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Review of Potential Water Supply Augmentation Projects and Management Actions

Sierra Valley, Sierra and Plumas County California

Prepared for:

Sierra Valley Groundwater Management District
PO Box 88
Chilcoot, CA 96105

November 2022

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1. EXECUTIVE SUMMARY

This technical document serves as a guide for evaluating and advancing those Projects and Management Actions identified in the Sierra Valley Groundwater Sustainability Plan (GSP) that relate to supply augmentation using surface water resources. The GSP was submitted to the California Department of Water Resources in January of 2022. Modeling estimates put the Basin's sustainable yield roughly between 5,500 – 6,500 acre-feet annually (AFA). Historical groundwater pumping has averaged about 8,500 AFA, with an estimated overdraft of 1,300 to 3,000 AFA as a long-term average. The GSP identifies Projects and Management Actions to better align supply and demand. Collectively, the Projects and Management Actions address supply augmentation, demand management, and other management actions such as outreach and data collection and analysis.

This review of surface water resources in Sierra Valley was conducted to help identify potential supply augmentation for advancing sustainable groundwater management. A review of surface water resources in Sierra Valley has been conducted to help identify potential for advancing sustainable groundwater management in Sierra Valley. Surface waters in Sierra Valley are subject to a 1939 court decree. Surface water uses today are essentially the same as when the decree was issued, except for flows of the Little Last Chance Creek, which since 1961 have been regulated by Frenchman Reservoir. Water right permits issued for Frenchman Reservoir include up to 15,194 acre-feet annually (AFA) of storage and annual release for irrigation and stockwater uses, and 20,000 AFA of retention for recreation uses. A 2 cubic feet per second (cfs) release to Little Last Chance Creek is required to maintain minimum fish flows. Spill from Frenchman Reservoir has been relatively infrequent in the past two decades, but was more frequent in prior decades. Spill occurs when there is excess water above the maximum storage elevation of the reservoir, and therefore, is released downstream without being allocated for a beneficial use. Potential for reservoir reoperation to minimize spill is limited, because spills are not a frequent occurrence.

The most promising opportunity to gain additional surface resources for agriculture from Frenchman Reservoir is to convey Plumas County owned water rights from Lake Davis to Frenchman Reservoir. Plumas County has 2,700 acre-feet annually (AFA) of Lake Davis water rights, and 1,100 AFA are currently available for acquisition. This strategy would involve a transfer of the available Plumas County water rights to Frenchman Reservoir, which would require a water right permit from the State Water Resources Control Board, and an environmental assessment during the application process. If additional water rights are transferred to Frenchman Reservoir, they would be available for acquisition by farms that rely upon both groundwater and Little Last Chance Creek water, with the objective of increasing surface water availability in place of groundwater pumping.

Four potential managed aquifer recharge (MAR) Opportunity Areas have been identified in this study, located along the northern, southern, and eastern side of Sierra Valley. The Opportunity Areas are situated on the alluvial fans at the periphery of the valley. These areas are likely to provide recharge that would make its way down to the deeper aquifers in the valley that are pumped for agriculture. Recharge to the deep aquifer by applying water on valley floor locations is not technically feasible due to the extensive presence of clays in the shallow soils. Each of the potential Opportunity Areas would require significant additional investigation to determine feasibility, the size of the opportunity, and the potential for unintended consequences. We offer a prioritized approach based on the initial promise identified relative to challenges and potential drawbacks.

The northern MAR Opportunity Area focuses on diversion of Little Last Chance Creek water during high runoff / reservoir spill conditions occurring on average in about one in five years. A potential diversion and infiltration project sized at 20 cfs might deliver 250 acre-feet annually (AFA) as a long-term average recharge volume. The capacity could be larger if higher-capacity diversion, conveyance, and infiltration facilities could be built. This MAR area is optimally situated to address the portion of the Sierra Valley aquifer that has the most pronounced drawdown. Challenges include conveyance of water multiple privately owned parcels, and achieving diversion rights that do not infringe upon decreed water rights of the Little Last Chance Creek.

The southern MAR Opportunity Area would use Smithneck Creek water during high runoff conditions. Focusing on diversion and infiltration in a December to March period when natural flow conditions exceed 28 cfs (90th percentile), it is estimate that a 10 to 20 cfs capacity infiltration facility could produce approximately 177 to 295 AFA, as a long-term average. Diversions in April and May might be possible, but would need to be accomplished without infringing upon decreed water rights.

In the northwestern side of the valley, an Opportunity Area has been identified on the Mapes Creek alluvial fan, which might be possible to produce about 70 AFA. A preliminary review to route Big Grizzly Creek water to this area suggests that land elevations are not sufficient for a gravity flow diversion ditch to reach alluvial fans, and therefore it does not appear feasible to benefit deep aquifer recharge from potential importation of Big Grizzly Creek water. The water source would be from high-flow conditions when they occur in Mapes Creek. Down-stream environmental concerns (wetlands) would need to be carefully considered in advancing this MAR concept

A smaller-scale MAR Opportunity Area has also been identified on the eastern side of the valley, that would rely upon retention and recharge of stormwater runoff from ephemeral streams, and potentially could produce 20-30 AFA as a long-term average.

In order to implement any MAR project in Sierra Valley, several important items would need to be successfully addressed, including: analyzing potential unintended consequences, securing landowner access and utilization agreements, securing water rights for diversion of surface waters, successful outcomes of technical evaluations, preliminary design and engineering, and CEQA permitting. Advancing a pilot MAR program is suggested as a next step for Smithneck Creek, subject to securing grant funding. Advancement of landowner discussions and technical feasibility reviews are also recommended for the Little Last Chance Creek water source, focusing on taking advantage of Frenchman Reservoir spill.

Estimated costs for advancing the MAR opportunities, with a prioritization of the Smithneck Creek opportunity are summarized in **Table 1.1**. As a preliminary recommendation, the Smithneck Creek opportunity area could be prioritized to advance at the feasibility evaluation and pilot program level. Discussions and initial steps are also recommended for the next level of reviews for the Little Last Chance opportunity area.

Table 1-1 Managed Aquifer Recharge (MAR) Opportunities in Sierra Valley

Opportunity Area	Potential Avg. Yield	Pilot Est. Cost	Notes
A Smithneck Creek	177-295 AF	$1.1 M	• Format: diversion to off-stream infiltration basin • Water sources - Diversions at >90 percentile, Dec. – March - Opportunity for diversions after Sept. 30 (decreed rights) - Perhaps high flow opportunities in April and May • Land ownership: CA DFW in upper watershed, private parcels below • Advance through permitting to pilot implementation project
B Little Last Chance Creek	250 AF	$0.6 M	• Format: large diversion structure to off-stream infiltration basins • Water sources: spill capture from Frenchman Reservoir - Perhaps high flow opportunities prior to spill • Land ownership: involves up to 12 private parcels and 1 federal parcel • Advance technical, preliminary design, and permitting
C Eastern Ephemeral Drainages	20-30 AF	TBD	• Format: small in-channel infiltration basins • Does not involved decreed water rights • Low implementation costs • Could provide local benefits • Land ownership: private
D Mapes / Big Grizzly Creek	72 AF	TBD	• Water Sources - Diversions at >90 percentile, Dec. – March - Opportunity for Mapes diversions after Sep. 30 (decreed rights) - Perhaps high flow opportunities in April and May • Could benefit northern wetland areas • Land ownership: private and CA DFW • Big Grizzly Creek source does not appear to be viable based on elevation of stream and recharge area

2. INTRODUCTION

2.1 GSP Management Actions and Projects

The Sierra Valley GSP was submitted to DWR in January of 2022. The document is available at https://www.sierravalleygmd.org/gsp-documents. The Basin's sustainable yield is estimated between 5,500 – 6,500 AFA, with overdraft estimated at 1,300 to 3,000 AFA, as a long-term average. To advance sustainable ground water management the GSP proposes Projects and Management Actions (PMAs) relating to Supply Augmentation, Demand Management, and Other Management Actions (e.g., data, outreach).

This technical document serves as a guide for evaluating and advancing PMAs relating to supply augmentation using surface water resources. Two additional reports address Agricultural Irrigation Efficiency (demand management) and Metering and Monitoring activities (other management actions).

This evaluation was funded by a grant from DWR for the development of the Sierra Valley GSP by the Sierra Valley Groundwater Management GSA and the Plumas County GSA.

2.2 Purpose of this Document

Chapter 4 of the GSP identifies and describes Projects and Management Actions (PMAs) for enhancing sustainable groundwater management. The GSP includes several potential PMAs relating to surface water resource management; these are reviewed here at the level of a preliminary feasibility study. The PMAs addressed in this document are:

Section 4.3.3 Reoperation of Surface Water Supplies: *Opportunities to use surface water resources differently may be an important strategy to reduce long-term groundwater pumping in Sierra Valley. Opportunities may exist for Frenchman Lake / Little Last Chance Creek, Lake Davis / Big Grizzly Creek (Plumas County water right allotment), Smithneck Creek, and smaller tributaries to the northern and eastern sides of the basin.*

Section 4.3.4 Off-Stream Storage: *Increased off-stream surface water storage projects are a potential strategy to augment water supply by diverting and storing surface water that would otherwise exit the SV Subbasin as runoff.*

Section 4.3.10 Groundwater Recharge/Managed Aquifer Recharge: *Managed Aquifer Recharge (MAR) is the process of intentionally adding water to aquifers. Both active and passive conjunctive uses could provide water supplies for MAR projects in the SV Subbasin. Active conjunctive use, or direct recharge, includes any practice that delivers water to the aquifer and increases groundwater storage. Passive conjunctive use, or indirect recharge, includes conjunctive use practices (i.e., coordinated uses of surface water and groundwater) that reduce the amount of groundwater withdrawals.*

2.3 Acknowledgements

The McGinley team responsible for this evaluation and document would like to thank the Sierra Valley Groundwater Management District and Plumas County for the opportunity to provide professional services on this important component of the newly adopted Groundwater Management Plan (GSP) for Sierra Valley. This project has been funded through a grant received from CA Department of Water Resources (DWR), and we are thankful to the State for making it a priority to assist the Sierra Valley residents with funding necessary to advance sustainable groundwater management in the valley. We would like to acknowledge the Sierra Valley DWR representative Ms. Debbie Spangler for being an active and accessible resource over the course of all work related to the GSP development, and initial implementation steps.

The McGinley team would like to acknowledge to assistance of Mr. Jay Huebert, the SVGMD Meter Technician for taking us through the valley on multiple occasions, driving to all active wells and farms/ranches that utilize groundwater, and for gladly sharing his local knowledge of the valley. We would also like to thank the SVGMD Board members (Mr. Einen Grandi, Mr. Don Wallace, Mr. Dave Goioechea, Mr. Greg Ramelli, Mr. Paul Roen, Mr. Jim Roberti, and Mr. Dwight Ceresola) and local farmers that have helped to educate us and share ideas on water resources management over the course of this study. Appreciation is also extended to Ms. Jenny Gant, SVGMD Board Clerk for her day-to-day assistance and coordination.

We appreciate the input of all the GSP planning committee members during development of the GSP projects and management actions, including Kristi Jamason, Tracey Ferguson, and Laura Foglia and Betsy Elzufon from the Larry Walker and Associates GSP development team. We also appreciate the efforts and input of the GSP Technical Advisory Community members during initial discussions on potential implementation projects and management actions.

We would like to thank Dr. Gus Tolley with Daniel B. Stephens & Associates for sharing additional details on surface water modeling completed for the GSP (GSP Appendix 2-7), and providing PRMS model output for surface water runoff simulations for major streams in the valley. Thanks are also expressed to the DWR Watermaster for Sierra Valley, Mr. Luis Sepulveda, and Oroville Field Division manager Mr. Clint Womack, for helpful conversations for understanding current regulation of surface waters in Sierra Valley and administration of the decreed surface water rights.

3. SURFACE WATER RESOURCES OVERVIEW

3.1 Watersheds and Historical Flows

The Sierra Valley watershed, approximately 540 square miles in area, forms the headwaters of the Wild and Scenic-designated Middle Fork of the Feather River. Numerous perennial and intermittent streams converge on the valley floor to form the head of the Middle Fork of the Feather River, and support an extensive wetland, riparian, and meadow area. Surface water flows are braided through this wetland area, but converge to form a single main channel of the Middle Fork of the Feather River that exits Sierra Valley at the northwest corner (**Figure 3.1**). Numerous streams originate from the western watershed of Sierra Valley, including (from north to south): Carman Creek, Fletcher Creek, Turner Creek, Berry Creek, and Hamlin Creek. The southern-most watersheds are the source areas for Bonta Creek, Perry Creek, Webber Creek, Cold Stream, and Lemon Creek.

Southeastern streams include Antelope Creek, Smithneck Creek and Staverville Creek. Bear Valley and Badenough Creeks are tributary to Smithneck Creek. There are no perennial streams on the central-eastern side of Sierra Valley; all drainages are ephemeral on the valley floor. The Little Last Chance Creek flows from the northeastern watershed of Sierra Valley and is regulated up-stream by Frenchman Reservoir. Frenchman Reservoir was constructed in 1960 as part of the State Water Project, for both recreation and irrigation water management. There are no perennial streams from the central-northern watersheds, but Mapes Creek is derived from the northwestern watershed. The confluence of Big Grizzly Creek and the Middle Fork of the Feather River occurs at the northwestern Sierra Valley basin boundary. Flows in Big Grizzly Creek are regulated by the up-stream Lake Davis reservoir.

Most streams in Sierra Valley do not have stream flow gages. The outflow of the Little Last Chance Creek from Frenchman Reservoir has a gage that is operated by DWR. Outflow from Lake Davis is also gaged outside the basin boundary, and the flows of the Middle Fork of the Feather River are gaged down-stream of the basin boundary.

Waters of the Little Truckee River are diverted from the Truckee River watershed into southern Sierra Valley watershed via Cold Stream, a tributary to Webber Creek, providing a source of irrigation season water to the southern and central Sierra Valley ranches, extending north to lands owned by the Feather River Land Trust. This water is owned by Sierra Valley Mutual Water Company (SVMWC), with a maximum diversion rate of 60 cfs from March 15 to September 30, but minimum flows of 5 cfs must be maintained in the Little Truckee River below the diversion from March 15 to June 15, and 3 cfs for the rest of the year. This water right is administered by the Sierra Valley Watermaster, and is acknowledged in the Orr Ditch Decree for the Truckee River, and as adjudicated in District Court of the United States for the Northern Division of the Northern District of California, Civil Case No. 5597.

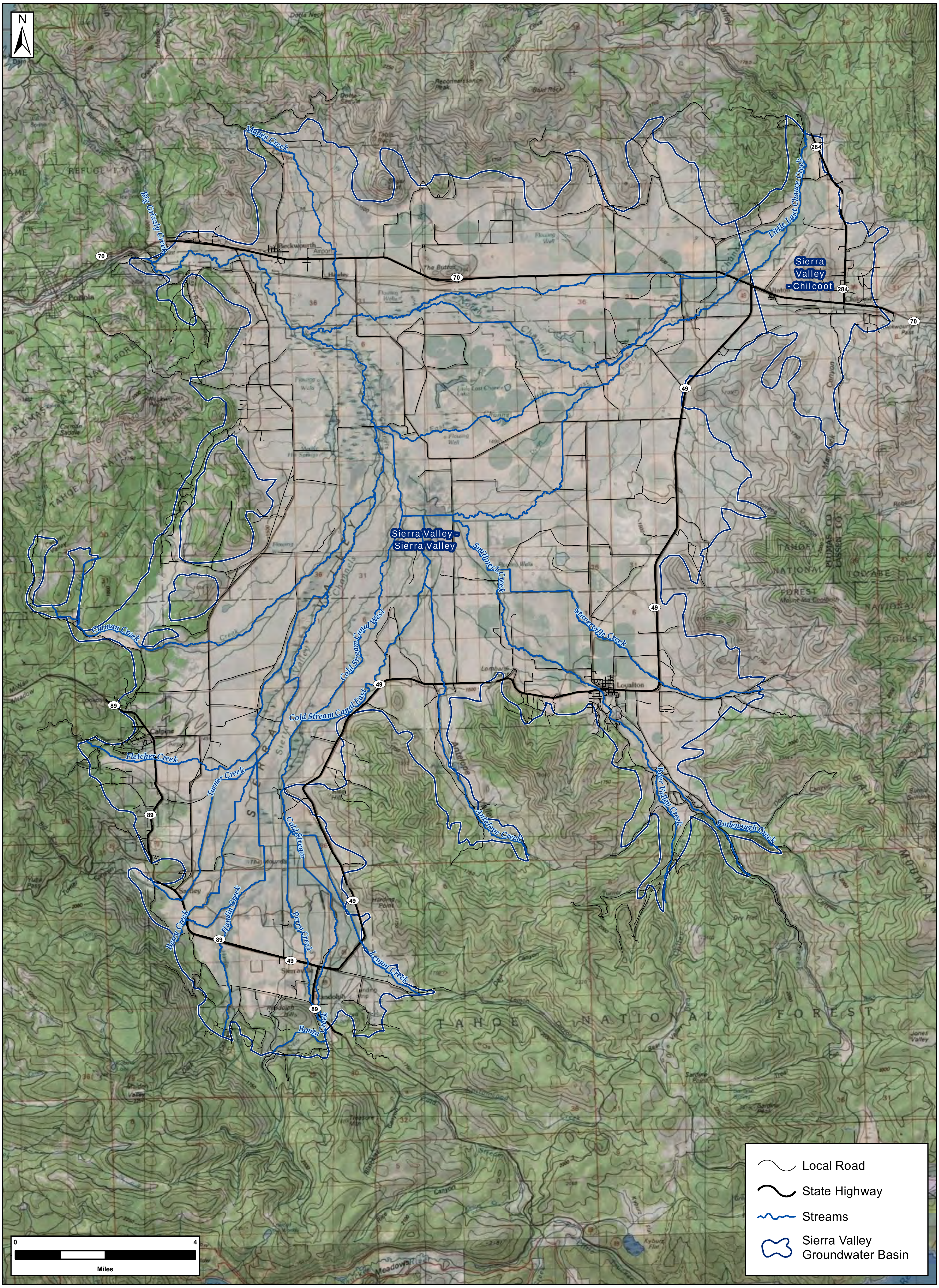

FIGURE 3.1

TITLE:

VICINITY MAP
-SHOWING-
Surface Water Features in
Sierra Valley, California

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FILE: Figure 3.1 – Surface Water Features in Sierra Valley

COORDINATE SYSTEM: NAD 1983 UTM Zone 10N

JOB NO.:	DATE:	REF.					REVISION:
SVGMD001	11/23/2022		DESIGNED	HC	CHECKED	DS	-
			DRAWN	HC	APPROVED	DS	

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 3.1 – Surface Water Features in Sierra Valley.mxd

3.2 Decreed Surface Water Rights

Surface water in Sierra Valley was adjudicated in 1936-1940 by the Superior Court of California, in Case No. 3095, for the *Middle Fork of the Feather River and its Tributaries Situated Above Beckwith, Plumas and Sierra Counties, CA* (here in referred as the "decree"). In the decree, the relative rights are established for all surface waters being diverted and placed to a "beneficial use" in the valley, with irrigation being the primary beneficial use. The decree identifies approximately 40,500 acres of valley-floor ground that was classified as irrigated lands, approximately 92% of which was used for production of meadow hay and meadow pasture at the time of the decree. The remaining 8% was used for production of alfalfa and grains. These forage crops were consumed locally by livestock and dairy industries. DWR (1965) reports 84 individual water right owners with total allotments of 370.865 cubic-feet per second (cfs).

