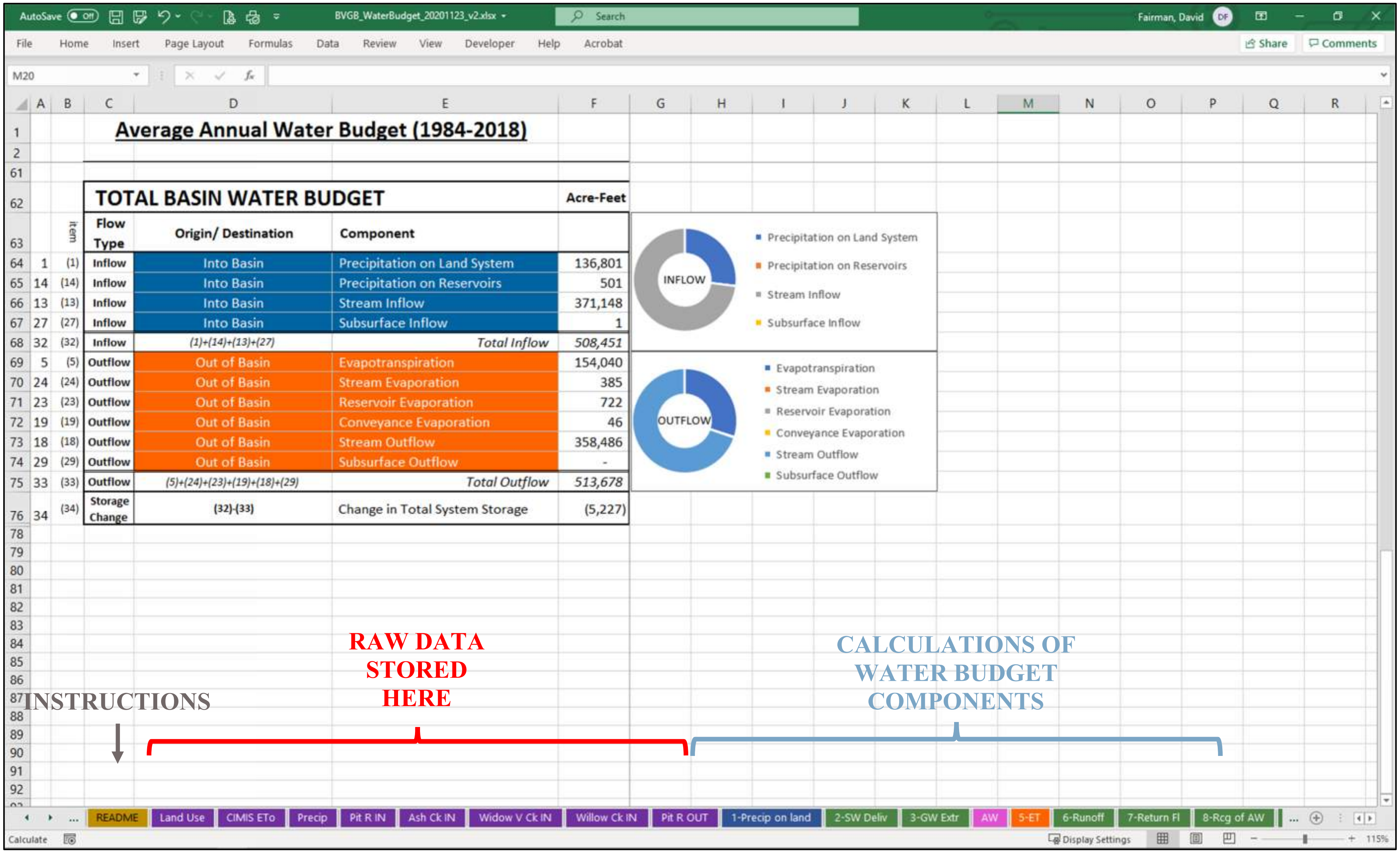


Figure 10-1 Excel Water Level Tool



Average Annual Water Budget (1984-2018)

TOTAL BASIN WATER BUDGET					Acre-Feet
	item	Flow Type	Origin/ Destination	Component	
1	(1)	Inflow	Into Basin	Precipitation on Land System	136,801
14	(14)	Inflow	Into Basin	Precipitation on Reservoirs	501
13	(13)	Inflow	Into Basin	Stream Inflow	371,148
27	(27)	Inflow	Into Basin	Subsurface Inflow	1
32	(32)	Inflow	(1)+(14)+(13)+(27)	*Total Inflow*	*508,451*
5	(5)	Outflow	Out of Basin	Evapotranspiration	154,040
24	(24)	Outflow	Out of Basin	Stream Evaporation	385
23	(23)	Outflow	Out of Basin	Reservoir Evaporation	722
19	(19)	Outflow	Out of Basin	Conveyance Evaporation	46
18	(18)	Outflow	Out of Basin	Stream Outflow	358,486
29	(29)	Outflow	Out of Basin	Subsurface Outflow	-
33	(33)	Outflow	(5)+(24)+(23)+(19)+(18)+(29)	*Total Outflow*	*513,678*
34	(34)	Storage Change	(32)-(33)	Change in Total System Storage	(5,227)