The decreed water rights are managed in six separate hydrologic groups:

- Little Last Chance Group,
- Smithneck Creek Group,
- West Side Canal Group,
- Fletcher Creek Group,
- Little Truckee River Group (SVMWC), and
- Middle Fork of Feather River (Webber) Group.

The groups are regulated independently, but the first five groups are superior in priority to the Middle Fork of the Feather River Group.

The decree defines the irrigated area for each claim, and the diversion rate under each priority class. Rather than determining priority dates of each right, the decree established different priority classes (first class, second class, etc.) based on the history of initiation of beneficial use, with the first class having the senior-most right to water. Each group has five priority classes, except Webber Creek and tributaries which has six, and Fletcher Creek which has three. The Little Truckee River imported water has one priority class. Schedules for irrigation water diversion rates are established in the decree for each allotment and for each priority class within the allotment. Some "surplus" class rights exist, but are minimal and are inferior to the "special class" rights.

The state appointed Watermaster regulates the delivery of surface water based on the decree and a determination of priority class that can be met, and schedule of areas under which to deliver water for the priority class. Manual flow measurements, made on the primary streams throughout the irrigation season, establish the priority class.

The irrigation and diversion season for decreed water rights begins on March 15 and ends on September 30. Water can be diverted and delivered to the farms/ranches as long as the flows persists in the source, which varies by water-year and stream source, and in some instances ceases as early as May. Small amounts of non-irrigation diversions are allowed under the decree, generally as surplus rights, as defined for storage, domestic, and stock-watering, having a January 1 to December 31 diversion period.

DWR (1965) reports the following observations regarding the stream sources and deliveries of decreed water rights.

Flow of Little Last Chance Creek is reregulated and supplemented by stored water through use of Frenchman Dam which was constructed on the stream by the Department of Water Resources in 1961. This water is now released and used as needed.

Smithneck Creek flow is normally sufficient to supply allotments until about the middle of May and then decreases rapidly until June 1 when only first and second priority allotments are available for the remainder of the season.

Natural flow of Webber Creek is normally sufficient to supply allotments until the middle of May. At that time foreign water, up to 60 cubic feet per second, is used to supplement the flow. This foreign water is diverted from Little Truckee River through the Little Truckee Ditch into Cold Stream and then into Webber Creek for the use of shareholders in the Sierra Valley Mutual Water Company. This supplemental supply decreases rapidly during July producing only small amounts of water for the latter part of the season.

The West Side Canal streams normally supply all allotments until the first part of June, with the flow gradually declining throughout the season.

The flow of Fletcher Creek and Spring Channels normally supplies all allotments until July 1 with the flow then gradually declining for the remainder of the season.

3.3 Frenchman Reservoir

Frenchman Dam was constructed in 1961 by DWR as part of the State Water Project, forming Frenchman Lake, by impounding the waters of Little Last Chance Creek and tributaries. The rock-fill and earthen dam is approximately 129 feet in height and 720 feet in length. The reservoir, when full, has a surface area of 1,580 acres, and depth of water of approximately 101 feet, with a storage capacity of approximately 54,500 acre-feet.

The Middle Fork of the Feather River decree was amended by a contract between DWR and the Little Last Chance Water District, and through the terms of two water right permits issued for storage of water in Frenchman Lake. The Little Last Chance Water District is comprised of approximately ten ranch/farm owners that have decreed water rights on Little Last Chance Creek.

Permit 12945 (License 9128) is for irrigation, domestic, stock-watering and recreational uses, with a priority date of March 20, 1956. The permit allows for irrigation water use on 10,000 acres of the 31,600 acres defined within the boundaries of the Little Last Chance Water District. The duty of the water storage and use right is as following:

- 30,000 AFA to be collected in the reservoir from November 1 to June 1.
- 15,194 AFA of maximum withdrawal
- Minimum fish flow release of 2 cfs between October 1 to March 31.
- If reservoir storage is less than 16,000 AF, then the minimum fish flow is equal to 2 cfs, or the inflow to the reservoir, whichever is less.

Permit 12946 (License 9928) is for recreational water use, with a priority date of July 6, 1959, and allows the following:

- 20,000 AFA maximum storage for refill for recreational, environmental and maintenance purposes
- 34,962 AFA of maximum storage, combined with License 9182.

- Not to exceed 50,000 AFA of collection in one season.
- Right to retain 55,447 AFA in storage in the reservoir.
- Minimum fish flow release of 2 cfs between October 1 to March 31.
- If reservoir storage is less than 16,000 AF, then the minimum fish flow is equal to 2 cfs, or the inflow to the reservoir, whichever is less.

3.4 Surface Water Flow Data

3.4.1 Little Last Chance Creek and Frenchman Reservoir

Flows of Little Chance Creek at the Frenchman Reservoir dam were recorded by gages operated by the US Geological Survey (USGS), in cooperation with DWR, from October 1958 to August of 1980. The USGS data are available from the National Water Information System (NWIS) database. For water-year (WY) 1961 to present, stream flow data below the dam is published by DWR on the California Data Exchange Center (CDEC), and DWR has current responsibilities for operation of the gaging station. Data on Frenchman Lake (Reservoir) water surface elevation (stage) is recorded at the dam by DWR and is also available from CDEC for WY 1961 to present. The volume of water stored in the lake is calculated based on a stage-volume curve that has been developed from a bathymetry survey.

Figure 3.2 is a plot of the average monthly volume of water stored in Frenchman Lake. On this plot, it is interpreted that when the average monthly volume is approximately equal to the reservoir volume (54,500 AF) some spill occurs (volume of inflow exceeded the holding capacity of the reservoir). The plot shows that full reservoir and spill conditions occurred frequently during the first 10 years after the reservoir filled in 1965. Reservoir spill occurred over multiple years during the wet conditions of 1982-1986, and 1995 to 2000. However, since year 2000, full reservoir conditions and spill have occurred less frequently, with single year full reservoir events in 2006 and 2011, and in 2017 and the two years following. The apparent less frequent occurrence of full reservoir conditions in the past 20 years could have ramifications for future management actions, such as managed aquifer recharge (MAR), that may focus on deriving benefits from spilled water. The less frequent reservoir fill and spill conditions is likely related to the prolonged drought cycles that the western US has been facing over the past two decades; it is unclear if recent trends will be representative of future conditions.

Figure 3.3 shows the computed volume of spill that occurred for each water-year over the period of record from WY1961 to WY2021. From this plot, it can be observed that when spill occurs, it is a large volume of water, normally exceeding 1,000 acre-feet, and commonly exceeding 10,000 AF during multi-week spill events.

Figures 3.4 to 3.6 are plots of the daily accounting of releases made for Frenchman Reservoir by the Watermaster for WY 2000 to 2021. Released water is classified as “water right” or “contract” for releases made to satisfy irrigation and stock-watering water rights on the Little Last Chance Creek. These releases are made based on a seasonal available water determination made each year by the Watermaster using snow-survey data and predictions of reservoir inflow for the upcoming season. In 2021, the total allocation of water rights from Frenchman Reservoir was set at 8,000 AF, well below the annual maximum of 15,194 AF. Contract water may be called upon by down-stream water right owners between April 1 to December 31 of the year. Late season calls are for stock-watering purposes. As observed in **Figure 3.4**, commonly the water rights are called upon commencing in early to late-May, and ending in early to late-September, with peak deliveries commonly occurring in mid- to late-

May, and also in August. Since 2016, peak releases have occurred later in the summer in August. The timing of call for releases likely relates to the absence or occurrence of spring and early summer precipitation and soil moisture, and planning for crop growth and cuttings over the season. However, it should be noted that retention of water in the reservoir through the hot summer months of July and August results in greater amounts of evaporation loss of the stored water resources.

Releases categorized as environmental exceeded the required minimum 2 cfs in years 2015, 2016, 2017 and 2019 (**Figure 3.5**). This is in part due to how the water is accounted by the Watermaster, rather than specifically targeted environmental releases. Releases in 2017 and 2019 under the environmental category can be lumped with the spill category, for simplification. Environmental releases in 2015 and 2016 above a 2 cfs rate are related to calls for decreed water for Little Last Chance Lake, which has an off-season decreed diversion right to fill the lakes situated on the Roberti Ranch for storage and use during the irrigation season.

Also, an important observation in the daily records of spill over the past 21 water-years (**Figure 3.6**) is that spill occurrences are of short durations, most commonly in the months of April and May. The timing and duration of spill events will need to be carefully factored into consideration for any AR project under consideration, and will necessitate the ability to divert and infiltrate a high rate of water over a short duration when spill is available.

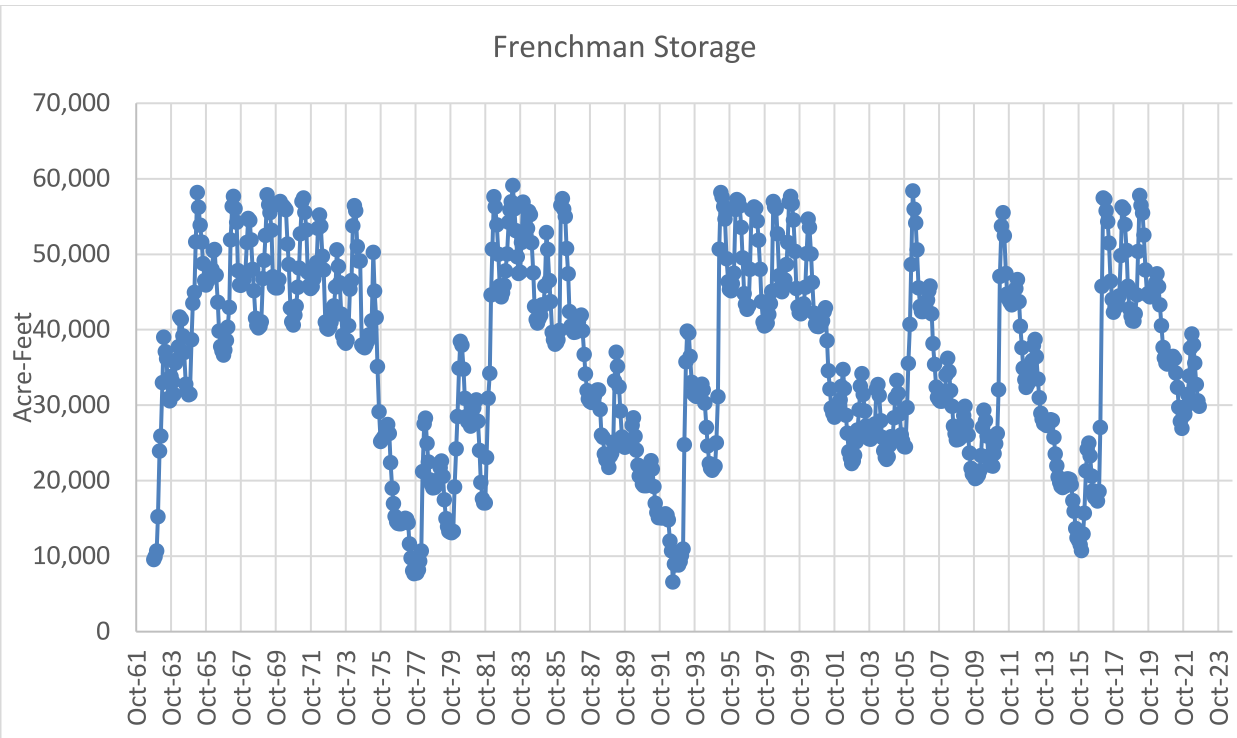

Figure 3.2 – Frenchman Lake Historical Volume of Water Storage (Monthly Average)

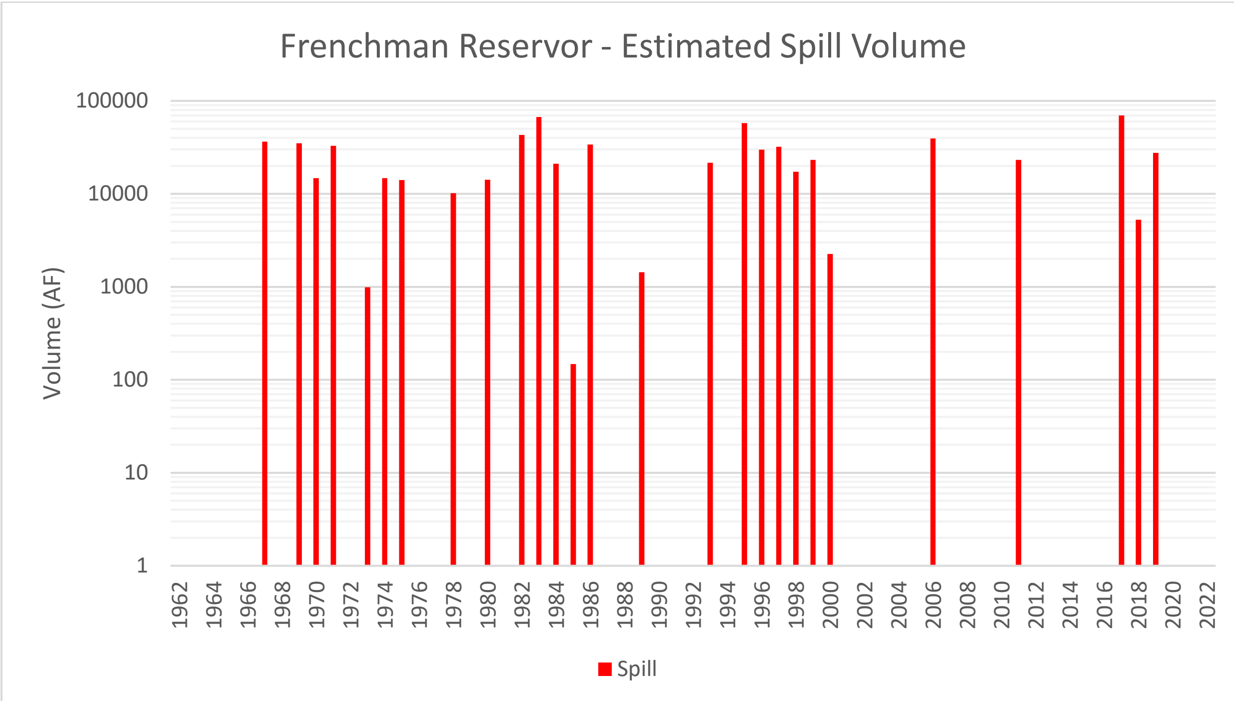

Figure 3.3 – Frenchman Lake Interpreted Volume of Historical Spill (Log Scale)