Figure 10-2 Excel Water Budget Tool

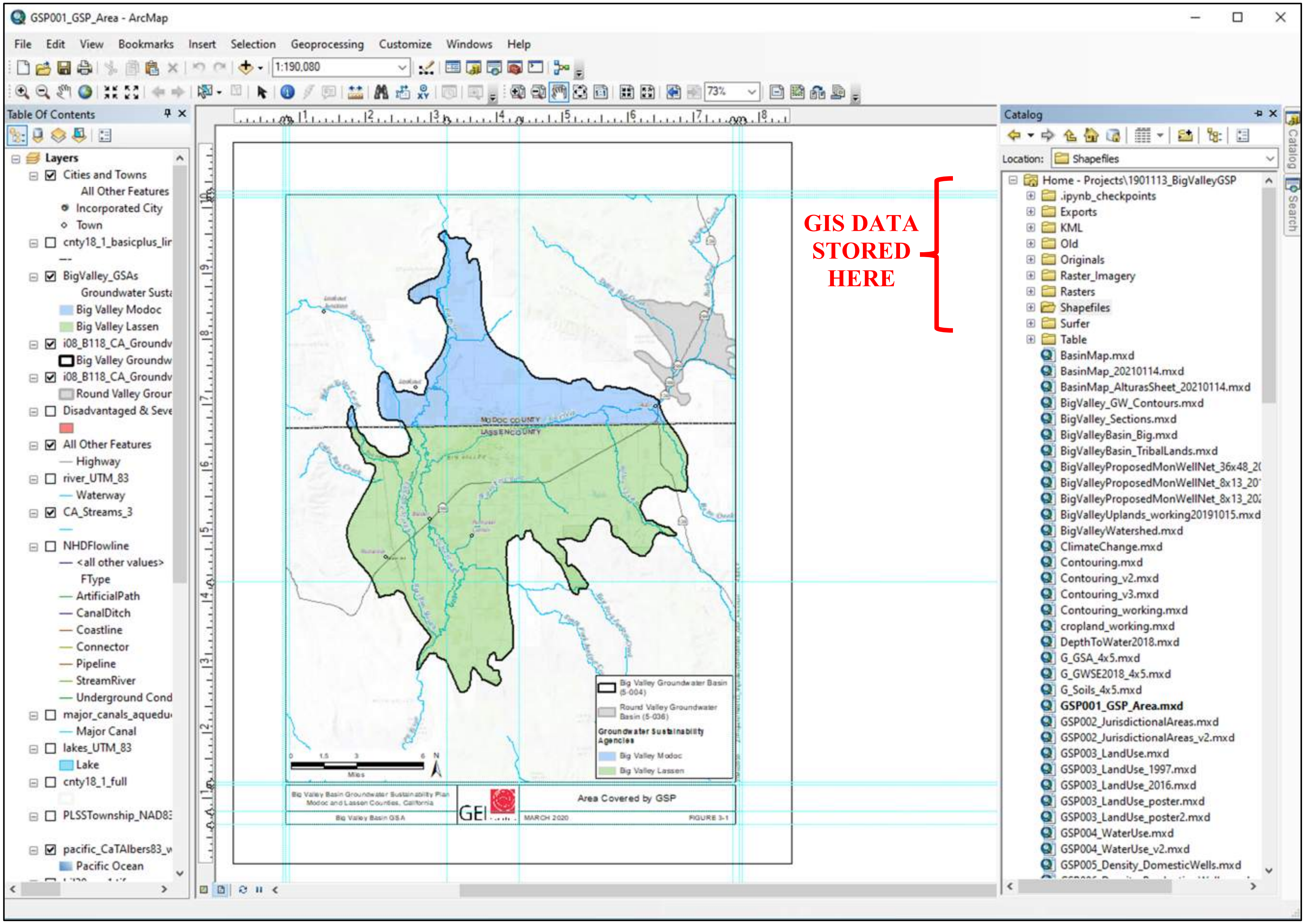


Figure 10-3 GIS Database

10.4 Periodic Evaluations of GSP (5-Year Updates)

Updates and amendments to the GSP can be performed at any time, but at a minimum the GSAs must submit an update and evaluation of the plan every 5 years. (§356.4) While much of the content of the GSP will likely remain unchanged for these 5-year updates, the Regulations require that most chapters of the plan be updated and supplemented with any new information obtained in the preceding 5 years. Chapters that are likely to require significant updates and re-evaluation include:

- Chapter 4 – Hydrogeologic Conceptual Model
- Chapter 5 – Groundwater Conditions
- Chapter 6 – Water Budget
- Chapter 7 – Sustainable Management Criteria
- Chapter 8 – Monitoring Network
- Chapter 9 – Projects and Management Actions

~~Similar to this first version of the GSP, the~~The Basin Setting (Chapters 4-6) ~~will need to be~~is signed and stamped by a California Professional Geologist or Engineer.

10.5 Implementation Schedule

Figure 10-5 shows the implementation schedule. *See* Chapter 9 – Projects and Management Actions for the schedules for individual projects that are still under development.

10.6 Cost of Implementation

The legislation and regulations provide little guidance on how to develop and define costs. An analysis of GSPs from critically ~~overdrafted~~over drafted basins found a broad variety of approaches, categories of costs and level of detail, from a single cost with no detail or justification to detailed costs for multiple categories. The purpose of this section is to present some information of cost ranges given for other basins and to give estimates of costs for the categories of implementation presented in this chapter, listed below. These costs may change based on how the GSAs choose to implement the GSP (e.g., the amount and type of public outreach and the amount and type of support sought from outside hydrology professionals such as consultants and/or UCCE).

- GSA Administration and Public Outreach
- Monitoring and Data Management
- Annual Reporting
- Plan Evaluation (5-year updates)
- Projects and Management Actions

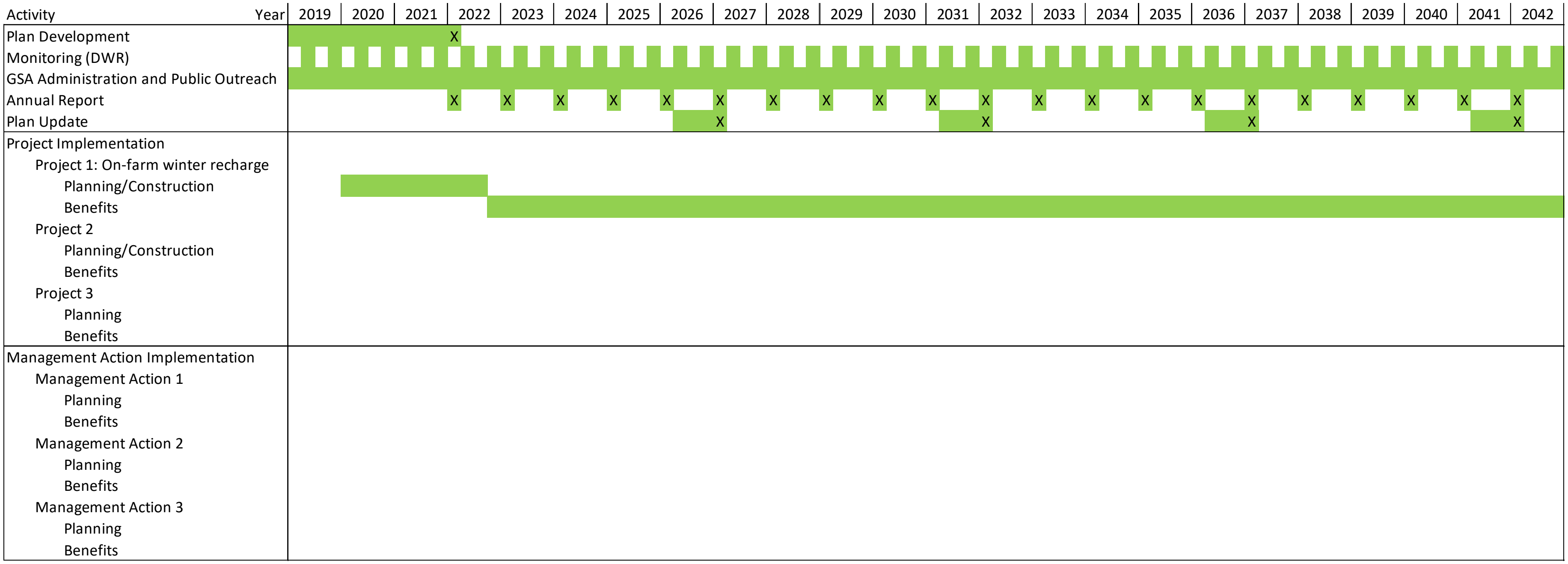


Figure 10-4 Implementation Schedule

Cost is a fundamental concern to the GSAs and stakeholders in the BVGB, as the Basin is a disadvantaged community and there is little to no revenue generated in the counties to fund the state unfunded ~~requirements~~mandates of SGMA. This is a big burden for a small, disadvantaged Basin that has no incorporated cities, low value crops and no revenue stream to pay the costs for the mandated GSP. Therefore, the approach in implementing the plan and estimating costs is to leverage as much outside funding and technical support as possible to cover costs. For costs that must be borne by the GSAs, efficient implementation methods while still meeting SGMA requirements to support the GSP is the desired outcome. **Table 10-3** shows a summary of the costs from GSPs submitted in 2020. As mentioned, not every GSP had every category of costs listed, but the number of GSPs that did detail costs for each category is shown. It should be noted that Big Valley is extremely unique in a variety of ways documented in this GSP.

Table 10-3 GSP Implementation Cost Statistics for 2020 GSPs in California

		Annual Cost Details					
	Total Annual	GSA Admin	Public Outreach	Annual Monitoring	DMS Update	Annual Report	5-Year Update
count	34	21	11	23	8	15	20
min	$ 50,000	$ 51,000	$ 5,000	$ 20,000	$ 10,000	$ 20,000	$ 50,000
max	$ 2,596,384	$ 1,538,794	$ 75,000	$ 1,057,590	$ 170,000	$ 350,000	$ 1,400,000
mean	$ 981,296	$ 607,861	$ 27,573	$ 293,907	$ 42,875	$ 56,267	$ 455,369
median	$ 720,100	$ 418,900	$ 20,000	$ 136,000	$ 20,000	$ 25,000	$ 330,000

Source: Fricke 2020

10.6.1 GSA Administration and Public Outreach

The fundamental activities that will need to be performed by the GSAs are public outreach and coordination of GSP activities. Public outreach may entail updates at County Board of Supervisors' meetings and/or public outreach meetings. At a minimum the GSAs will receive and respond to public input on the Plan and inform the public about progress implementing the GSP as required by §354.10(d)(4) of the Regulations. Coordination activities would include ensuring monitoring is performed, annual reports to DWR, 5-year GSP updates, and projects and management action coordination. Based on current grants which have funded filling of data gaps and identifying recharge opportunities, the GSA administrative costs of projects and management actions may be largely covered by grant funds.

In other GSPs already submitted, 21 itemized GSA administration and their estimates ranged in cost from $51,000 to over $1.5 million (M) per year, with a median of about $200,000. However, most of these basins are much larger than Big Valley, have more complex governance structures (i.e., have multiple GSPs in the Basin) and have more stakeholder groups. This cost for Big Valley could vary depending on the nature of public outreach written in the GSP.

10.6.2 Monitoring and Data Management

Twenty-three GSPs submitted to DWR to date have itemized annual monitoring with cost estimates ranging from $20,000 to over $1M per year with a median of about $65,000. Twelve GSPs itemized DMS updates with costs ranging from $3,000 to $170,000 with a median cost of $15,000.

DWR staff currently measures water levels in the Basin and posts them on their website and has indicated that they will continue to do so for the foreseeable future. DWR has also indicated that they could monitor water levels in the newly constructed monitoring wells. If DWR follows through on this assumption, there would be little to no costs to the GSAs for monitoring. The GSAs would need to download and populate the DMS tools detailed above. However, for costing purposes, we have assumed this to be covered under the Annual Report cost category.

If DWR chooses to discontinue its water level monitoring of wells in Big Valley, the cost could be on the order of $2,000 to $3,000, which equates to 40 to 60 staff-hours.

10.6.3 Annual Reporting

Annual report costs were estimated in 15 GSPs ranging from $20,000 to $350,000 with a median cost of $25,000. Annual reports have substantial requirements, including assembling the data, processing and generating the necessary charts, maps and tables and writing the text described in Section 10.2 – GSP Annual Reporting. There are ways to streamline and automate the process of retrieving, reformatting and returning the data to the state, many of which are described in Section 10.2.3 – Plan Progress. The level of effort and cost will be reduced over the course of the first few years, but an initial estimate of $25,000 for developing an annual report, then dropping to perhaps about $10,000, if the annual report is developed, written and submitted by GSA staff, this would equate to about 200 staff-hours.

10.6.4 Plan Evaluation (5-Year Updates)

The cost of updates to the GSP will be lower than the cost of initially developing the GSP. However, the Regulations require all parts of the GSP to be updated with recent data and information and will require substantial effort from a licensed professional. Of the 20 GSPs submitted that had GSP update cost estimates, they ranged from $50,000 to $1.4M with a median cost of $330,000. However, many of the GSPs already submitted are in basins with multiple GSPs. In those types of basins, the Basin Setting (Chapters 4-6) is typically performed on a Basin-wide basis. Big Valley will have to update the complete document. Therefore, a range of about $200,000 to $300,000 is estimated to update the GSP.

10.6.5 Projects and Management Actions

Costs of projects and management actions are addressed in Chapter 9 – Projects and Management Actions. If, and when, the GSAs seek outside funding, the costs will be put out to bid to ensure the reasonableness of the costs when implemented.

Table 10-4 summarizes the cost estimates of annual and 5-year updates discussed above. When the GSAs seek outside funding, the costs will be put out to bid to ensure the reasonableness of the costs.