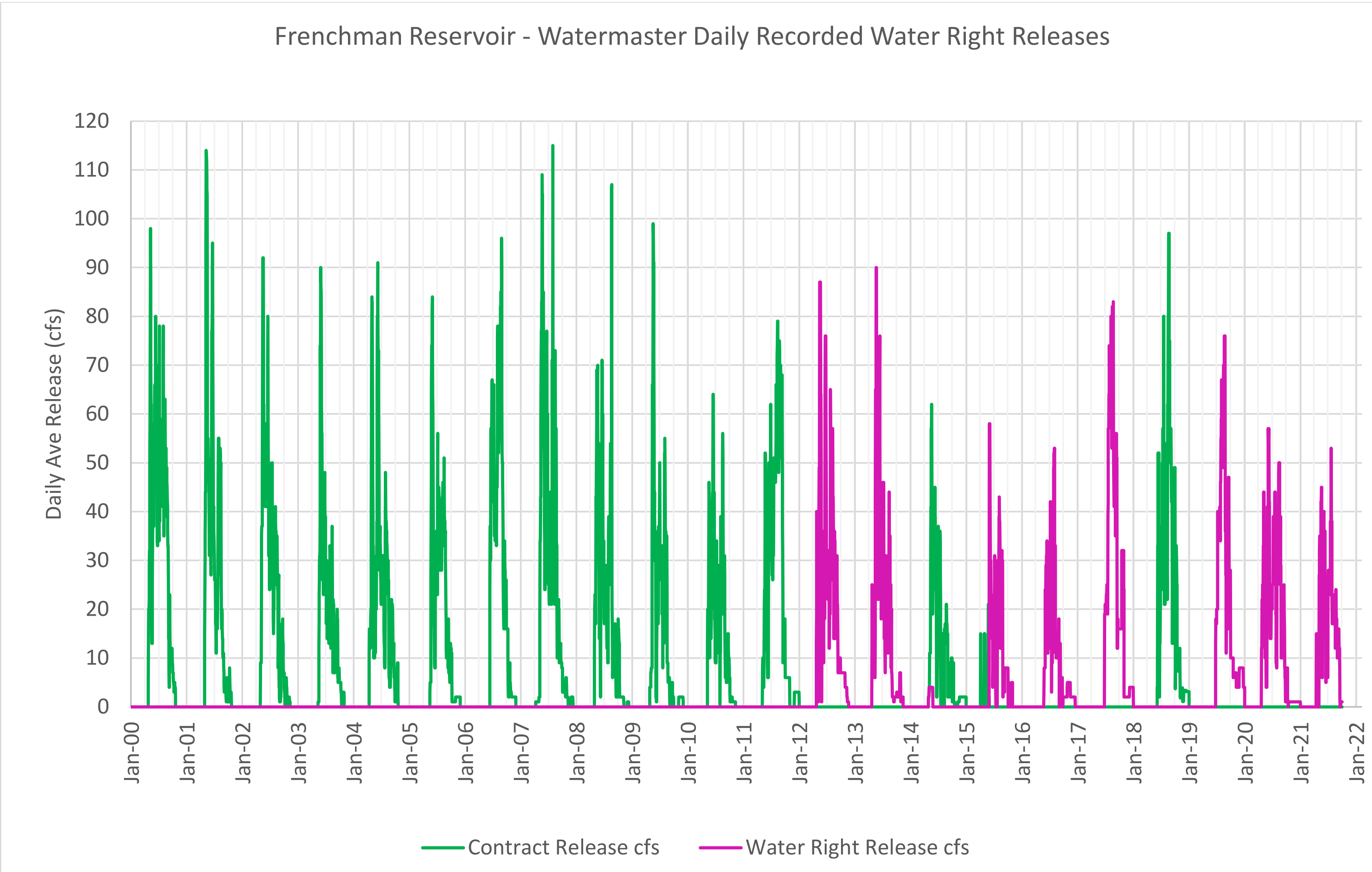

Figure 3.4 – Frenchman Lake Daily Releases made for Contract Water or Water Rights WY2000 to WY 2021

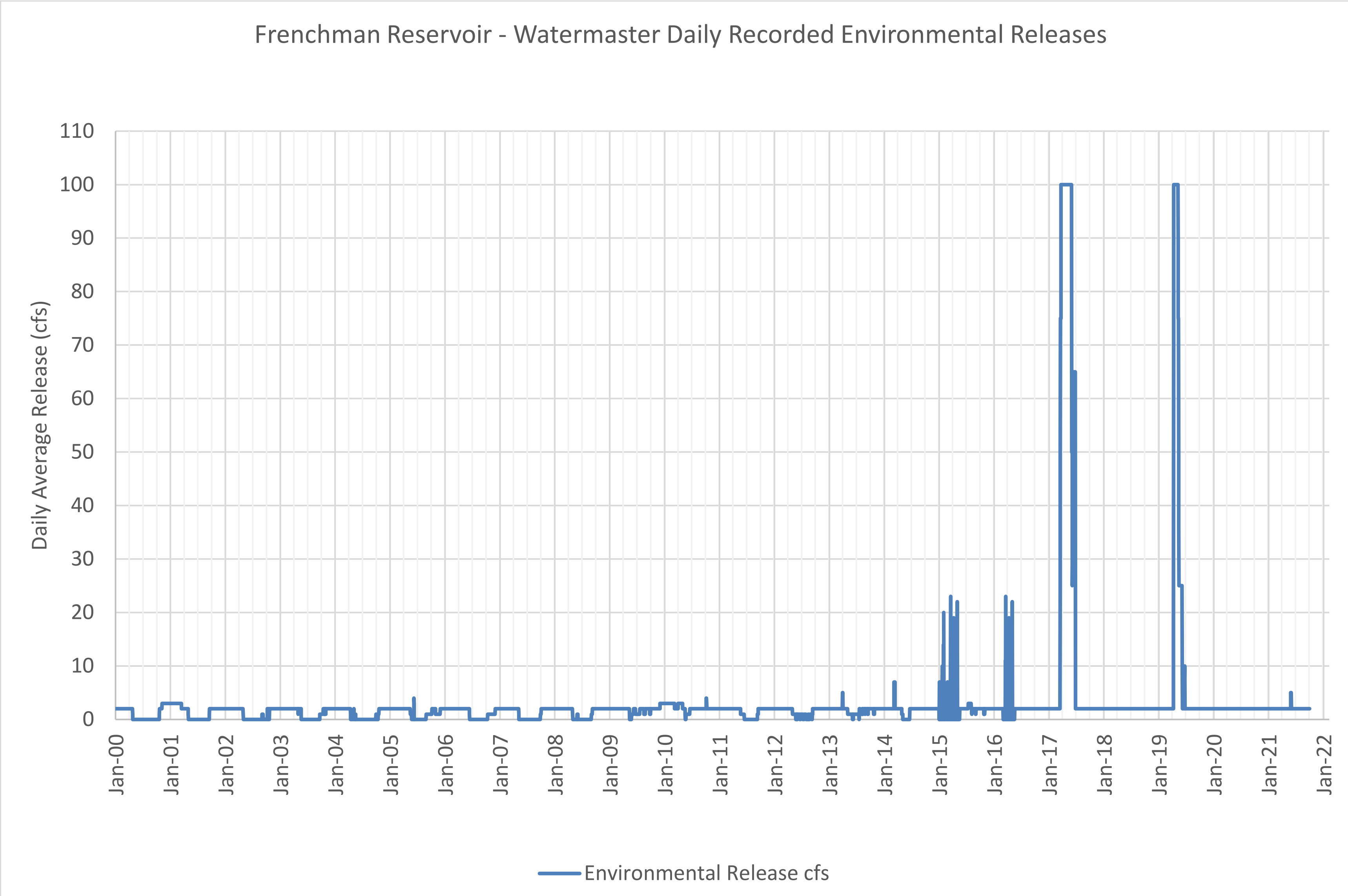

Figure 3.5 – Frenchman Lake Daily Releases for Fish Flows (Environmental) WY2000 to WY 2021

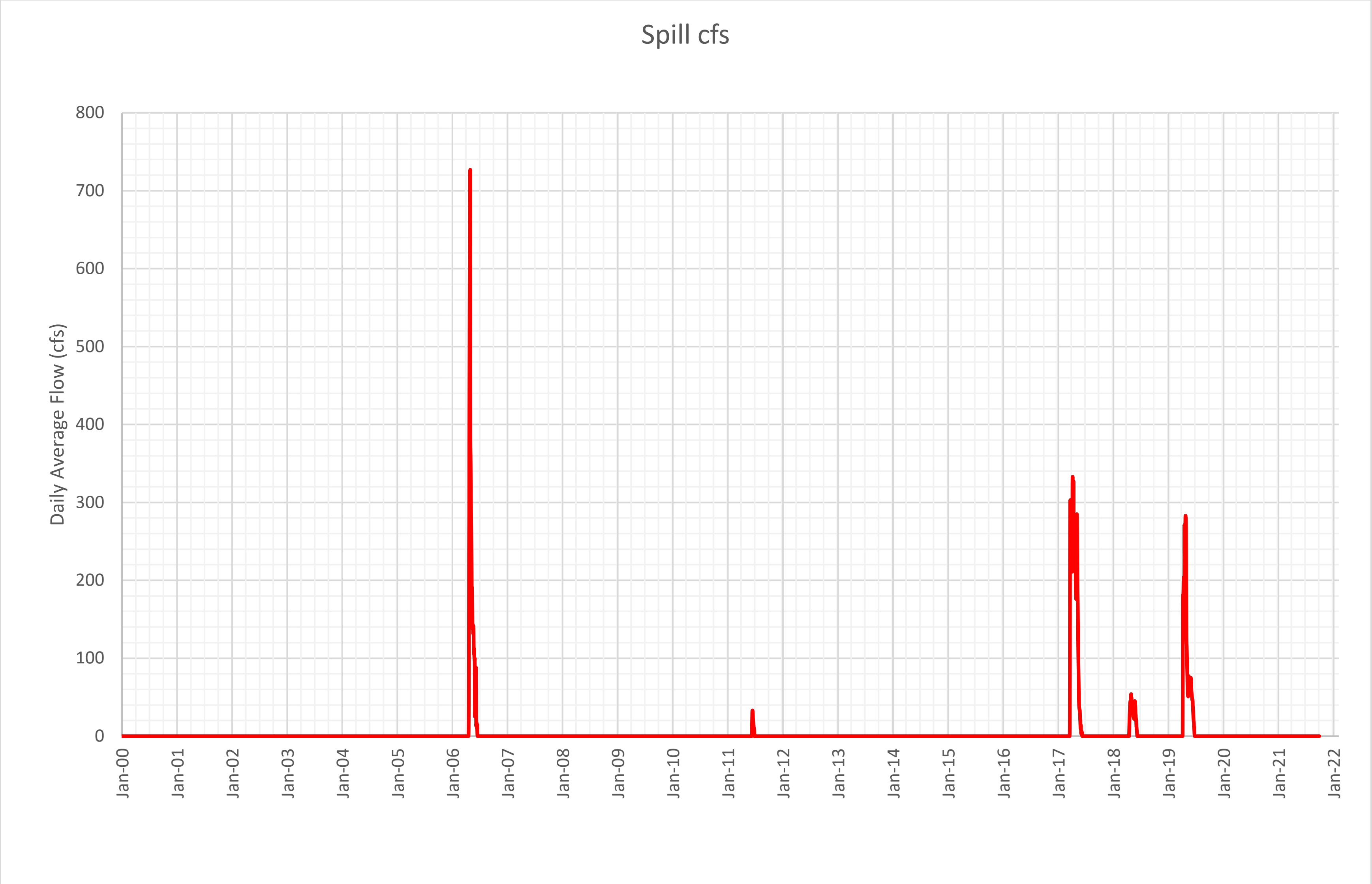

Figure 3.6 – Frenchman Lake Daily Recorded Spill WY2000 to WY 2021

3.4.2 Other Streams - Water Master Measurements

The Watermaster makes instantaneous field measurements of flows from primary streams entering the valley over the course of the irrigation season, as part of water right administration duties. The measurement location points are shown in **Figure 3.12**. Streams measured include:

- Smithneck Creek
- Staverville Creek (infrequent)
- Turner Creek
- Miller Creek
- Hamlin Creek
- Railroad Springs (East and West)
- Fletcher Creek
- Cold Creek
- Webber Creek
- Lemmon Creek, and
- Little Truckee River Diversion

Watermaster field measurements were obtained for water-years 2007 to 2020. **Figures 3.7a and b** present plots of the measurements made for Smithneck Creek, using linear and log units for the y-axis. August flows range from approximately 4 to 5 cfs, and are the seasonal low flow measurements. Early summer measurements range from about 6 to 12 cfs, and in wet years can exceed 100 cfs. No flow measurements were made in 2017, an extremely wet year, as there was no need to regulate water rights by priority (all priorities / classes being served).

The other Watermaster stream flow measurement points are located on the western side of Sierra Valley, and do not directly relate to stream resources that may have an association with GSP Projects and Management Actions being reviewed in this report.

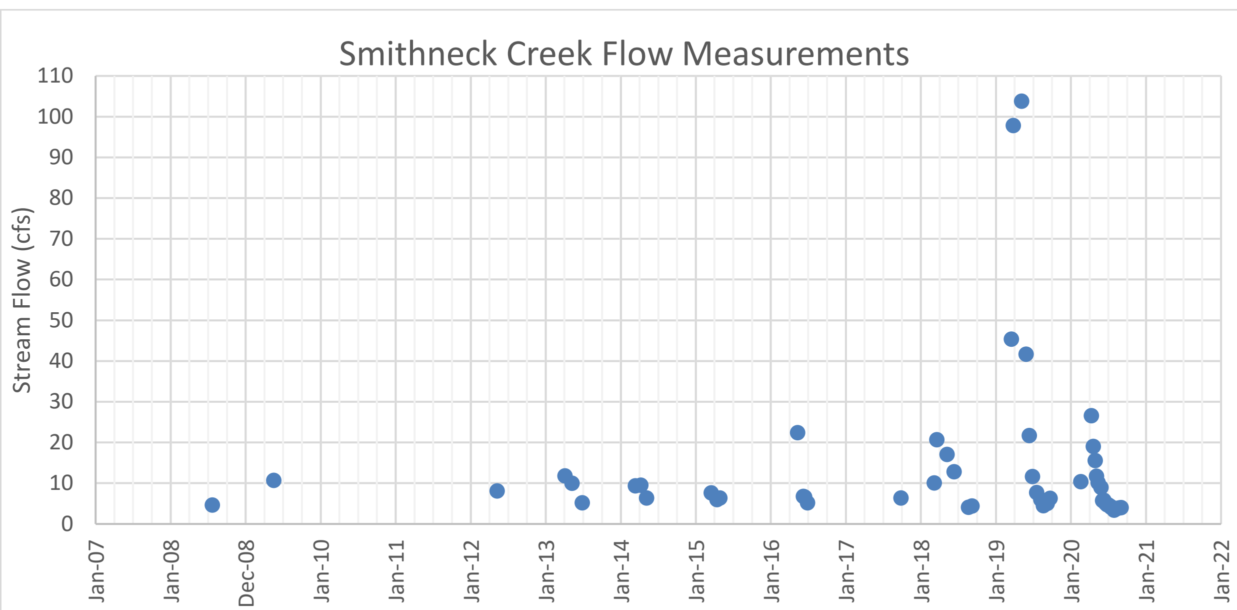

Figure 3.7a – Smithneck Creek Stream Flow Measurements made by Watermaster for WY2007 to WY2020 (Linear Plot)

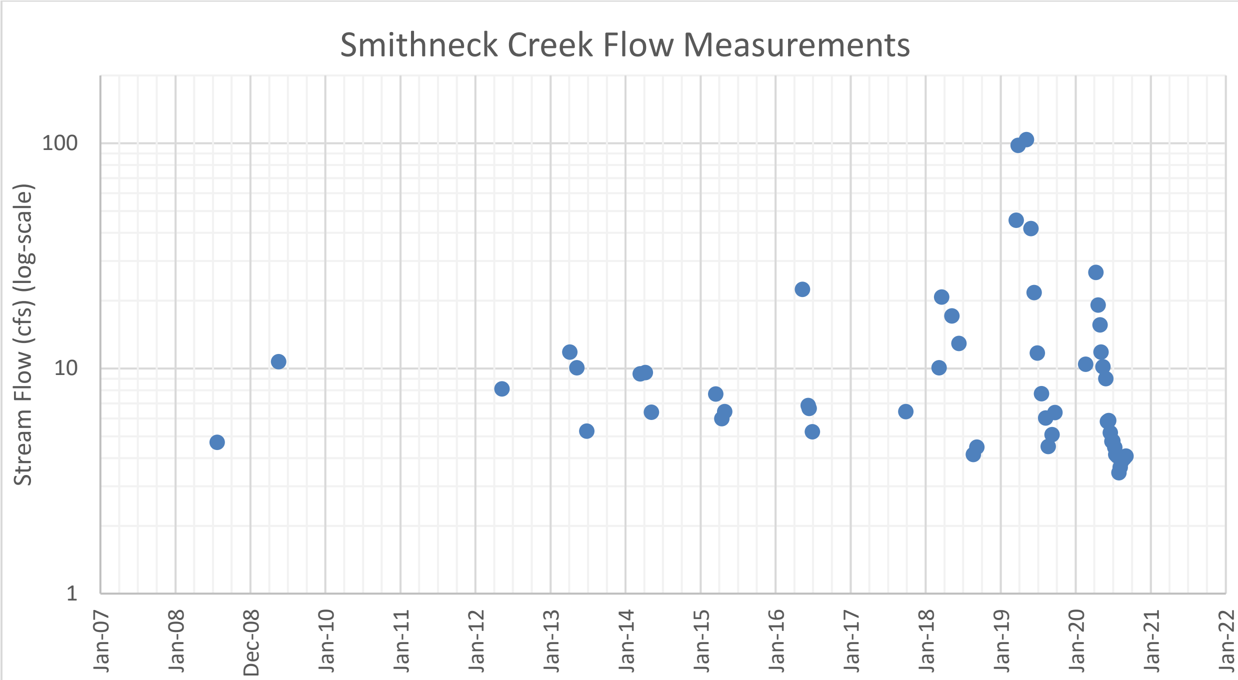

Figure 3.7b – Smithneck Creek Stream Flow Measurements made by Watermaster for WY2007 to WY2020 (Semi-log Plot)

3.4.3 Lake Davis and Big Grizzly Creek

Big Grizzly Creek enters the Sierra Valley basin on the far northwestern edge. Flow of Big Grizzly Creek is regulated by Lake Davis. The Grizzly Valley Dam was constructed in 1966 as part of the State Water Project. Lake Davis reservoir has a storage capacity of 83,000 AF. **Figure 3.8** shows the past 21 years of storage volume. Spill occurred in 2017, 2018 and 2019. Outflows at the dam to Big Grizzly Creek are shown in **Figure 3.9**.

Plumas County currently holds 2,700 AFA of water rights to Lake Davis, 1,600 AFA of which has been sold to Portola, Grizzly Ranch Golf Club, and Grizzly Lake Community Services District. This water is allocated based on water-year projections, and in 2022 there was only a 5% allocation (135 AF). However, the County anticipates gaining firm "guaranteed" duty of 1690 AFA in an amendment to the executed in 2023, provided there is sufficient water in Lake Davis. This firm yield would be expected to be prioritized to municipal users, but could also provide a base amount for irrigation that has not yet been quantified. The current value of these County water rights based on DWR invoicing to the County is about $110 per acre-foot per year, and future values can be expected to be higher.