Table 10-4 Summary of Big Valley Cost Estimates

		Annual Cost Details			
	Total Annual	GSA Admin and Public Outreach	Annual Monitoring and DMS Update	Annual Report	5-Year Update
Low	$ 30,000	$ 20,000	$ -	$ 10,000	$ 200,000
High	$ 68,000	$ 40,000	$ 3,000	$ 25,000	$ 300,000

10.7 Funding Alternatives

This section discusses funding alternatives. As discussed in various parts of this GSP, the GSAs and residents of Big Valley have no ability to take on the ongoing costs of implementing this GSP and contend that SGMA is an unfunded mandate. Therefore, the GSAs are forced to rely on outside sources to fund the Plan. **Table 10-5** describes the various funding options available to the GSAs. The table describes both outside funding (state and federal assistance and grants) and local funding (general fund, fees and taxes). Annual costs are less likely to be funded directly by outside sources because of the premise of SGMA that groundwater basins are best managed locally, and administration, monitoring and reporting costs are most likely to be seen as an obligation for the local GSAs under this premise. However, 5-year updates and ~~particularly~~ projects and management actions are good candidates for outside funding. Some of this outside funding that currently exists could be through the DWR Prop 1 grants obtained by the North Cal-Neva and Modoc County could potentially be leveraged to support annual reporting in the next year or two. This depends on the degree that there is overlap between the scopes of work for the grants and the annual report requirements. These two existing grants are laying the groundwork for recharge projects and filling data gaps.

The entire BVGB is a disadvantaged community with much of the Basin designated as severely disadvantaged. The GSAs adamantly oppose new taxes or fees as additional taxes or fees would harm the community and alter the ability of residents to live and work in the Basin. The GSAs will identify and pursue grants to fund the implementation of this GSP. To that end the GSA will look toward funding options presented by the California Financing Coordinating Committee (CFCC) through their Funding Fairs[77].

[77] More information on CFCC including their 2021 Funding Fairs Handbook is available at https://www.cfcc.ca.gov/funding-fairs/.

Table 10-5 Summary of GSP Funding Mechanisms

Funding Mechanism		Description
Assistance Programs		DWR offers Technical Services Support and Facilitation Services Support Programs to assistance GSAs in development and implementation of their GSPs. If granted, services provided under these programs are offered at no-cost to the GSAs.
Grant Funding	State Grants	DWR's Sustainable Groundwater Management Grant Program, funded by Proposition 1 and Proposition 68, provides funding for sustainable groundwater planning and implementation projects. Both DWR and the State Water Board offer a number of grant and loan programs that support integrated water management, watershed protection, water quality improvement and access to safe drinking water. Other state agencies and entities with grant or loan programs related to water and environment include the CDFW and California Water Commission.
Grant Funding	Federal Grants	Federal grant and loan programs related to water planning and infrastructure include the Water Infrastructure Finance and Innovation Act, Water Infrastructure Improvement for the Nation Act and the DOI Reclamation's WaterSMART program.
General Funds		Cities and counties maintain a general fund which include funding from taxes, certain fees, state shared revenue, interest income and other revenues. While not a funding mechanism, the general funds from cities and counties may be used to fund or provide in-kind services for GSA activities and GSP implementation.
Fees	Fees	Fees include "various charges levied in exchanges for a specific service" (Hanak et al., 2014). This includes water and wastewater bills, or developer or connection fees, and permitting fees. Under rules established by Proposition 218 (1996), new property-related fee increases are subject to a public hearing and must be approved by either a simple majority of property owners subject to the fee or by two-thirds of all registered voters (Hanak et al., 2014; League of California Cities, 2019).
Fees	Groundwater Extraction Fees	SGMA grants GSAs certain powers and authorities including the authority to impose fees. Section 10730 of the Water Code states that a GSA may "permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption and amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve."
Fees	Assessments	Assessments are a specific type of fee that are levied on property to pay for a public improvement or service that benefits that property.
Taxes		Taxes imposed by local agencies include general taxes, special taxes, and property taxes. Taxes generally fall into one of two categories: general or special (Institute for Local Government, 2016). *General taxes* are defined as "any tax imposed for general governmental purposes." (Cal. Const. art. XIII C, § 1, subd. [a]) *Special taxes* are "any tax imposed for specific purposes, including a tax imposed for a specific purpose, which is placed into a general fund." (Cal. Const. art. XIII C, § 1, subd. [d]). Proposition 218 (1996) states that special districts, "could not levy general taxes, but only special taxes, and it clarified that local general taxes always required simple majority voter approval and that local special taxes always required two-thirds voter approval."

11. Notice and Communications §354.10

11.1 Background

SGMA compliance, outreach and communication efforts in the BVGB began before GSP development. When SGMA was signed into law, local agencies in the BVGB explored options for forming GSAs by the June 30, 2017 statutory deadline. On February 23, 2016, Lassen and Modoc counties held a public meeting of the Lassen and Modoc County Boards of Supervisors in Adin to explore whether the District[78] could become a GSA for the Basin and if that option was preferred over the two counties becoming the GSAs. These were the only two options available under existing public agency structures. The preferred options resulting from the meeting was that the two counties become the GSAs for their respective Basin jurisdictions and develop a single, coordinated GSP.

The county boards moved forward to become GSAs, held public hearings and passed resolutions in early 2017. They registered with DWR as the Big Valley Modoc GSA and Big Valley Lassen GSA, each covering the portion of the Basin in their respective county. After becoming established as the GSAs, the counties developed a workplan under guidance from consultants to determine the scope, schedule and cost for GSP development; an application for a state grant was submitted and grant awarded; and the GSAs submitted a notice of intent to develop one GSP to cover the entire BVGB. A timeline of these events is presented in **Table 11-1** ~~below~~.

Table 11-1 Pre-GSP Development Outreach Efforts

Date	Activity
November 2015	Public Outreach meeting in Adin
February 2016	Joint Lassen-Modoc Board of Supervisors meeting to explore GSA options to comply with SGMA
February 2016 to present	Modoc County Groundwater Advisory Committee Meetings (bimonthly)
January 2017	Public outreach meeting in Bieber to solicit comment on the counties becoming GSAs
February 2017	County of Modoc GSA Formation Public Hearing
March 2017	County of Lassen GSA Formation Public Hearing
July-September 2017	GSP Workplan developed to determine scope, schedule and cost of GSP development
November 2017	Lassen County submits application for state grant to fund GSP development
June 2018	Notice of Intent to develop one GSP for the entire BVGB submitted to DWR
November 2018	Lassen County entered into SGMA grant agreement with the state
February 2019	GSP development started

[78] Lassen-Modoc Flood Control and Water Conservation District

11.2 Challenges of Developing GSP During COVID Pandemic

A major challenge and constraint during the development of the GSP was the COVID 19 pandemic that started in early 2020. The pandemic made thorough and proper public outreach and participation impossible throughout 2020 and early 2021, the time during which key GSP content was developed and discussed by consultants, GSA staff and the BVAC. Due to state restrictions from the Governor's executive orders, GSA staff had to cancel BVAC meetings, restrict public attendance at meetings and facilitate participation through remote technology. Many interested parties did not feel safe attending meetings in person and remote attendance did not facilitate appropriate participation.

Internet connectivity and quality in this portion of the state is poor to nonexistent and the counties have very limited technological resources. These disadvantaged communities are on the losing end of the digital divide. While the GSAs made every attempt to conduct BVAC meetings with the ability for remote public participation, there were still major logistical and technical challenges both with conducting such meetings as well as members of the public participating. Those participants that had internet connectivity frequently could not hear or understand the dialogue in the Big Valley community venues and could not interact in the most effective way. However, the GSAs made the best of the circumstances and addressed all comments provided through the various means.

The GSAs recognized the obstacles presented by the COVID pandemic early in the efforts to develop a GSP and were proactive in reaching out to both the Governor and Legislature to identify potential solutions. The Governor severely restricted public meetings (and initially did not allow public meetings at all) because of the pandemic. Obviously, this made the GSAs' efforts to develop a GSP with constructive input from the public extremely difficult since, as outlined above, there is limited internet connectivity to conduct meetings remotely. Further, the limited GSA staff and technology was challenged to offer meetings remotely.

One obvious solution would be to recognize the emergency that is occurring across the state (and nation) and provide additional time to submit the required GSP. As such, on August 11, 2020, a letter was sent from the Lassen County Board of Supervisors (acting as the Lassen County GSA) to both the Legislature and the Governor requesting additional time. There was no response from either the Legislature or the Governor, so the Lassen County Board of Supervisors sent follow up letters to the Governor on November 17, 2020, February 16, 2021, March 23, 2021 and April 27, 2021. Neither the Legislature nor the Governor responded. However, a response was eventually received (dated June 3, 2021) from Karla A. Nemeth with DWR, denying said request, even though the Board of Supervisors sent the above letters to the Governor and not to DWR.

In February 2021, State Assembly Member Devon Mathis introduced Assembly Bill 754 which would have extended the GSP deadline. The Lassen and Modoc County Boards of Supervisors sent letters to State Assembly committee leaders in support of the bill. Supervisor Byrne testified before both the Senate and Assembly committees in support of the bill citing the constraints of inadequate broadband in the community for meaningful public participation. The bill was passed by the State Assembly but did not pass out of committee in the State Senate.

Letters from the GSA to the governor and assembly, along with the response letter from DWR are included in **Appendix 11A**.

11.3 Goals of Communication and Engagement

In developing the GSP, the GSAs implemented communication and engagement (C&E) with the goals of:

Educating the public about the importance of the GSP and their input. Public input is an important part of the GSP development process. The local community defines the values of the Basin and the priorities for groundwater management. This input guided decision-making and development of the GSP, particularly the development of the sustainability goal, sustainable management criteria and projects and management actions.

Engaging stakeholders through a variety of methods. One size does not fit all when it comes to stakeholder engagement in GSP development. This chapter outlines how the GSAs performed C&E at multiple venues through a variety of media to reach varied audiences.

Making public participation easy and accessible. The C&E described in this chapter describes the many methods employed to make it easy for the public to be informed and provide input.

Providing a roadmap for GSP development. The GSAs provided a schedule for stakeholders, keeping C&E efforts consistent and on track.

11.4 Stakeholder Identification

The Water Code §10723.2 requires consideration of all beneficial uses and users of groundwater. Primary beneficial uses of groundwater in the BVGB include agriculture, domestic use and habitat. In addition to farmers and individual well owners in the valley, this includes a small community system in Bieber, the Intermountain Conservation Camp and the CDFW which uses groundwater to supplement and maintain some habitat in the ACWA in the center of the Basin. Other significant uses include industrial uses such as logging, construction and fire suppression.

The Big Valley GSAs recognize that C&E with Big Valley water users and stakeholders is key to the success of GSP development and implementation. Particularly important is the engagement of local landowners given that the county seats are distant from Big Valley. Both counties have engaged stakeholders through various processes and efforts, including Modoc County's groundwater committee, the LCGMP development and Basin Management Objectives program implementation and the BVAC described in this chapter. In addition, the GSAs performed several public workshops to solicit more input from interested parties. A listing of the BVAC, public workshop and other public outreach meetings is included in **Appendix 11B**.

The following is an initial list of interested parties that were contacted during GSA formation and GSP development:

- Agricultural users
- Domestic well owners
- Public Water Systems ~~(including Lassen County Waterworks District No. 1)~~
- CDFW
- Surface Water User Groups (including BVWUA)
- Lassen-Modoc County Flood Control and Water Conservation District
- Modoc County Groundwater Advisory Committee
- Federal Agencies (including the Forest Service and BLM)
- Tribes (including the Pit River Tribe)
- DWR
- North Cal-Neva

Prior to establishing themselves as the GSAs, the names and contact information for the above groups were compiled in spreadsheets. People on the interested ~~parties~~parties’ lists were under no obligations and received information about GSP development, including meeting announcements and opportunities to provide input and become more involved.

The GSAs developed a website (described below) to facilitate C&E, and anyone interested in GSP development or implementation in the BVGB was able add themselves to the interested parties list. In addition, sign-in sheets at all public meetings allowed attendees to add themselves to the interested parties list.

Outreach with the Pit River Tribe was performed, and tribal contacts were added to the interested parties list when it was first developed in February 2016. Therefore, tribal contacts have received all notifications of GSP development activity. Applications to become members of the BVAC were sent to the tribes. In addition, the Modoc County Groundwater Resources Advisory Committee, a committee of the Modoc County Board and a forum for obtaining updates about GSP development, has a tribal position. Numerous contacts between Modoc County staff and tribal contacts have occurred during GSP development. A list of outreach activities with tribal contacts is included in **Appendix 11C**.

11.5 Venues and Tools

11.5.1 Stakeholder Survey

The GSAs performed a C&E survey with the purpose of soliciting information about how stakeholders wish to be involved in the GSP and what concerns they have relevant to the GSP. Paper copies of the survey were available at public meetings and was also available online.[79]

[79] https://www.surveymonkey.com/r/TQ9HCQK

11.5.2 Website and Communication Portal

A website[80] was deployed for GSP development to facilitate communication and track the communication in a database. The website ~~was~~is not meant to replace, but to enhance, outreach efforts. Tools of the website allowed the GSAs to communicate with interested parties. These tools include the following:

- **Calendar.** The website ~~included~~includes a calendar with meeting dates, locations, times and documents such as meeting agendas, meeting minutes, presentations and BVAC packets.
- **Interested Parties List.** The website allows users to add themselves to the interested parties list and to select whether they wish to receive communication through email or physical mail.
- **Documents.** In addition to the meeting documents mentioned above, the website has a general documents page where the GSAs posted GSP chapters, scientific references and other supported documents related to GSP development.
- **E-Blast.** E-mails ~~will be~~are sent to interested parties using the e-blast tool. E-blasts ~~helped~~help to notify interested parties with email addresses to receive information about GSP development progress, upcoming meetings and new information or documents available.
- **Public Comment.** GSP chapters posted on the website ~~were~~are available for public comment~~.~~ during comment periods throughout GSP development. A web form ~~was~~is available for anyone to submit comments on ~~draft GSP~~ documents~~.~~ open for comment. The form ~~allowed~~allows the user to comment by page and line number~~ stored the information~~ for GSA review and response.