Preliminary discussions between the County and DWR suggests that the water right might be conveyed to Frenchman Lake, which presents a significant opportunity for agricultural users on the Little Last Change Creek. It is possible that a portion of the Plumas County water rights could be transferred to Frenchman Lake. This would provide an opportunity for irrigators to purchase or lease the water for normal conveyance in Little Chance Creek. However, some caution is needed, as allocating additional irrigation rights from Frenchman Lake would result in less water retained for recreational purposes. Water rights would need to be amended / established for the conveyance from Lake Davis to Frenchman Lake.

The potential diversion of excess spill water from Big Grizzly Creek in wet years is also an opportunity. As examined later in this report, opportunities to convey flows from Big Grizzly Creek into areas that could support agriculture or for aquifer recharge are limited due to inadequate topographic relief for a gravity conveyance system – Big Grizzly Creek enters Sierra Valley near the lowest elevation in the valley. However, future opportunities might exist for the Big Grizzly Creek water source to support wetlands and groundwater dependent ecosystems in the northwestern part of the valley.

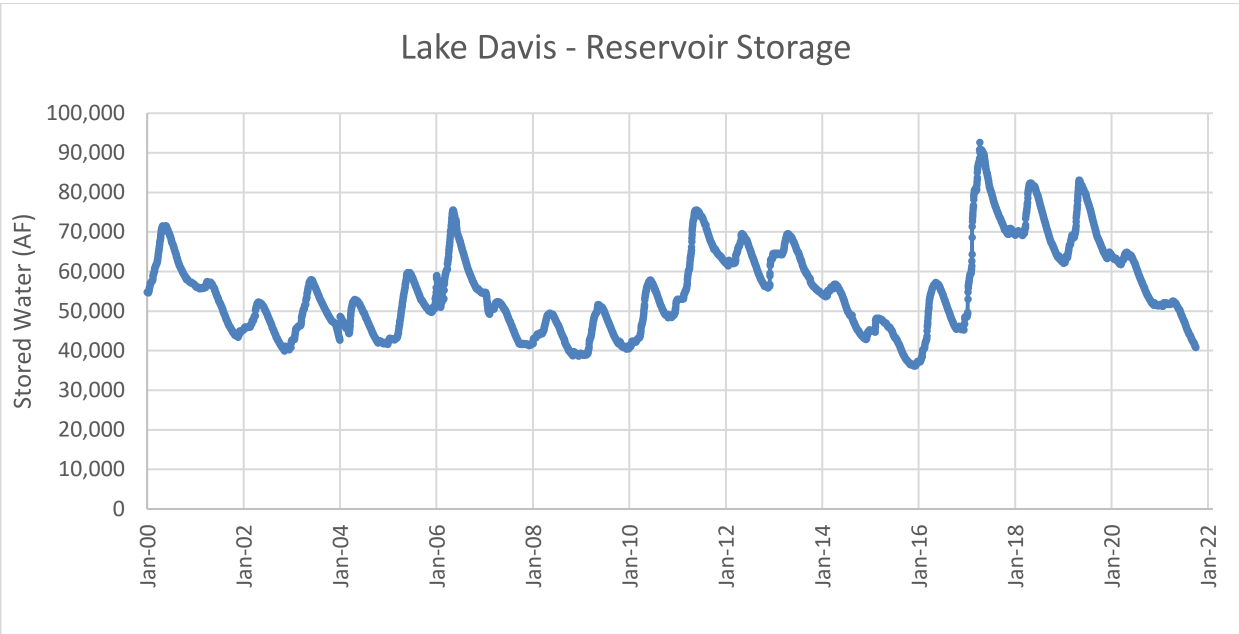

Figure 3.8 – Daily recorded storage in Lake Davis from 2000 to 2021

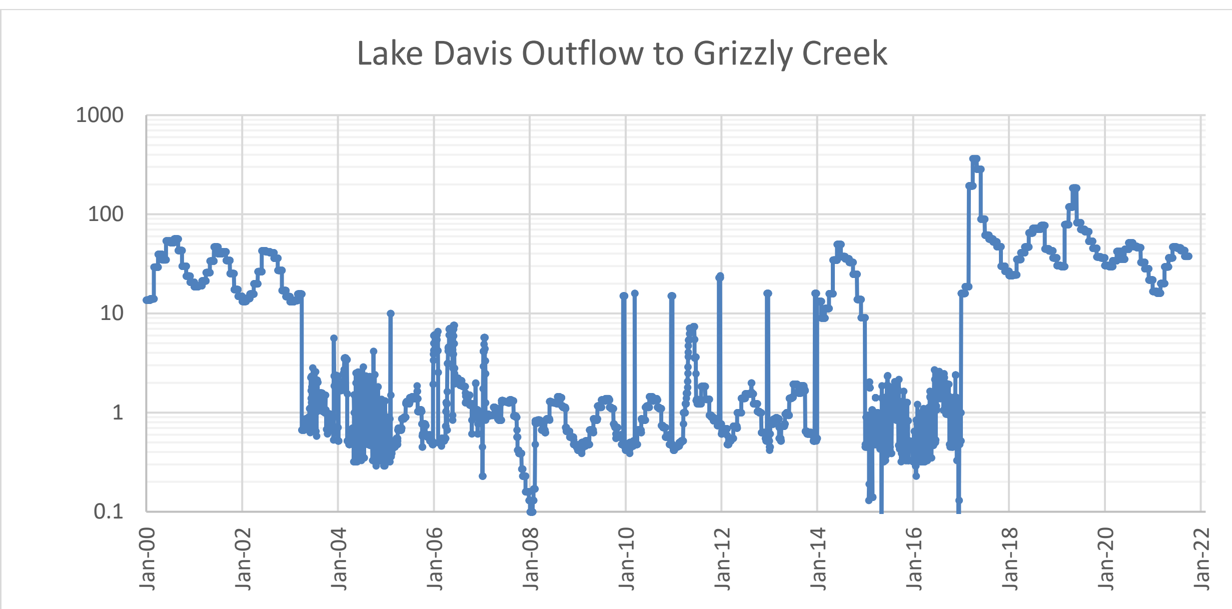

Figure 3.9 – Daily recorded outflow from Lake Davis from 2000 to 2021

3.4.4 Middle Fork of the Feather River

The Middle Fork of the Feather River exits Sierra Valley below the confluence with Big Grizzly Creek. Flow in the river ranges from a low of approximately 2 cfs to highs under flood conditions exceeding 7000 cfs (USGS, 2022). Average annual river flow ranges from 54.8 cfs, or approximately 40,000 AFA, to a high of approximately 475.8 cfs, or approximately 350,000 AFA. Mean monthly discharge is shown in **Figure 3.10**.

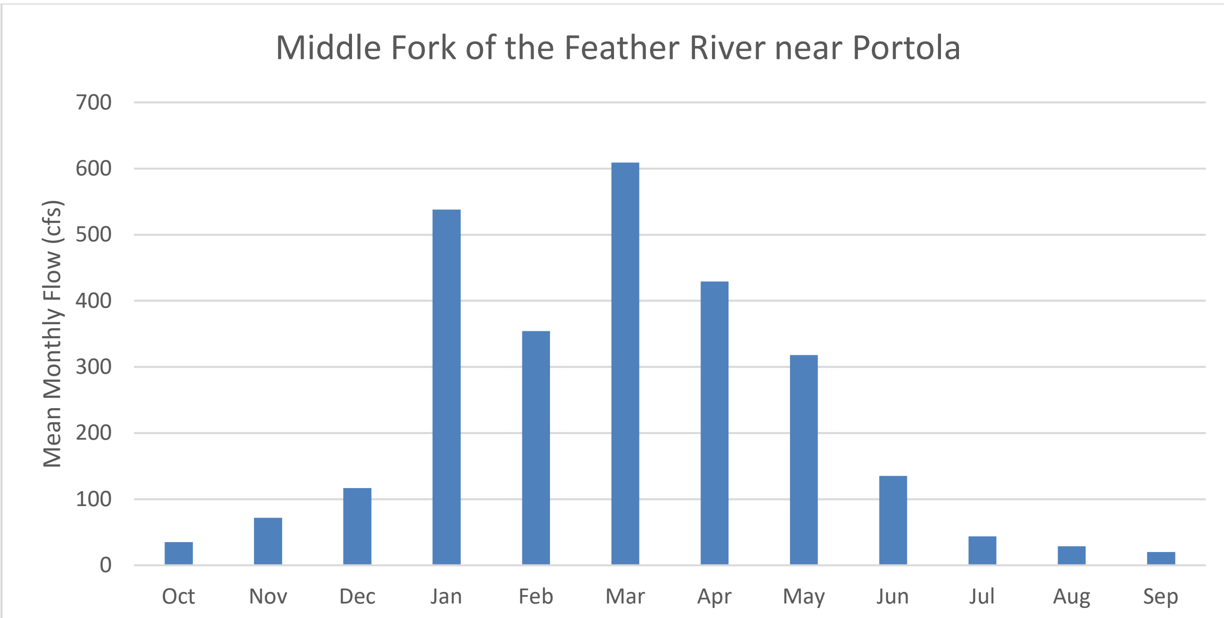

Figure 3.10 – Mean Monthly Flows of the Middle Fork of the Feather River near Portola (USGS, 2022)

3.4.5 Lake Oroville

Sierra Valley streams and the Middle Fork of the Feather River are tributary to Lake Oroville, constructed in the late 1950s as part of the State Water Project. Lake Oroville has a storage capacity of approximately 3.5 million AF. The maximum lake water level is 900 ft above mean sea level (amsl), with spill occurring at 901 ft amsl. Lake Oroville is also managed for flood control, and with releases to accomplish a winter pool elevation of 640 ft amsl by mid-October (storage volume of 750,000 AF).

From review of the historical stage data for Lake Oroville, in most recent years when spill occurs from Frenchman Reservoir, Lake Oroville is operating at or near the maximum storage capacity, leading to a preliminary observation that a case may be made for unappropriated water when spill is occurring from Frenchman Reservoir (i.e., diversion of Frenchman Reservoir spill for use in Sierra Valley is not impacting the stored water volume in Lake Oroville). More detailed analyses will be required to support this preliminary observation if advancing a water right application for additional diversions from Little Last Chance Creek. **Figure 3.11** is a hydrograph of Lake Oroville water stage elevations for the past nine years.

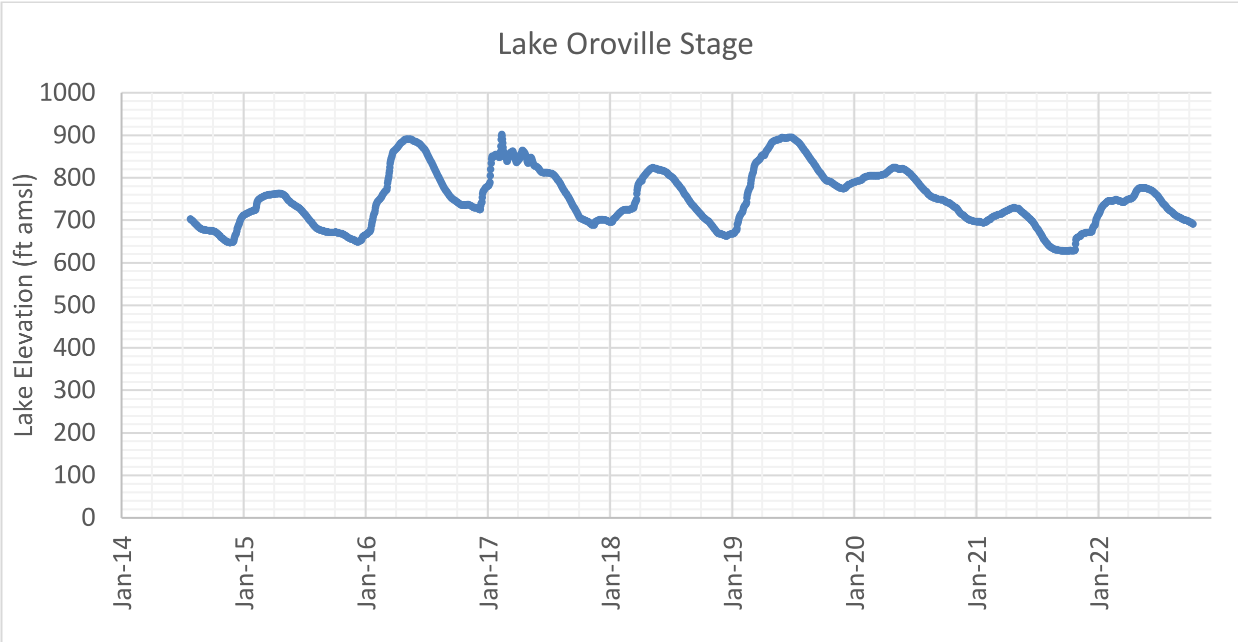

Figure 3.11 – Lake Oroville Reservoir Water Level from 2014-2022

3.4.6 PRMS Runoff Modeling

Modeling of stream runoff was conducted during development of the GSP, and is presented in GSP Appendix 2-7. The modeling used the USGS code PRMS (Precipitation Runoff Modeling System). The model produces daily average flow estimates for WY 2000-2020. The streams represented in the PRMS model are shown in **Figure 3.12**. Calibration of the PRMS model used available measurements of streamflow, including the gage records at Frenchman Reservoir and field measurements made by the Watermaster. Median, low, and high year runoff volumes predicted by PRMS for each watershed area in the model are also shown in **Figure 3.12**.

Figure 3.13 presents the PRMS model results for Smithneck Creek. The PRMS model results appear to represent the Watermaster stream flow measurements reasonably well, however, there are no measurement data to calibrate seasonal high and low flows. In the future, the PRMS modeling for Smithneck Creek would benefit from installing a continuous recording stream flow gage to collect additional stream flow data.

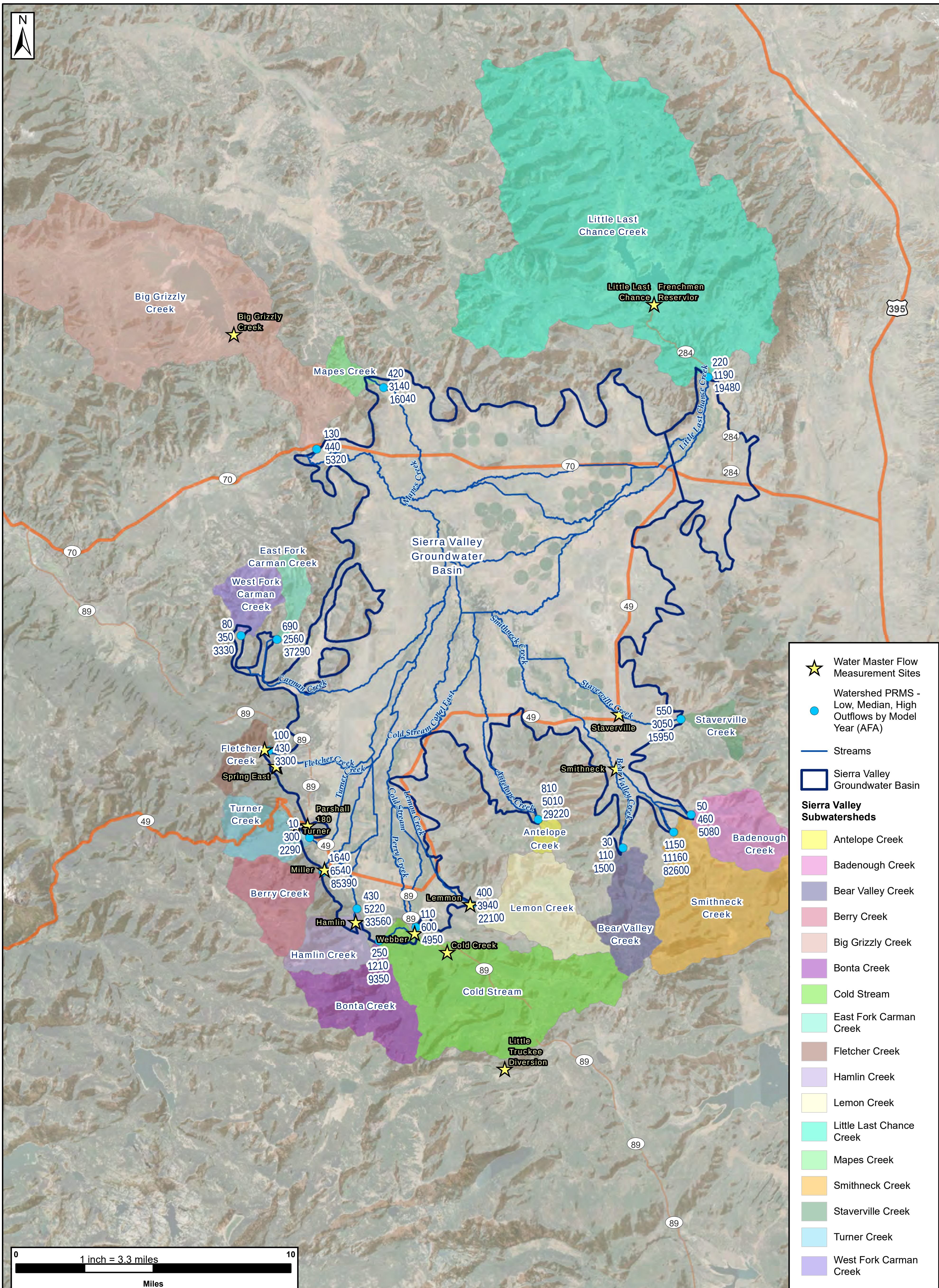

FIGURE 3.12

TITLE:

SITE MAP

-SHOWING-

PRMS Watersheds and Simulated Annual Runoff

Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

FILE:
Figure 3.12 – PRMS Watersheds and Simulated Annual Runoff

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

JOB NO.:	DATE:	REF.					REVISION:
SVGMD001.007	12/1/2022		DESIGNED	ATD	CHECKED	DS	-
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R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 3.12 – PRMS Watersheds and Simulated Annual Runoff.mxd