The website address ~~was~~is included on printed materials and announced at public meetings.

11.5.3 Community Flyers

Physical copies of flyers announcing upcoming public meetings ~~were~~are posted in heavily trafficked locations such as community centers, public buildings, local markets and post offices.

11.5.4 Newspaper

All public meetings, including BVAC meetings ~~were~~are announced in the Lassen County Times, the Modoc Record and the Mountain Echo.

11.5.5 Social Media

Information about GSP development and meeting announcements have been and will continue to be made available through social media. UC Cooperative Extension in Modoc County hosts the Devil's Garden Research and Education Facebook page, as well as a website with the same name. Through their Facebook page[81], events are publicized and shared with other connected pages in the area to reach a wider stakeholder base. This platform also enables workshops and other events to be shared through live

[80] https://bigvalleygsp.org
[81] http://www.facebook.com/devilsgardenresearchandeducation

video and recordings. Recently, a blog detailing stakeholder engagement in Big Valley was published to the website.[82].

11.5.6 Brochure

In 2021, the GSAs transitioned from the background and scientific portions of the GSP (Chapters 1-6, including Basin Setting and Water Budget) to the policy and decision-making portions of the GSP (Chapters 7-9, Sustainable Management Criteria, Monitoring Networks and Projects and Management Actions). To facilitate engagement of people who may have been coming into the process at that time, a four-page informational brochure was developed, summarizing Chapters 1 through 6. This brochure was distributed on the website, through email and at public meetings. The brochure is included as **Appendix 11D**.

11.5.7 Big Valley Advisory Committee

The GSAs established the BVAC through an MOU to advise both Lassen and Modoc counties on GSP preparation. The goals of the BVAC, as stated in the MOU (**Appendix 1C**), include the following:

- Advise the two GSAs on the preparation of a GSP.
- Provide a forum for the public to comment during the preparation of the GSP.
- Provide recommendations to the two GSAs that would result in actions which have as minimal impact as possible on the residents of Big Valley.
- Advise the two GSAs on the preparation of a GSP to produce the lowest possible future costs to the residents of Big Valley.
- Ensure local control of the BVGB be maintained by the two GSAs.
- ~~Provide a recommendation to the GSA boards on whether to approve the GSP.~~ Prepare a product that is acceptable to the GSA Boards for approval.

Membership of the BVAC ~~was~~is composed of:

- One member of the Lassen County Board of Supervisors selected by said Board.
- One alternate member of the Lassen County Board of Supervisors selected by said Board.
- One member of the Modoc County Board of Supervisors selected by said Board.
- One alternate member of the Modoc County Board of Supervisors selected by said Board.
- Two public members selected by the Lassen County Board of Supervisors. Said members must either reside or own property within the Lassen County portion of the BVGB.
- Two public members selected by the Modoc County Board of Supervisors. Said members must either reside or own property within the Modoc County portion of the BVGB.

The BVAC ~~operated~~operates in compliance with the Ralph M. Brown Act (Brown Act). BVAC meetings ~~were~~are noticed and agendas ~~were~~ posted according to the Brown Act. BVAC meetings

[82] http://www.devilsgardenucce.org/

~~were~~are open to the public and ~~allowed~~ public comment is allowed, as much as possible given COVID pandemic restrictions.

During the development of Chapters 7 through 9, the BVAC established Ad Hoc committees to investigate, discuss and recommend content for the sustainability goal, sustainable management criteria, monitoring network and projects and management actions.

11.6 Decision-Making Process

The MOA describes the decision-making process for the BVAC. However, while the BVAC made recommendations, it was not a formal decision-making body like the Lassen or Modoc GSAs. The Lassen County GSA, led by the Lassen County Board of Supervisors and the Modoc County GSA, led by the Modoc County Board of Supervisors, were ultimately responsible for adopting and submitting a GSP to DWR. The GSAs considered all input received from the BVAC and other interested parties.

To develop each chapter of the GSP, the GSAs followed an iterative process illustrated in **Figure 11-1**. The process involved multiple drafts of each chapter, including administrative, public and (often multiple) revised drafts. Once the BVAC was satisfied that the chapter was at a point where the GSAs were comfortable to move on, they voted to “set aside” the chapter until the entire draft GSP was assembled. This recommendation did not indicate approval but was implemented to keep the development process moving forward. The GSP was then assembled into a complete draft to undergo the same process of administrative, public and revised drafts. The BVAC will then vote whether to recommend to the GSA boards if they should approve the GSP. The GSA boards will vote whether to approve the GSP prior to submittal to DWR.