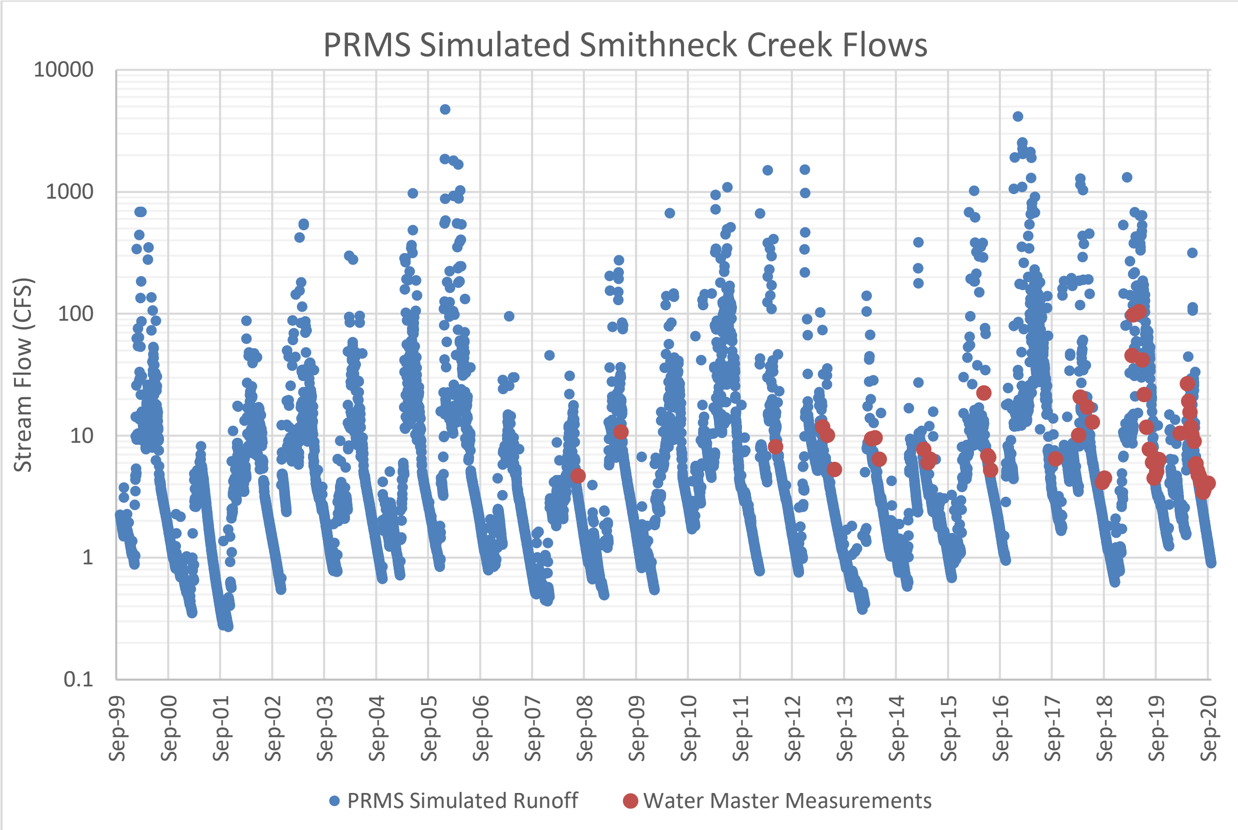

Figure 3.13 – PRMS Simulated Stream Flow in Smithneck Creek for WY2000 – WY2020

4. REVIEW OF SURFACE WATER RESOURCES MANAGEMENT

More efficient or effective use of surface water for irrigation could reduce groundwater pumping for farms that have a combined source of irrigation water (groundwater and surface water). Also, surface water may be utilized to augment natural groundwater recharge, thereby reducing the deficit between pumping and the sustainable aquifer yield. Concepts for more effective use of surface waters are examined in the sections to follow.

4.1 Concept: Increase Effective Use of Frenchman Reservoir

Data on Frenchman Reservoir storage and releases were reviewed to make a preliminary assessment of potential to increase effective storage and release of irrigation water to potentially lower groundwater pumping while sustaining agriculture on farms using both surface water and groundwater sources. Factors for consideration include:

- Release Timing and Magnitudes
- Carry-over Storage Management
- Reservoir Spill Water Management
- Winter Releases
- Augmentation of On-Farm Storage

This preliminary review did not identify substantial opportunities to become more efficient with Little Last Chance surface water use, but the following should be considered.

- Assure Little Last Chance Lake rights are called for to maintain full conditions at start of irrigation season (as noted in 2015 and 2016).
- When possible, avoid carrying stored water through the hotter summer months, when evaporation will consume greater volumes of stored water.
- Refine the timing and magnitudes of water deliveries during the irrigation season to match crop water requirements more precisely by using soil moisture sensors and other irrigation efficiency improvement strategies.
- Utilize reservoir spill, in manners that may be economically and technically meaningful, such as:
    - Develop aquifer recharge projects to benefit from high-flow conditions
    - Develop additional capacity for on-farm storage.

These measures must be supported by acquisition of water right permits, and due to the infrequency of occurrence of spill over the last 20 years, along with the short-duration of spill, economic viability of any proposed action such as MAR needs to be carefully evaluated. Additional on-farm storage development might be considered, but will need to avoid conflicts with decreed water rights; it may require securing a water right permit. The most substantial existing on-farm reservoir in the valley is the Little Last Chance Lake on the Roberti Ranch, with a decreed winter diversion and storage right of 331 AFA. On Smithneck Creek there are decreed winter diversion and storage rights for 50 AFA each at the Mill Pond and Lewis Reservoir, and a 140 AFA right for Ede Lake. Since the additional storage will not be a consistent annual source of water if utilizing only excess (non-decreed) flows, the economics of construction or expansion of on-farm storage ponds would need to carefully weighed by the farmer.

Winter release strategies as a reservoir management strategy do not appear viable, as three-quarters of the past 20 years have not produced sufficient runoff to fully fill Frenchman Reservoir. Furthermore, diverting spill for a winter icing strategy would depend on spill occurring in the winter months, which has not been the case the past 20 years (spill occurs in the spring months). The 1997 New Year's flood may have been the last significant winter-time spill event, and the occurrence of winter spill is too infrequent to warrant advancement of management action concept. Likewise, carryover storage concepts, that retain water in one year for use in subsequent years, do not make sense, as it exposes stored water to additional evaporation losses and potentially contributes to additional spill if the following year is wet.

The mid-summer holding of irrigation water in the reservoir does need further consideration, if it can be minimized without detriment to crops and farming. The monthly evaporation rate for Frenchman Reservoir is illustrated in **Figure 4.1**. In many years, evaporation rates increase by over 50% in July and August, as contrasted to May rates. The average July evaporation is approximately 7.5 to 9 inches, as contrasted with approximately 5 to 6 inches in May. The retention of irrigation water in the reservoir into the July and August months comes with an evaporation cost, and should be minimized, to the extent possible.

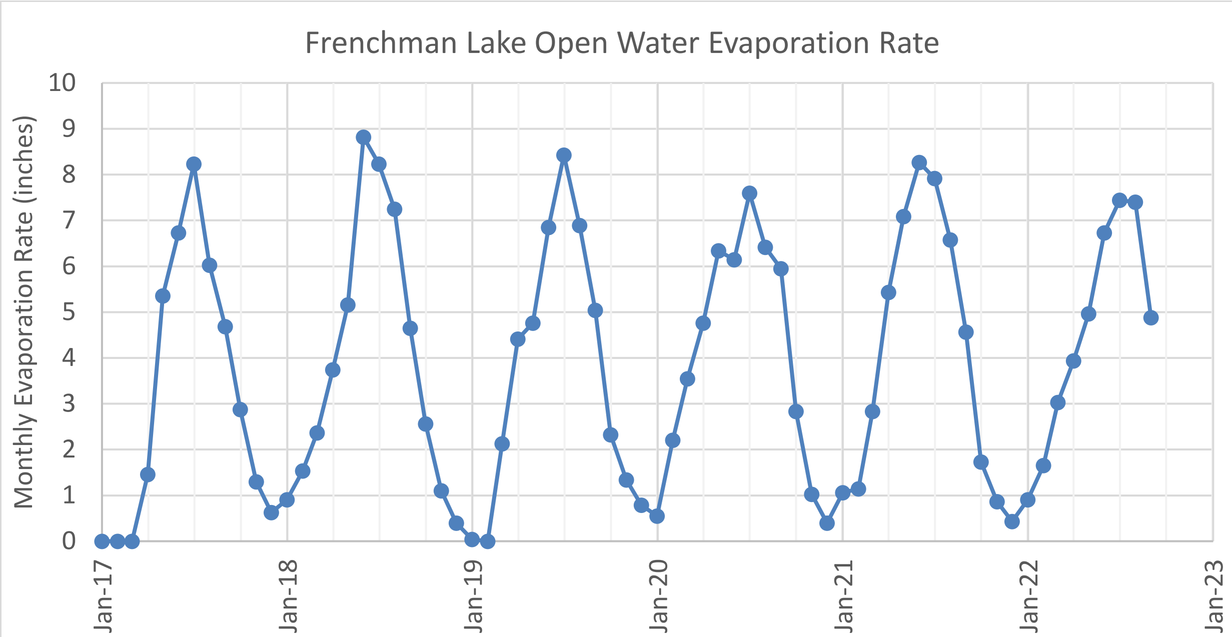

Figure 4.1 – Monthly Open Water Evaporation Rate at Frenchman Lake / Reservoir 2017-2022 (data source: OpenET)

4.2 Concept: Surface Water Use for Managed Aquifer Recharge

As identified in the GSP for Sierra Valley, managed aquifer recharge (MAR) may be a route for helping achieve sustainable groundwater use in the valley. Geographic and hydrogeological conditions inform the feasibility of different MAR methods and approaches, as detailed in the following sections. Several different styles of MAR can be considered and utilized, including the following.

4.2.1 Spreading Basins

Excavated pits or basins are created at locations where soils have high infiltration rates, at geographic locations that will provide recharge to the aquifer area and depth of interest. Spreading basins are used extensively for treated wastewater disposal and return of treated water back to the aquifer. Rapid Infiltration Basins (RIBs) have the capacity to infiltrate large volumes of water over a short period of time. Sources of water for spreading basins could be:

- Seasonal flows that are not otherwise allocated, such as non-irrigation season flows in streams such as Smithneck Creek, or excess spring-time flows that are above allocated water rights,
- Flood flows, such as unregulated spills from Frenchman Reservoir,
- Stormwater runoff, or ephemeral runoff from drier drainages, or
- Treated effluent flows from water treatment facilities (Loyalton has the only wastewater treatment facility in the basin, and this water is already being used to offset groundwater use on adjacent farm fields).

Infiltration basins are commonly used for MAR projects, especially in the wastewater industry, where rapid infiltration basins are a common means disposing of treated effluent, while returning water to the aquifer. Suitable soils for rapid infiltration are necessary in order to recharge large volumes of water in as small of a basin area as possible. Infiltration basins are also becoming a popular means for retaining stormwater runoff in urban areas, with a subsidiary benefit of supporting aquifer recharge.

The infiltration basin approach could be viable for Sierra Valley, and an example of an implemented MAR project using infiltration basins is presented later in the report (Vicee Canyon project in Carson City).

4.2.2 Flooding agricultural fields (Flood-MAR)

As described in the GSP, this practice involves use of floodwater or stormwater for managed aquifer recharge on agricultural lands and engineered landscapes. Flood-MAR projects can provide multiple benefits to the ecosystem and wildlife habitat by increasing water supply reliability, flood risk mitigation, drought preparedness, aquifer replenishment, ecosystem enhancement, water quality improvement, working landscape preservation and stewardship, climate change adaptation, recreation, and aesthetics. The concept is used and implemented throughout the Central Valley of California, but may not be feasible in Sierra Valley to accomplish deep aquifer recharge, and may be limited in effectiveness by climatic (freezing) conditions.

Flood-MAR is a recharge concept that could be employed in the Sierra Valley to recharge the shallow water-table aquifer, but is not likely to be viable for deep aquifer recharge. Most agricultural land in Sierra Valley exists on the valley floor, where underlying clays are present that separate the shallow water table aquifer and deeper aquifers. Flood-MAR of agricultural lands is therefore not well-suited to provide recharge to the deep aquifers from which high-capacity irrigation wells derive water in Sierra Valley. A possible exception may be on the lower alluvial fan of Smithneck Creek, where some existing agriculture occurs. Flood-MAR could be a concept used to support the shallow water table aquifer and groundwater dependent ecosystems (GDEs), if desired or necessary.

4.2.3 Injection wells

Using injection wells involves the installation and operation of pumps and wells to inject water into specific aquifers. This type of MAR is in wide-spread use by municipalities, where high quality (drinking water quality) water is injected into the aquifer using dedicated or dual purpose wells. These systems are expensive to construction and operate.

Injection wells to the deep aquifer are expensive to drill and to operate, and require that sediment and turbidity be removed prior to injection to avoid well plugging. Although a popular form of MAR for municipal agencies, injection wells are not known to be economically viable for agriculture, especially for forage crops.

4.2.4 Dry wells and infiltration galleries

Dry wells and infiltration galleries are a hybrid between an infiltration basin and injection well. Infiltration galleries are used commonly for treated wastewater disposal, and are constructed with an excavation backfilled with gravel, and piping to route flow throughout the basin. These commonly utilize gravity flow.

Dry wells are large-diameter holes or excavations with a vertical pipe (well) placed in gravel backfill into the excavation. These infiltration approach requires separation distance between the water table and the base of the gallery or well, and sufficient soils permeabilities to accept volumes of water desired for infiltration. Dry wells or infiltration galleries may be a MAR approach that could be operated in lieu of, or as a supplement to, an infiltration basin approach, in areas with soils with high infiltration capacities that do not require spreading of water over a broader area. These approaches may also be advantageous in climates with freezing soil conditions, such as Sierra Valley.

4.2.5 Streams and canals

These features can be used to infiltrate water and increase groundwater recharge. For example, diverting water during non-irrigation seasons into unlined canals can supplement groundwater recharge if canal seepage reaches the underlying aquifers. Flow profile dams (gabions) can be constructed in ephemeral channels to impound runoff and facilitate infiltration.

4.2.6 Geographical and Hydrogeological Considerations

Site-specification soils and infiltration rate testing will be needed to review the technical feasibility of MAR options and to advance design for a MAR project. Pilot testing may be advisable to advancing consideration of MAR design options and capacities. Applicability of MAR approach also needs to consider the timing and occurrence of the water source for recharge, and potential limitations due to climatic conditions such as freezing.

As an initial step in consideration of MAR for Sierra Valley, potentially suitable locations for MAR must be identified. Key geographical and geological criteria for consideration include:

- Proximity to a significant recharge water source,
- Proximity to aquifer areas in need of recharge,
- Surface and near-surface soil types, and infiltration rates to accommodate high volume recharge,
- Ability for recharged water to reach the aquifer identified for recharge,
- Depths to groundwater, and consideration of water table mounding that can inhibit recharge basin functionality,
- Soil stratigraphy at depth down to the water table, with attention to clay layers that can perch recharge water and prevent deep percolation,
- Land ownership to access areas of interest and for potential future implementation of a MAR project,
- Ability to secure surface water rights to divert for recharge purposes, without conflicting with decreed water rights in Sierra Valley, or State Water Project rights lower in the tributary system.

Mountains surrounding the valley are comprised of generally low permeability rocks that are not suitable for site-specific high-volume recharge. Because the valley floor sediments are comprised of shallow clays extending over much of the valley (GSP Chapter 2 and Appendix 2-7), recharge to the deeper alluvial sand and gravel aquifers tapped by high-capacity irrigation wells will need to focus on the alluvial fans at the valley periphery. Alluvial fans that receive runoff can be augmented to retain runoff and allow for greater infiltration volumes. **Figure 4.2** illustrates a conceptual alluvial fan recharge area.

In Sierra Valley, north-south cross-cutting faults are interpreted to create some partitioning of aquifer. The Grizzly Valley Fault and Loyalton Fault (**Figure 4.3**) are represented in the numerical flow model for the basin as having some flow resistance (GSP Appendix 2-7). These faults tend to form eastern and western boundaries to the irrigated areas near the Smithneck watershed, and tend to form the western boundary for the irrigated areas in the northern part of the valley. Successful MAR would need to introduce additional recharge within these aquifer "compartments" if desired to help alleviate long-term declining water levels in these parts of the valley.

Extensive clay deposits occur regionally over the valley floor in Sierra Valley. These clays were identified in early hydrogeologic studies of Sierra Valley (DWR, 1983) and are related to sediments deposited in Pleistocene lakes which occupied Sierra Valley. These clays are represented in the geologic framework model and numerical flow model developed for the GSP (Appendix 2-7), based on reviews of the lithologies reported in well drilling reports ("well logs") on file with DWR. The presence of these clays was recently observed by McGinley during drilling of two replacement irrigation wells in the southern part of the valley, in the Smithneck Creek area; the Grandi Ranch replacement well (DMS-31 site) and Lafoon replacement well (DMS-65). Drilled cuttings from these wells were logged by a McGinley hydrogeologist. The log for the Grandi well, which included electrical logging, is presented as **Figure 4.4**, and documents the presence of a thick sequence of clay extending from near land surface to approximately 195 ft in depth. Beneath the clay layer are interbedded sands and clays to approximately 500 ft in depth. High-capacity wells in this area are completed with screened intervals targeting the interbedded deeper sands.

DWR has collected airborne electromagnetic (AEM) geophysical data for the valley, which will be processed and published soon. The AEM geophysical survey will provide useful information on the extent of shallow clays, and the transition zones between clays and coarser grained alluvial fan deposits around the periphery of the valley. The AEM data may also improve the hydrogeologic understanding of the fault structures and aquifer compartmentalization. When available, the AEM data should be integrated into the geologic and numerical flow models for Sierra Valley, and will aid in refining potential areas for MAR.

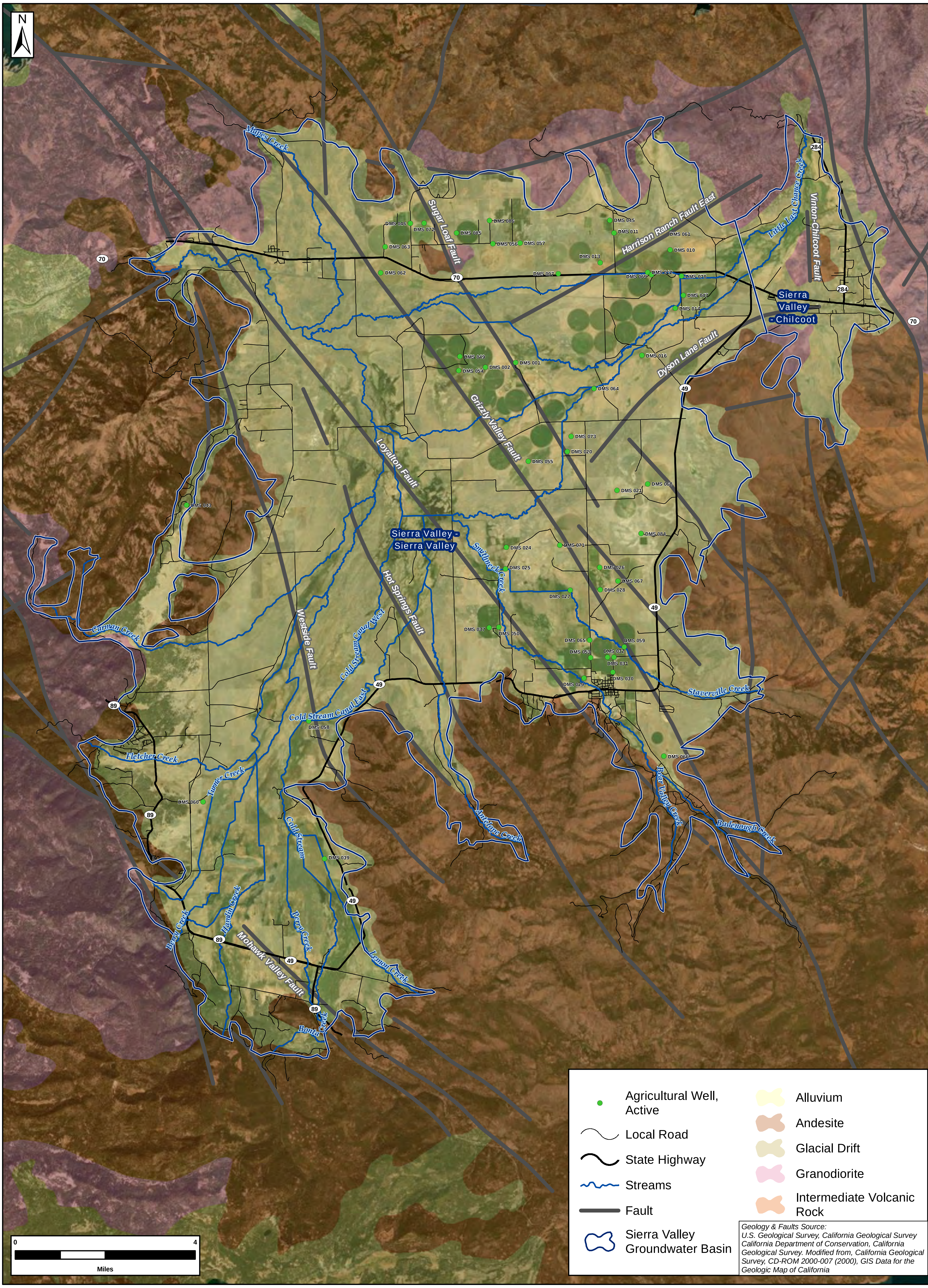

FIGURE 4.2

TITLE:

SITE MAP
-SHOWING-
Geology and Faults
Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

FILE: **Figure 4.2 Geology & Faults**

COORDINATE SYSTEM: **NAD 1983 UTM Zone 10N**

JOB NO.:	DATE:	REF:					REVISION:
SVGMD001	11/23/2022		DESIGNED	HC	CHECKED	DS	-
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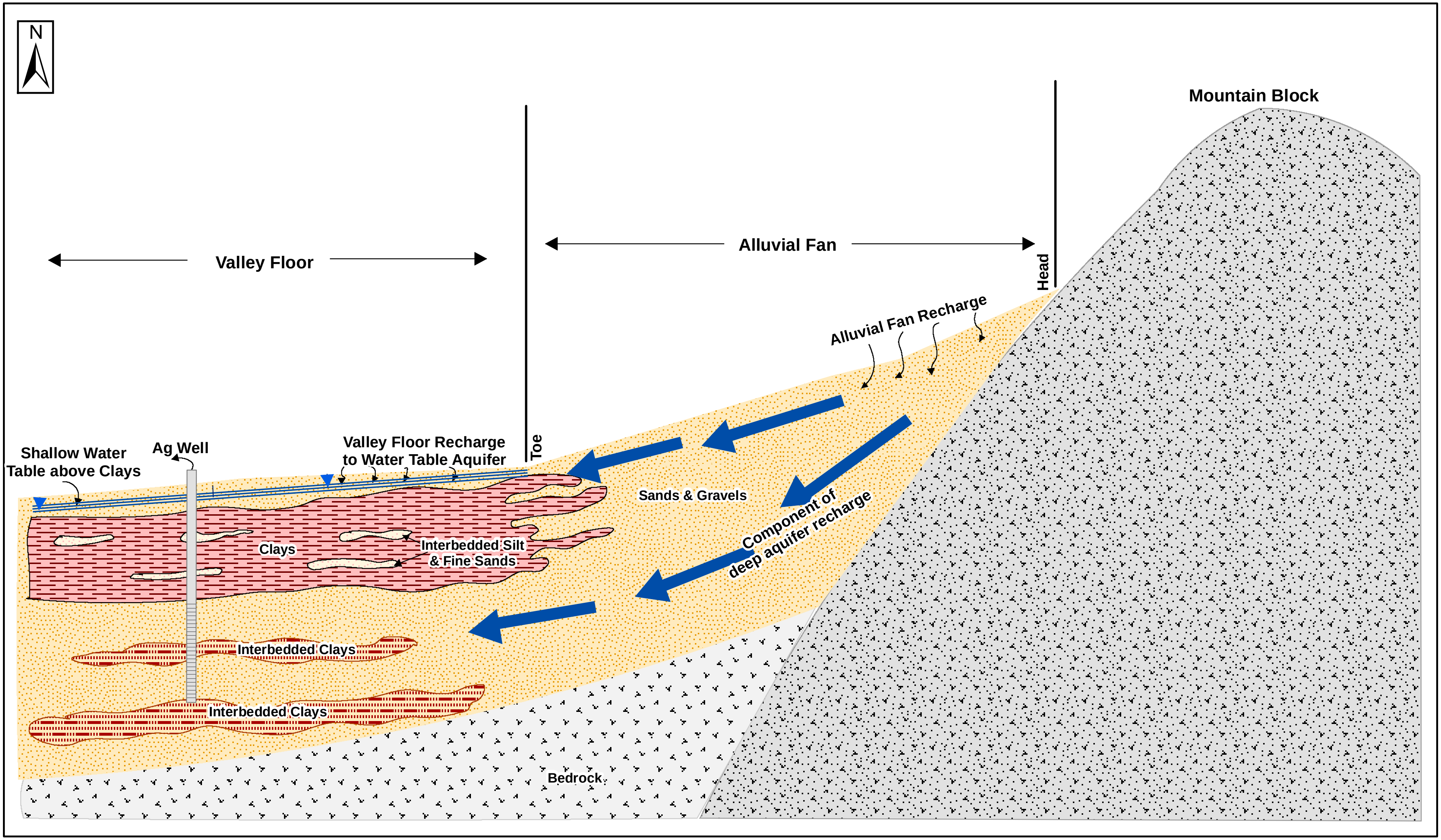

FIGURE 4.3

TITLE:

Conceptual Recharge on Alluvial Fans

McGinley & Associates
A Universal Engineering Sciences Company

FILE:
Figure 4.3 Conceptual Recharge on Alluvial Fans

COORDINATE SYSTEM:
NAD 1983 UTM Zone 11N

JOB NO.:
SVGMD001.007

DATE:
11/23/2022

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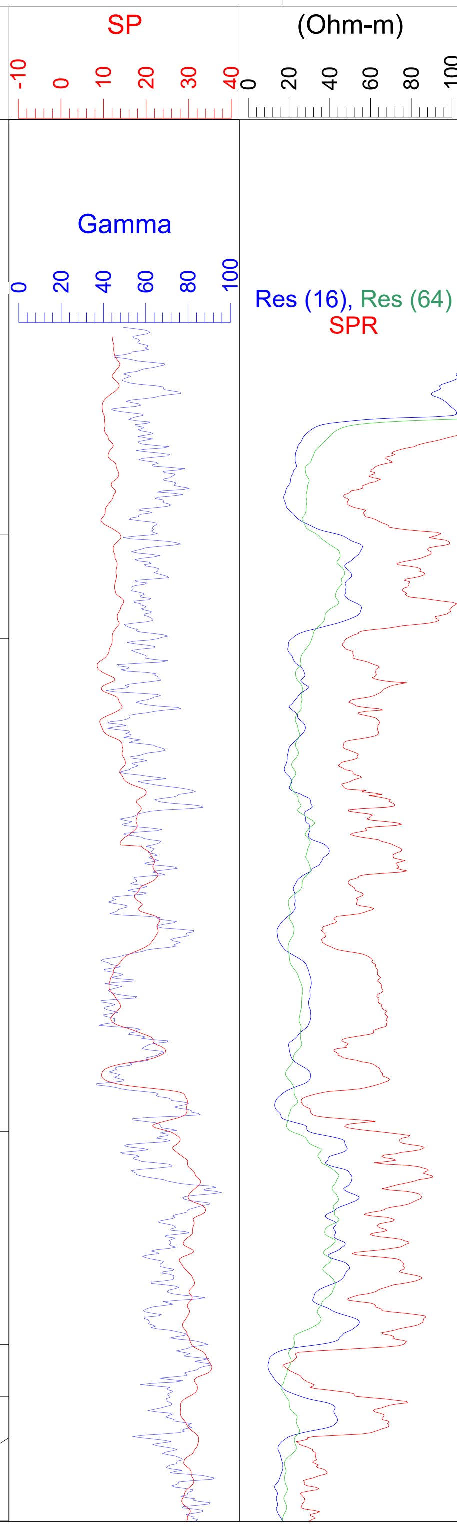
PROJECT: Grandi West Replacement Well	WELL/BOREHOLE NAME: Replacement	McGinley & Associates A Universal Engineering Sciences Company	
WELL/BOREHOLE LOCATION: Loyalton, CA			
DRILLING CONTRACTOR: Stonehouse Drilling		DATE FINISHED:	MEASURING POINT:
DRILLING METHOD:		TOTAL DEPTH: ft bls	CONSTRUCTED DEPTH: ft bls
DRILLING EQUIPMENT:		DEPTH TO WATER: FIRST ft bls	COMPL. ft bls
SAMPLING METHOD:		LOGGED BY: D. Smith	
LOCATION (UTM NAD83, m): North	East	COLLAR ELEVATION & DATUM: ft amsl NAVD88	

Depth (feet)	Graphic	General Lithology	Description
0 – 80		CL	dark brown-gray silty clay
80 – 100		SM	very fine grained black sands in silty matrix
100 – 195		CL	medium gray silty clay
195 – 236		SW	fine to coarse grained volcanic sands, subangular to sub rounded, with thin lenses of silty clay
236 – 246		CL	dark brown-gray silty clay
246 – 255		SW	fine to coarse grained volcanic sands, subangular to sub rounded
255 – 270		CL	dark brown-gray silty clay

Depth (feet): 0, 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260



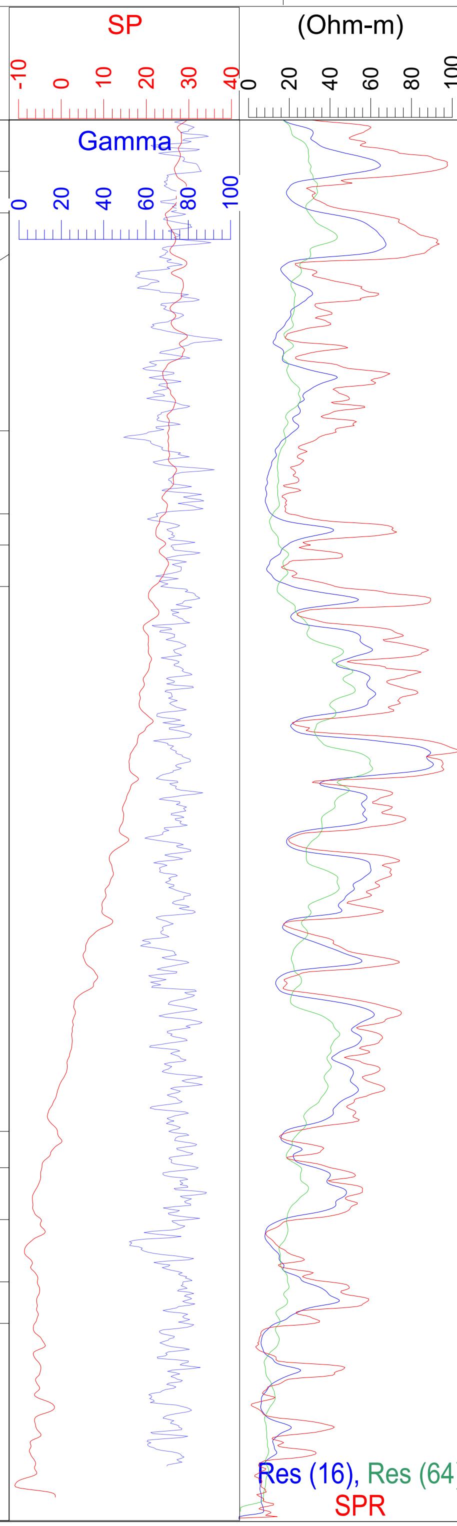
Remarks	Well Construction (inches) 0 5 10 15 20	Depth (feet)

PROJECT:	WELL/BOREHOLE NAME:
Grandi West Replacement Well	**Replacement**

McGinley & Associates
A Universal Engineering Sciences Company

WELL/BOREHOLE LOCATION:	Loyalton, CA		
DRILLING CONTRACTOR:	Stonehouse Drilling	DATE FINISHED:	MEASURING POINT:
DRILLING METHOD:		TOTAL DEPTH: ft bls	CONSTRUCTED DEPTH: ft bls
DRILLING EQUIPMENT:		DEPTH TO WATER: FIRST ft bls	COMPL. ft bls
SAMPLING METHOD:		LOGGED BY:	D. Smith
LOCATION (UTM NAD83, m):	North East	COLLAR ELEVATION & DATUM:	ft amsl NAVD88

Depth (feet)	Graphic	General Lithology	Description
		SW	fine to coarse grained volcanic sands, subangular to sub rounded
280		CL	dark brown-gray silty clay
		SW	fine to coarse grained volcanic sands, subangular to sub rounded
300–320		SM	fine sands with silty interbedded with thin to medium thick beds of silty clay
340		CL	medium brown silty clay
		SM	fine grained silty sand
		CL	medium brown silty clay
360–460		SW	fine to coarse grained volcanic sands, subangular to rounded, with ~1-2 ft thick inerbeds of silty clay
		CL	medium brown silty clay
480		SW	fine to medium grained sand
		CL	medium brown silty clay
500		SW	fine to medium grained sand
520–540		CL	medium brown silty clay with thin silty lenses



Remarks	Well Construction (inches)	Depth (feet)
	0 5 10 15 20	280, 300, 320, 340, 360, 380, 400, 420, 440, 460, 480, 500, 520, 540

4.2.7 MAR Opportunity Areas

Potential Opportunity Areas for MAR in Sierra Valley were identified on a preliminary basis using the following screening-level factors:

- geographic area within the valley, and proximity to areas with declining water levels,
- potential ability to be effective in augmenting natural recharge to deep aquifers,
- soil characteristics,
- land ownership, and
- potential water sources to divert for recharge or augment naturally occurring recharge.

Four distinct Opportunity Areas labeled A through D were identified, as shown in **Figure 4.5.** Each area is discussed in the following sections.