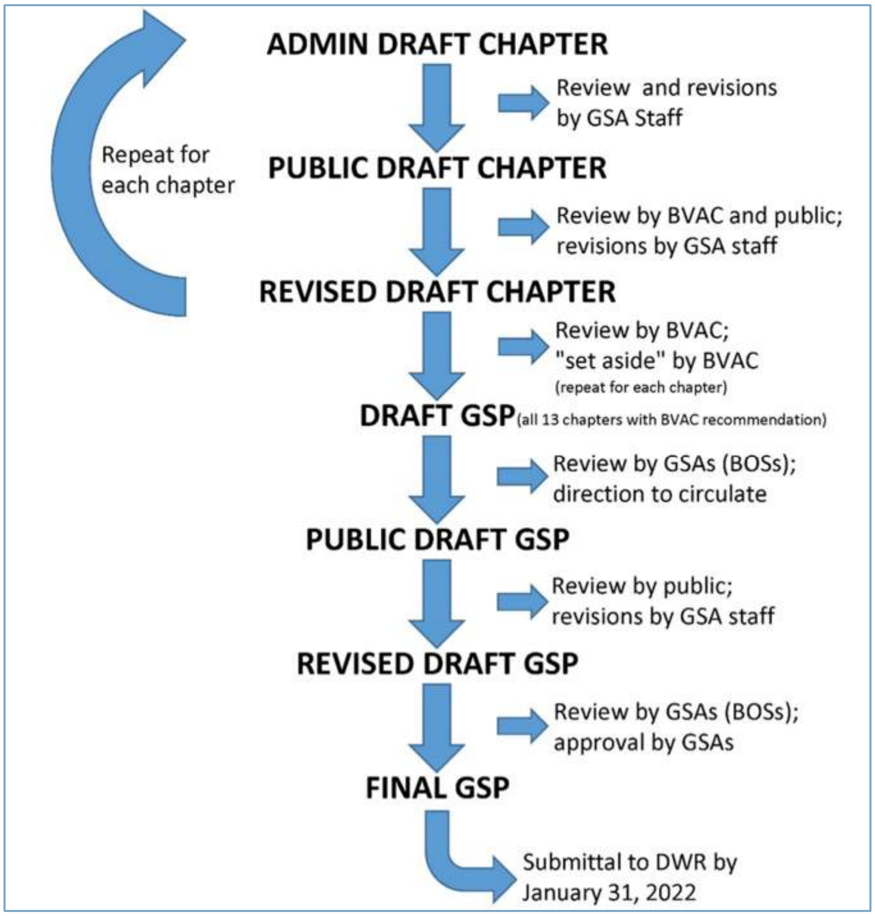


Figure 11-1 GSP Development Process

11.7 Comments and Incorporation of Feedback

All formal feedback on the GSP were documented both through the GSP website and from public meetings. The comments received, including how each comment was addressed is included in **Appendix 11E**.

11.8 Communication and Engagement During Plan Implementation

The BVAC was established by the GSAs for the specific purpose of advising during development of the GSP and providing a product that is acceptable to the GSA Boards for approval. ~~making recommendations to the GSA boards on whether to approve the GSP.~~ The MOU establishing the BVAC therefore expires after the GSP is adopted by the GSAs and submitted to DWR. The C&E during Plan implementation will then shift to the GSA Boards who will continue to inform the public about Plan progress and status of projects and management actions as required by §354.10(d)(4) of the regulations.

This ongoing C&E will be performed through the forum of meetings of the County Boards of Supervisors where GSA staff will give regular reports to the boards and the public along with annual reports to be submitted to DWR as required by GSP Regulations. Communication to stakeholders on the interested parties list will continue to occur *via* email and physical mail. Development of annual reports and coordination and implementation of projects and management actions will require significant effort from GSA staff. The GSAs are considering the development of an MOU to clearly define roles, responsibilities and costs of each GSA.

12. References

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Appendix 3A Monitoring Well Surveyors Report

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Project: Big Valley Groundwater Basin Survey, Adin, Ca.
Client: GEI Consultants
2868 Prospect Park Drive, Suite 400
Rancho Cordova, Ca 95670

REGISTERED PROFESSIONAL ENGINEER
KEVIN R. BUTLER
No. C057153
CIVIL
STATE OF CALIFORNIA

Project Details

Equipment Used:

Trimble Precision GPS R-12 Surveying System
SECO 4811-32 Level System

Report Units:

Lat/Lon:	WGS84 formatted Degree, Minutes, Seconds
Elevation:	US Survey Feet
Grid Coordinates:	California State Plane Zone 1 Coordinates

Survey Conditions:

Date Surveyed:	7.28.2020
Date of Report:	8.3.2020, Revised 8.5.2020
Weather:	Sunny 60°F - 95°F, Smokey, Wind <10 MPH

Survey Benchmarks:

Source:	National Geodetic Survey	
Designation:	"B 136 RM 2"	
Description:	Brass disc set in concrete	
Location:	Northeast end of runway near Adin, Ca.	
	NAD 83 (2011)	
	Latitude	41° 11' 04.52985" N
	Longitude	120° 57' 00.44655" W
	Ortho Height	4237.75 ft.
	California State Plane Zone 1 Coordinates	
	Northing:	2,316,557.62
	Easting:	6,850,625.60

Source:	National Geodetic Survey	
Designation:	"W 135 RESET"	
Description:	Brass disc set in concrete	
Location:	Approximately 2.5 miles North on HWY 299 from Bieber	
	NAD 83 (2011)	
	Latitude	41° 08' 43.09015" N
	Longitude	120° 06' 43.08683" W
	Ortho Height	4152.57 ft.
	California State Plane Zone 1 Coordinates	
	Northing:	2,301,751.78
	Easting:	6,806,227.62

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Project Procedures:

Project control was established by using our GPS equipment to calibrate to the two NGS benchmarks described above.
Horizontal control is derived from both of the NGS benchmarks, Vertical control is derived from one NGS benchmark designation "B 136 RM 2".

At each site, all monitoring wells were located and each vault lid and casing plug was removed. Then a notch approximately 1/4" wide x 1/4" deep was cut into the side of the PVC well casing in line with the two vault lid mounting bolts. This notch is the elevation point for each well per tasks #1 & #2

At each site, all monitoring wells were located and the center of the vault lid was shot for horizontal location. This was recorded as Latitude / Longitude per task #1 & #2

At each site monitoring well 3 was identified and a PK nail was inserted into the concrete well pad 4" away from the vault lid in line with the two mounting fasteners. This PK nail serves at the site control for subsidence monitoring per task #3

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Task #1 Lassen County Monitoring Well Survey

Site 5 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 5-1	Center of Lid	41°07'18.77103"N	121°08'01.91978"W	-
	Notch on PVC Casing	-	-	4,128.72
MW 5-2	Center of Lid	41°07'19.02273"N	121°08'01.90396"W	-
	Notch on PVC Casing	-	-	4,128.59
MW 5-3	Center of Lid	41°07'16.26339"N	121°08'11.92014"W	-
	Notch on PVC Casing	-	-	4,131.40
MW 5-4	Center of Lid	41°07'14.01725"N	121°08'02.37919"W	-
	Notch on PVC Casing	-	-	4,129.90

Site 5 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.04 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #2 Modoc County Monitoring Well Survey

Site 1 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 1-1	Center of Lid	41°11'16.91704"N	120°57'35.46950"W	-
	Notch on PVC Casing	-	-	4,213.84
MW 1-2	Center of Lid	41°11'17.17232"N	120°57'35.20508"W	-
	Notch on PVC Casing	-	-	4,214.21
MW 1-3	Center of Lid	41°11'16.05393"N	120°57'33.61346"W	-
	Notch on PVC Casing	-	-	4,218.17
MW 1-4	Center of Lid	41°11'16.95194"N	120°57'32.38078"W	-
	Notch on PVC Casing	-	-	4,218.06

Site 1 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.03 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #2 Modoc County Monitoring Well Survey

Site 2 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 2-1	Center of Lid	41°12'42.69267"N	121°01'43.03716"W	-
	Notch on PVC Casing	-	-	4,216.18
MW 2-2	Center of Lid	41°12'42.61763"N	121°01'42.78528"W	-
	Notch on PVC Casing	-	-	4,216.44
MW 2-3	Center of Lid	41°12'39.42222"N	121°01'43.25643"W	-
	Notch on PVC Casing	-	-	4,213.93
MW 2-4	Center of Lid	41°12'43.18967"N	121°01'45.76289"W	-
	Notch on PVC Casing	-	-	4,209.62

Site 2 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.03 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #2 Modoc County Monitoring Well Survey

Site 3 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 3-1	Center of Lid	41°13'00.98392"N	121°06'17.84041"W	-
	Notch on PVC Casing	-	-	4,164.41
MW 3-2	Center of Lid	41°13'01.22973"N	121°06'17.84528"W	-
	Notch on PVC Casing	-	-	4,164.58
MW 3-3	Center of Lid	41°12'56.58659"N	121°06'18.32460"W	-
	Notch on PVC Casing	-	-	4,164.02
MW 3-4	Center of Lid	41°12'56.60289"N	121°06'19.47421"W	-
	Notch on PVC Casing	-	-	4,164.97

Site 3 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.04 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #2 Modoc County Monitoring Well Survey

Site 4 Survey Data

Well ID	Description of Surveyed Point	Latitude	Longitude	Elevation (ft.)
MW 4-1	Center of Lid	41°12'10.53971"N	121°09'31.31845"W	-
	Notch on PVC Casing	-	-	4,152.40
MW 4-2	Center of Lid	41°12'10.56692"N	121°09'31.64559"W	-
	Notch on PVC Casing	-	-	4,152.73
MW 4-3	Center of Lid	41°12'10.76781"N	121°09'28.29350"W	-
	Notch on PVC Casing	-	-	4,152.33
MW 4-4	Center of Lid	41°12'12.74277"N	121°09'28.23603"W	-
	Notch on PVC Casing	-	-	4,161.32

Site 4 Survey Accuracy

The elevation accuracy of the "Notch on PVC Casing" is ± 0.01 ft. in realtion to eachother which is based on the site control "PK Nail" from task 3 which is ± 0.04 ft. to the benchmark.

The horizontal accuracy of the "Center of Lid" to the benchmark is ± 0.1 ft.

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Task #3 Subsidence Monitoring Network

Well ID	Description of Surveyed Point	California State Plane Zone 1 Northing	California State Plane Zone 1 Easting	Elevation (ft.)	Accuracy Horizontal	Accuracy Vertical
MW 1-3	PK Nail in Concrete	2,317,688.600	6,848,083.631	4,218.51	±0.01 ft.	±0.03 ft.
MW 2-3	PK Nail in Concrete	2,325,906.143	6,828,905.491	4,214.55	±0.01 ft.	±0.03 ft.
MW 3-3	PK Nail in Concrete	2,327,419.328	6,807,866.938	4,164.48	±0.02 ft.	±0.04 ft.
MW 4-3	PK Nail in Concrete	2,322,637.642	6,793,395.855	4,152.75	±0.02 ft.	±0.04 ft.
MW 5-3	PK Nail in Concrete	2,292,892.375	6,799,525.718	4,131.74	±0.02 ft.	±0.04 ft.

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Doreen SmithPower 10/05/2021 4:54 PM

See the attachment. My comments refer to the document as a whole. I appreciate the committees time and efforts. I hope my comments are utilized.

Attachments:

letter to BVAC re 10 6 2021 meeting.pdf

Doreen SmithPower

Alturas California 96101

10/5/2021

Big Valley Advisory Committee re: Ground Water Plan

RE: Meeting Date of October 6, 2021

Dear Committee Members:

I have summitted comments on previous chapters and Chapters 1-6 were previously approved for publication, and after that several and I mean several changes were made. I have read through all the chapters initially once.

General Comments: I commented earlier that there graphs and figures references and some are incorrectly referenced. If you simple pulled all graphs, figures, maps, & tables in other words all (referenced data) (which the legal community refers to as evidence) and put it in "Appendix of Referenced Data or Information" it would be much and I mean much easier to understand and read the text portion of the document. Also putting all referenced data in a separate document would eliminate the duplication of referenced data and would help clarify the referenced data that you have in place because all of the writers would have to refer to the same referenced data to prepare his/her or their agency segment. The TEXT of the document would simply refer to the Reference Appendix Data at page ___, and an Index of the Appendix of Referenced data would be prepared and should cross reference the page numbers in the text of the document. The committee indicated earlier that the plan would not be in print format and would only be available on line. However, the committee should make the "Appendix of Referenced Data available to all agencies and the public through a print shop and that should be published within the text of the document.

Another overall general comment: I have heard several people including committee members state that we don't fully understand "Recharge". Recharge in the document has been referred recharge areas and simply replenishing the water system.

Recharge needs to be DEFINED – replenish the water system yes—but in terms; state the objectives then the goal; and then the many outcomes –

- Into the river
- Into the wells (through plug and pull ponding – rainwater replenishing – treated before into wells) Referenced to the water quality well information data would be helpful.
- Into canals
- Into irrigation (healthy crops – into water for ranching animals)
- Into drinking water ("systems" open and closed – end uses and users to be notified of which)
- Water flows down hill and mountains generally have snow that flows down hill in creeks (some seasonal or rivers) the water is replenished naturally (mountains are terms recharge areas)
- Recharge is identified but not defined

The information thus far is valuable. I would like to see the information used as it was intended by participating agencies, and water users (yes that covers – who everybody). Thank you for your time. I will be attending the meeting via zoom.

Doreen SmithPower

jeffrey middlebrook 10/07/2021 7:54 AM

My lady and I attended the meeting yesterday (Oct. 6, 2021) in Bieber mostly to learn what's going on regarding water rights in Big Valley, and if offered the opportunity, to ask questions and/or comment. We ended up leaving when a brief break was called because it was obvious that just more of the nitpicking over spelling, grammar, and semantics was going to drag on. This sort of very boring off-topic obsession over irrelevant minutia might be somewhat humorous at some level, but all of that needs to be done prior to a public meeting so that the meat of the issue(s) can be addressed and discussed. We ended up over at the Roundup and sat next to another couple that also bailed out of the meeting for the same reason I state above. Public meetings are supposed to be for the PUBLIC, not for inane grade school lessons regarding how to properly compose sentences. I have a degree in geology (though I never worked as a geologist) and a degree in civil engineering (which I worked in professionally for a couple of years in the 1970s). I independently study climate dynamics and I have a solid base of knowledge regarding paleo climate in our greater geographical region. We'd love to be involved in what looms on the horizon regarding the State's possible future water-snatching efforts, but if every "public" meeting is going to involve the nitpicking over how something has been structurally written then we will be loathe to be involved.