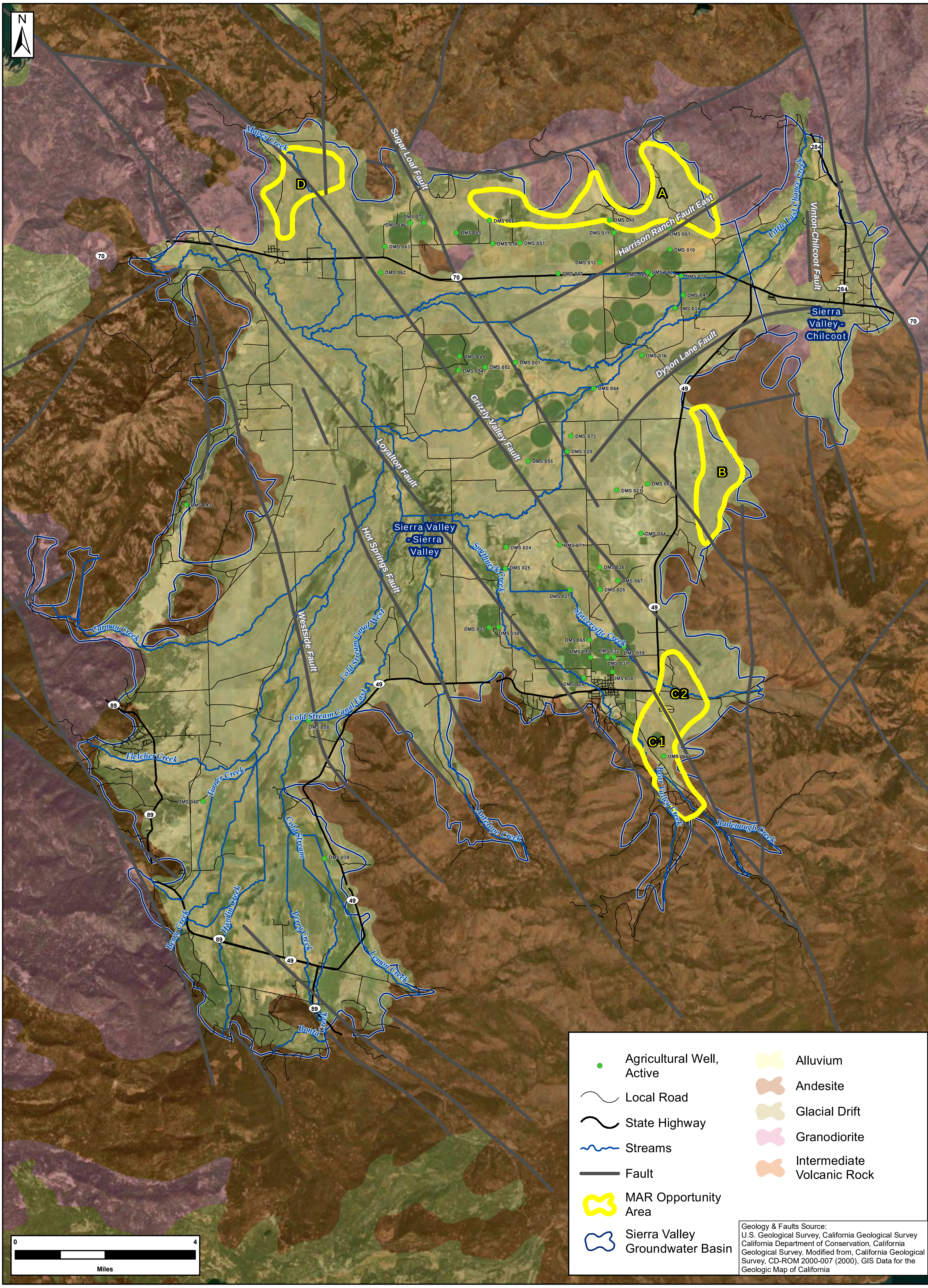


FIGURE 4.5

TITLE:

SITE MAP
-SHOWING-
Sierra Valley Preliminary MAR Opportunity Areas
Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

FILE:
Figure 4.5 – Sierra Valley Preliminary MAR Opportunity Areas

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

JOB NO.:	DATE:	REF.					REVISION:
SVGMD001	11/23/2022		DESIGNED	HC	CHECKED	DS	-
			DRAWN	HC	APPROVED	DS	

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.5 – Sierra Valley Preliminary MAR Opportunity Areas.mxd

4.2.7.1 Smithneck Creek and Tributaries

Identified as Opportunity Area C, the Smithneck watershed alluvial fan appears to have favorable characteristics for MAR. It is not known if the Grizzly Valley Fault bisecting the area creates any groundwater flow restrictions, and this will need to be assessed in future studies. The area is subdivided into area C1, west of the fault, and C2, east of the fault. The source of water for a MAR could be from:

- Smithneck Creek,
- Smithneck Creek tributaries Badenough Creek and Bear Valley Creek,
- Staverville Creek to the east, and/or
- Ephemeral drainages that are tributary to the alluvial fan between Smithneck and Staverville Creeks.

Water sources and a conceptual MAR system layout are depicted in **Figure 4.6**. Soils mapping from the NRCS for Opportunity Area C are shown in **Figure 4.7**. Land ownership (public and private parcels) is shown in **Figure 4.8**. The Opportunity Area includes land owned by California Department of Fish and Wildlife in the upper reaches, and private parcels in the lower elevations. The conceptual MAR layout on **Figure 4.6** is for illustration purposes only, and would need to be refined with site-specific soils, depth to groundwater, and infiltration testing data, along with considerations of land ownership and water source diversion and conveyance.

Flow measurements from Smithneck Creek are limited, but in combination with the PRMS modeling can provide some indication of magnitudes of water that could be potentially available to a recharge project. It is recommended that a continuous stream flow gage be installed on Smithneck Creek to enable better quantification of potentially available MAR recharge water. This is especially important given that flows of Smithneck Creek are decreed water rights, which cannot be infringed upon by any proposed MAR project. There are indications by DWR that applications to divert flows for MAR when flow conditions exceed the 90th percentile, not greater than a 20% flow diversion, and constrained to the months of December to March may be entertained. Winter climate and frozen soils conditions need to be considered when reviewing MAR techniques. To implement a pilot or full-scale MAR project, the GSA will need to prepare and file a water right application with the Division of Water Rights. The broad statement about potential considerations of this type of water right application does not take into account the factors of the adjudicated water rights in Sierra Valley and on Smithneck Creek, rather appears to relate to implications to the State Water Project. It may be possible to apply for water diversions outside the decreed March 15 to September 30 irrigation season, and possibly for additional spring diversions in April and May that would occur only in high runoff years, and without conflict with any decreed water rights. Clearly, a water right strategy and application to divert waters of Smithneck Creek, or Staverville Creek, will need to be carefully considered and developed to support any type of MAR project.

As a preliminary analysis, the PRMS model output was used to quantify the 90th percentile flows as $\geq$28.56 cfs. With a 10 cfs MAR diversion and infiltration capacity, the predicted available water to divert between December and March ranges from zero to 485 AF per year (**Figure 4.9**). The 21-year average predicted available flow from 2000 to 2020 is estimated at 177 AFA. When doubling the MAR diversion and infiltration capacity to 20 cfs, the 21-year average increases to 295 AFA (**Figure 4.10**), ranging from zero to 895 AF in any given year, during the December to March period.

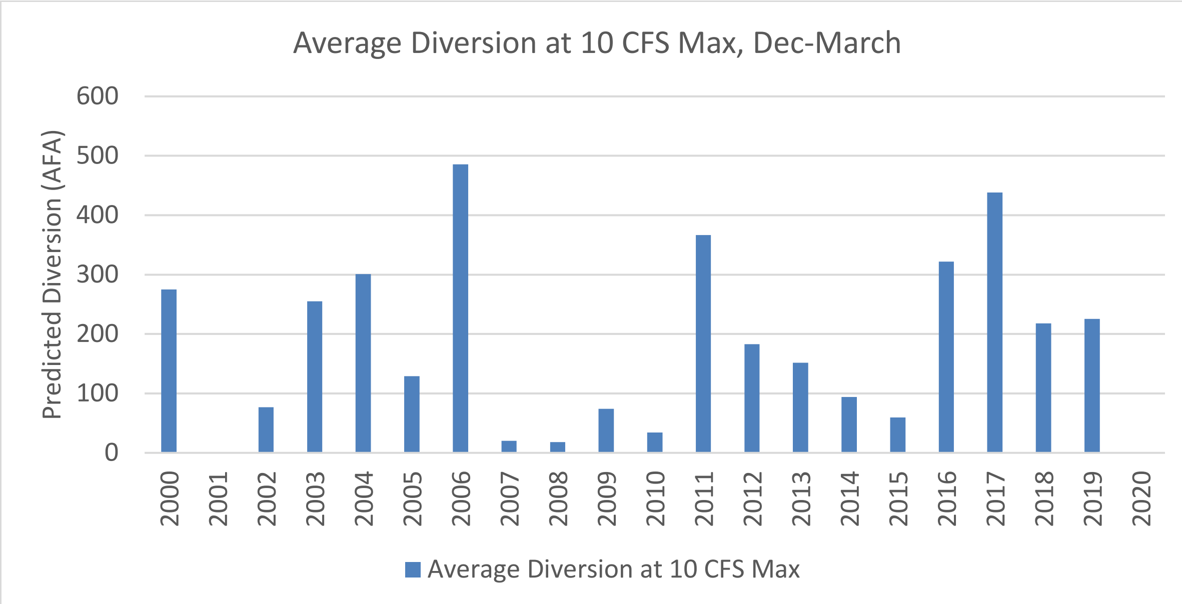


Figure 4.9 – PRMS Simulated Potentially Available Stream Flow from Smithneck Creek for a 10 CFS MAR Diversion

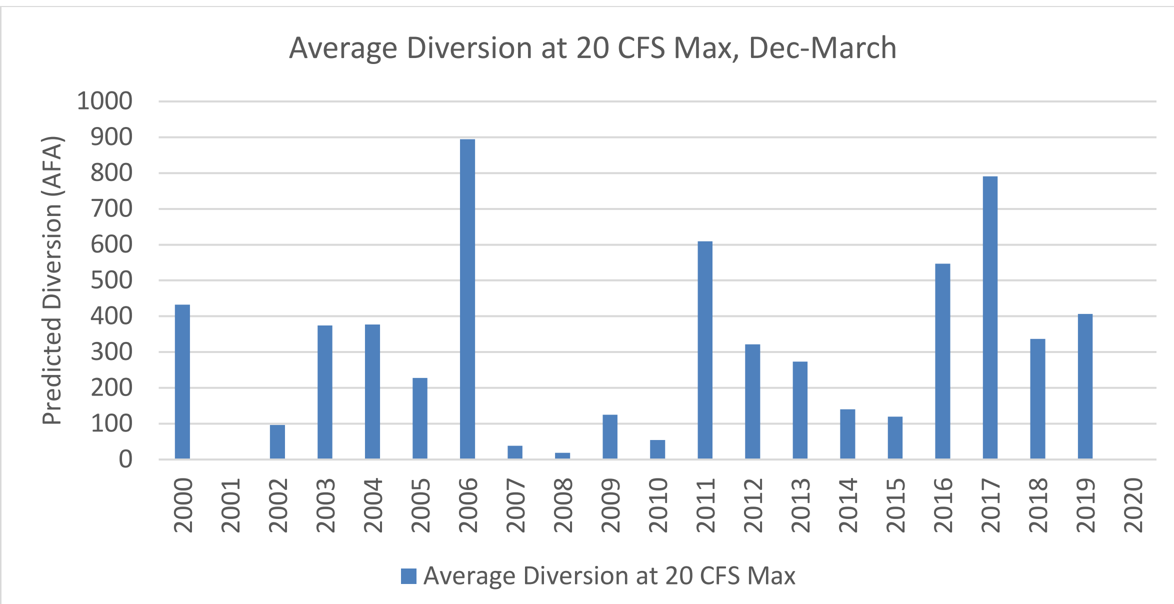


Figure 4.10 – PRMS Simulated Potentially Available Stream Flow from Smithneck Creek for a 20 CFS MAR Diversion

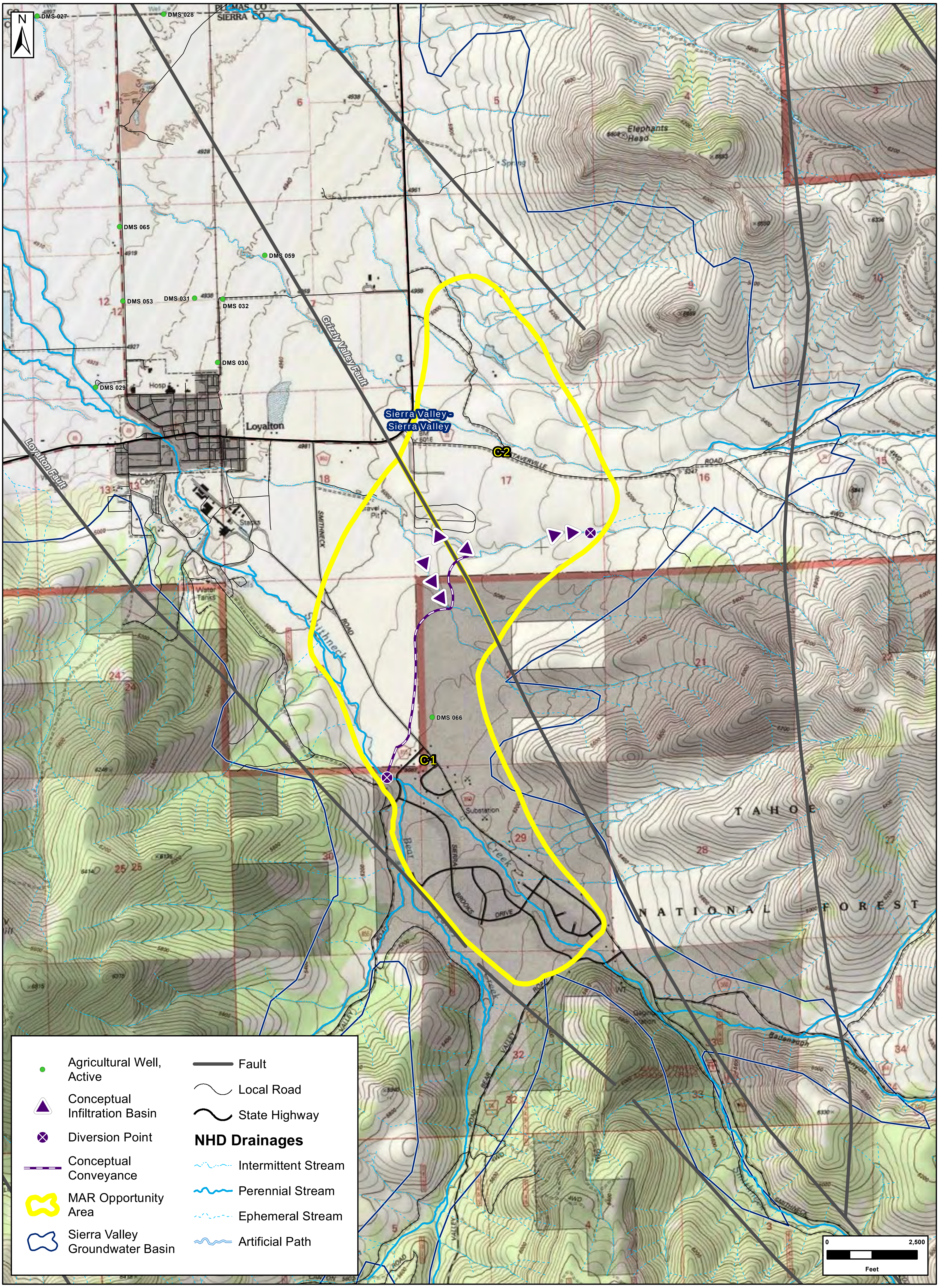


FIGURE 4.6

TITLE:

SITE MAP

-SHOWING-

Topography and Conceptual MAR Layout in Opportunity Area C
Sierra Valley, California

McGinley & Associates
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FILE:
Figure 4.6 – Topography and Conceptual MAR Layout in Opportunity Area C

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

JOB NO.:	DATE:	REF.					REVISION:
SVGMD001	11/23/2022		DESIGNED	HC	CHECKED	DS	-
			DRAWN	HC	APPROVED	DS	

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.6 – Topography and Conceptual MAR Layout in Opportunity Area C.mxd

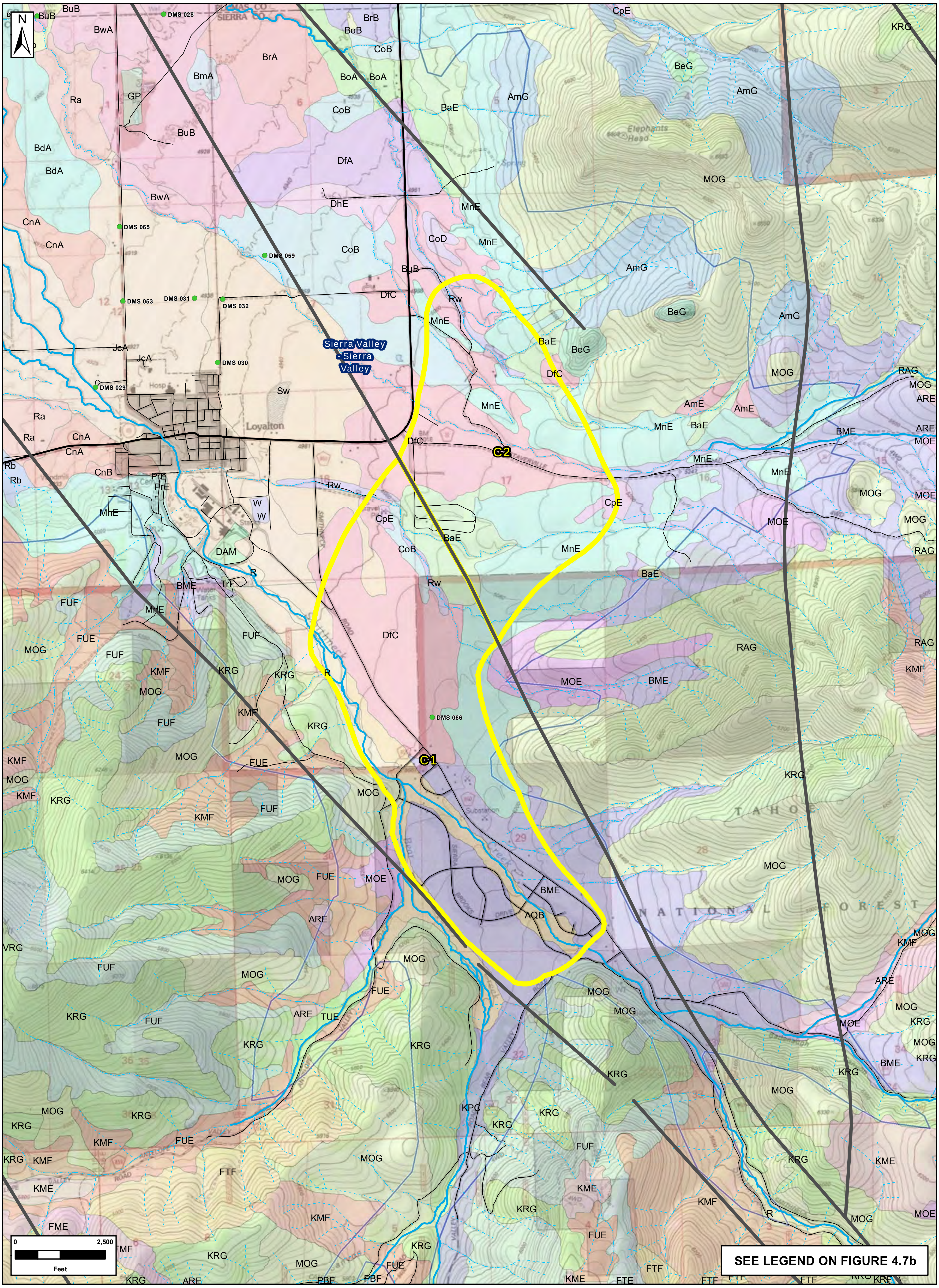

FIGURE 4.7a

TITLE:

SITE MAP
-SHOWING-
NRCS Soils Mapped in Opportunity Area C
Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

FILE:
Figure 4.7a – NRCS Soils Mapped in Opportunity Area C

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

JOB NO.:	DATE:	REF.					REVISION:
SVGMD001	11/23/2022		DESIGNED	HC	CHECKED	DS	-
			DRAWN	HC	APPROVED	DS	

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.7a – NRCS Soils Mapped in Opportunity Area C.mxd

Agricultural Well,
MAR Opportunity
Sierra Valley Groundwater Basin
Local Road
State Highway
Fault

NHD Drainage

Intermittent Stream
Perennial Stream
Ephemeral Stream
Artificial Path

NCRS Soils

AQB, Aquolls and Cryolls 0 to 5 percent slopes
ARE, Aldi-Kyburz complex 2 to 30 percent slopes
AmE, Aldax-Millich complex 5 to 30 percent slopes
AmG, Aldax-Millich complex 30 to 75 percent slopes
BME, Badenaugh-Martineck-Dotta association 2 to 30 percent slopes
BaE, Badenaugh very cobbly sandy loam 2 to 30 percent slopes
BdA, Balman-Ramelli complex 0 to 2 percent slopes
BeG, Basic rock land
BmA, Beckwourth-Loyalton complex saline-alkali 0 to 2 percent slopes
BoA, Bellavista loam 0 to 2 percent slopes
BoB, Bellavista loam 2 to 5 percent slopes
BrA, Bidwell sandy loam 0 to 2 percent slopes
BrB, Bidwell sandy loam 2 to 5 percent slopes
BuB, Bieber gravelly sandy loam 0 to 5 percent slopes
BwA, Bieber sandy loam moderately deep 0 to 2 percent slopes
CnA, Coolbrith silt loam 0 to 2 percent slopes
CnB, Coolbrith silt loam 2 to 5 percent slopes
CoB, Correco sandy loam 2 to 5 percent slopes
CoD, Correco sandy loam 5 to 15 percent slopes
CpE, Correco very cobbly sandy loam 2 to 30 percent slopes
DAM, Dams
DfA, Dotta sandy loam 0 to 2 percent slopes
DfC, Dotta sandy loam 2 to 9 percent slopes
DhE, Dotta cobbly sandy loam 2 to 30 percent slopes
FME, Fugawee sandy loam 2 to 30 percent slopes
FMF, Fugawee sandy loam 30 to 50 percent slopes
FTE, Fugawee-Tahoma complex 2 to 30 percent slopes
FTF, Fugawee-Tahoma complex 30 to 50 percent slopes
FUE, Kyburz-Trojan complex 9 to 30 percent slopes
FUF, Kyburz-Trojan complex 30 to 50 percent slopes
GP, Areas excavated for
JcA, James Canyon silt loam 0 to 2 percent slopes
KME, Kyburz-Aldi complex 2 to 30 percent slopes
KMF, Kyburz-Aldi complex 30 to 50 percent slopes
KPC, Aldi-Aquolls-Kyburz complex 2 to 9 percent slopes
KRF, Kyburz-Rock outcrop-Trojan complex 30 to 50 percent slopes
KRG, Aldi-Kyburz-Rock outcrop complex 30 to 75 percent slopes
Lo, Loyalton fine sandy loam
MOE, Franktown-Aldi-Rock outcrop complex 2 to 30 percent slopes
MOG, Franktown-Aldi-Rock outcrop complex 30 to 75 percent slopes
MnE, Martineck very stony sandy loam 2 to 30 percent slopes
PBF, Portola gravelly fine sandy loam 30 to 50 percent slopes
PrE, Portola cobbly coarse sandy loam 9 to 30 percent slopes
R, Riverwash 1 to 45 percent slopes
RAG, Rock outcrop-Franktown- Kyburz complex 50 to 75 percent slopes
Ra, Ramelli clay
Rb, Ramelli clay very poorly drained
Rw, Riverwash 1 to 25 percent slopes
Sw, Smithneck sandy loam 0 to 2 percent slopes
TUE, Trojan-Sattley-Cryumbrepts wet complex 2 to 30 percent slopes
TrF, Trojan stony sandy loam 30 to 50 percent slopes
VRG, Rock outcrop volcanic
W, Areas under water in ponds and reservoirs complex

Sources:
NRCS Web Soil Survey
US Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/

U.S. Geological Survey, National Geospatial Program, 20220920, USGS National Hydrography Dataset Best Resolution (NHD) for Hydrological Unit (HU) 8 - 18020123 (published 20220920) Shapefile: U.S. Geological Survey, accessed October 7, 2022 at URL https://www.usgs.gov/national-hydrography/access-national-hydrography-products

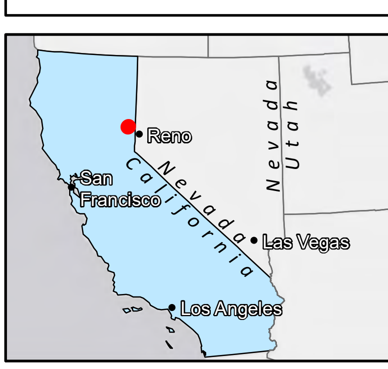

FIGURE 4.7b

TITLE:

LEGEND
-SHOWING-
NRCS Soils Legend in Opportunity Area C
Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

FILE: **Figure 4.7b – NRCS Soils Legend in Opportunity Area C**

COORDINATE SYSTEM: **NAD 1983 UTM Zone 10N**

JOB NO.: **SVGMD001**

DATE: **11/23/2022**

REF:	DESIGNED	HC	CHECKED	DS	REVISION: -
	DRAWN	HC	APPROVED	DS	

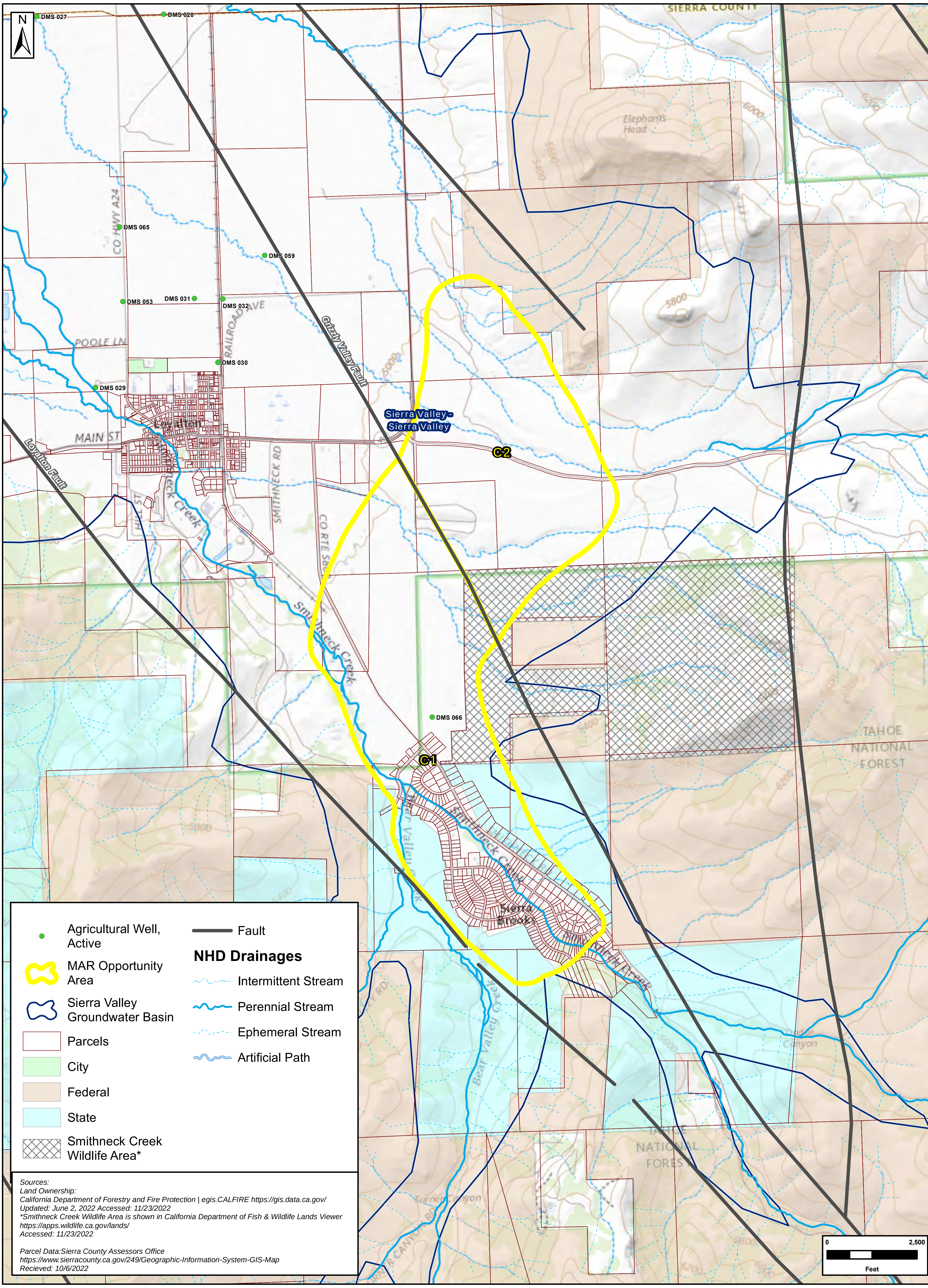

FIGURE 4.8

TITLE:

SITE MAP
-SHOWING-
Land Ownership in Opportunity Area C
Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

FILE:
Figure 4.8 – Land Ownership in Opportunity Area C

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

JOB NO.:	DATE:	REF:					REVISION:
SVGMD001	12/9/2022		DESIGNED	HC	CHECKED	DS	-
			DRAWN	HC	APPROVED	DS	

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.8 – Land Ownership in Opportunity Area C.mxd

4.2.7.2 Little Last Chance Creek

MAR on the alluvial fans along the northern basin boundary is identified as Opportunity Area A, and would have a primary water source from Little Last Chance Creek, with a secondary source of capturing ephemeral runoff from Trosi Creek, Whiskey Canyon and unnamed drainages to the west. Shown on **Figure 4.11** is a conceptual layout of a 7-mile diversion ditch contouring along the upper alluvial fan at approximate elevation of 5000 ft amsl, with a very mild drop in elevation to the west. Several infiltration basins are conceptually shown at ephemeral drainage crossings of the diversion ditch. The ditch could be unlined to provide recharge over its course, with high capacity volumes of recharge occurring at infiltration basins.

Figure 4.12 shows NRCS soils types mapped for Opportunity Area A. Technical evaluations are needed to determine if the infiltration rates and subsurface soils have sufficient characteristics for a MAR project.

Figure 4.13 shows private and public land ownership. The conceptual MAR ditch alignment would cross one parcel of federal land, but otherwise is on private lands. The geographic extent of a potential project from diversion point to infiltration basin sites would require numerous right-of-way agreements with landowners to cross property parcels and build and operate ditch and infiltration facilities. As conceptually drawn, approximately a dozen distinct parcels would be involved, and about eight distinct land owners. This may present an obstacle to advancing any MAR project in Opportunity Area A, but the geographic location is optimally sited to potentially address declining groundwater levels in the northern part of the valley.

Water rights on the Little Last Chance Creek are decreed, and subject to the contract for operation of Frenchman Reservoir. Determination of a 90th percentile flow is somewhat meaningless due to the reservoir regulation of natural flows. Diverting a portion of the reservoir spills, as quantified in Section 3.4.1, could be a concept for a proposed MAR project. However, because of the infrequent occurrence of spills over the past two decades, a MAR project would need to be designed to divert and infiltrate a large volume of flow over a limited time duration, in order to provide a meaningful long-term recharge amount. In the past 20 years, five spill events have occurred. Assuming a similar spill frequency in the future, if a 1000 AF could be diverted and recharged during each event, then the long-term average annual recharge would be equal to 250 AFA. The economics of constructing the diversion works and infiltration facilities would need to be carefully weighed with the derived long-term recharge benefits.

A water right application for MAR diversion would likewise need to be developed to not infringe upon water right owners of the Little Last Chance Creek. There are approximately 10 current owners of water rights on the creek, many of which rely solely on stream water rights for irrigation. Two of the larger ranches in the northern part of the valley rely in part on surface water from the Little Last Chance Creek and groundwater to supplement when surface water is not available. Detrimentally impacting available surface water to these ranches would be counter-productive to the goal of reaching groundwater sustainability.

Spill has been observed to primarily occur in the months of April to early June in the most recent spill events from Frenchman Reservoir. Securing a water right appropriation for diversion to a MAR project would need to overlap with the decreed diversion period of the Little Last Chance water rights, which begins in April, but in practice is usually not called upon for release from Frenchman Reservoir until early or mid-May.

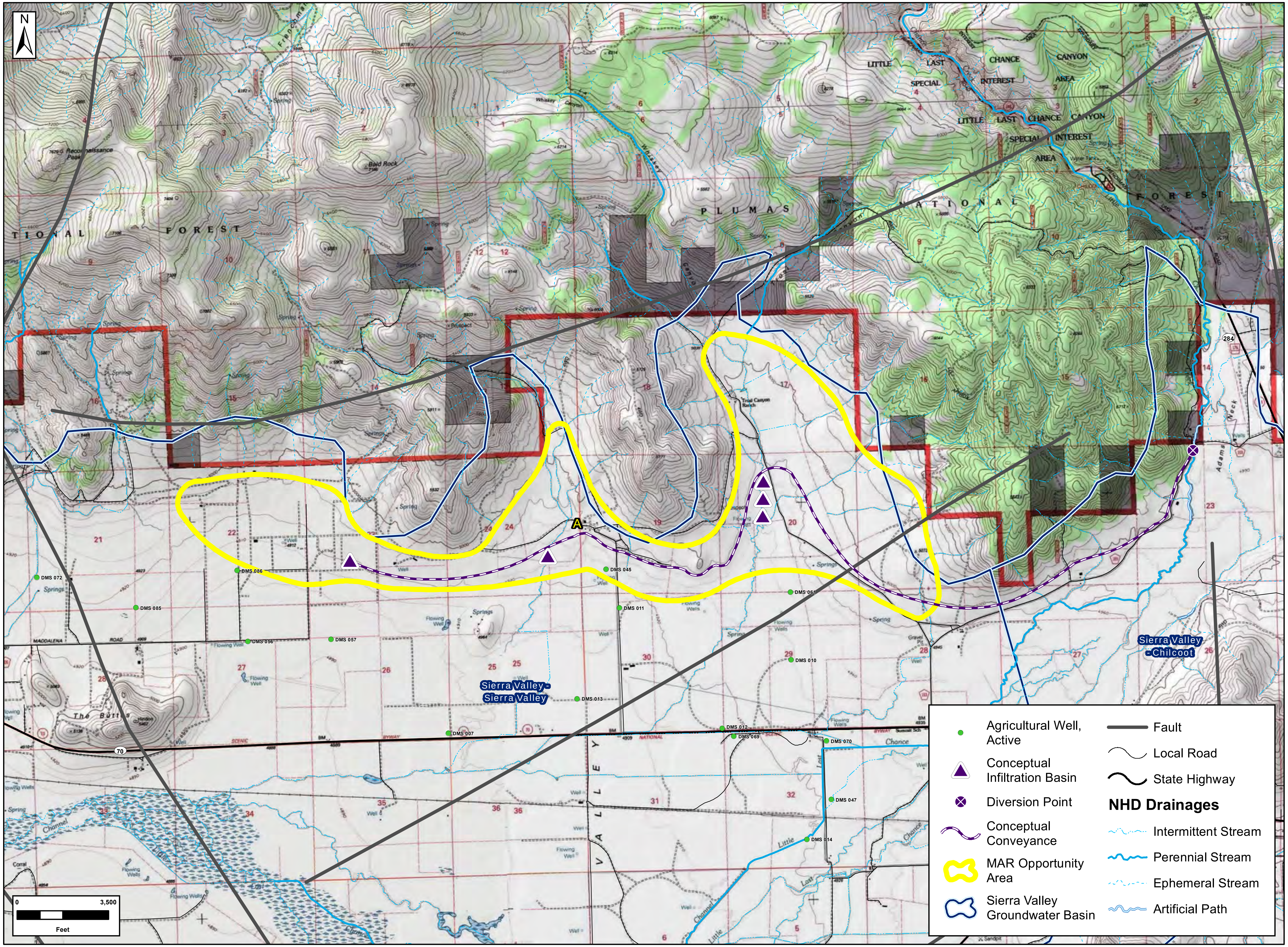

FIGURE 4.11

TITLE:

SITE MAP
-SHOWING-
Topography and Conceptual MAR Layout in Opportunity Area A
Sierra Valley, California

JOB NO.:
SVGMD001

DATE:
11/23/2022

FILE:
Figure 4.11 – Topography and Conceptual MAR Layout in Opportunity Area A

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

REF.

DESIGNED	HC
DRAWN	HC
CHECKED	DS
APPROVED	DS

REVISION:
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McGinley & Associates
A Universal Engineering Sciences Company

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.11 – Topography and Conceptual MAR Layout in Opportunity Area A.mxd

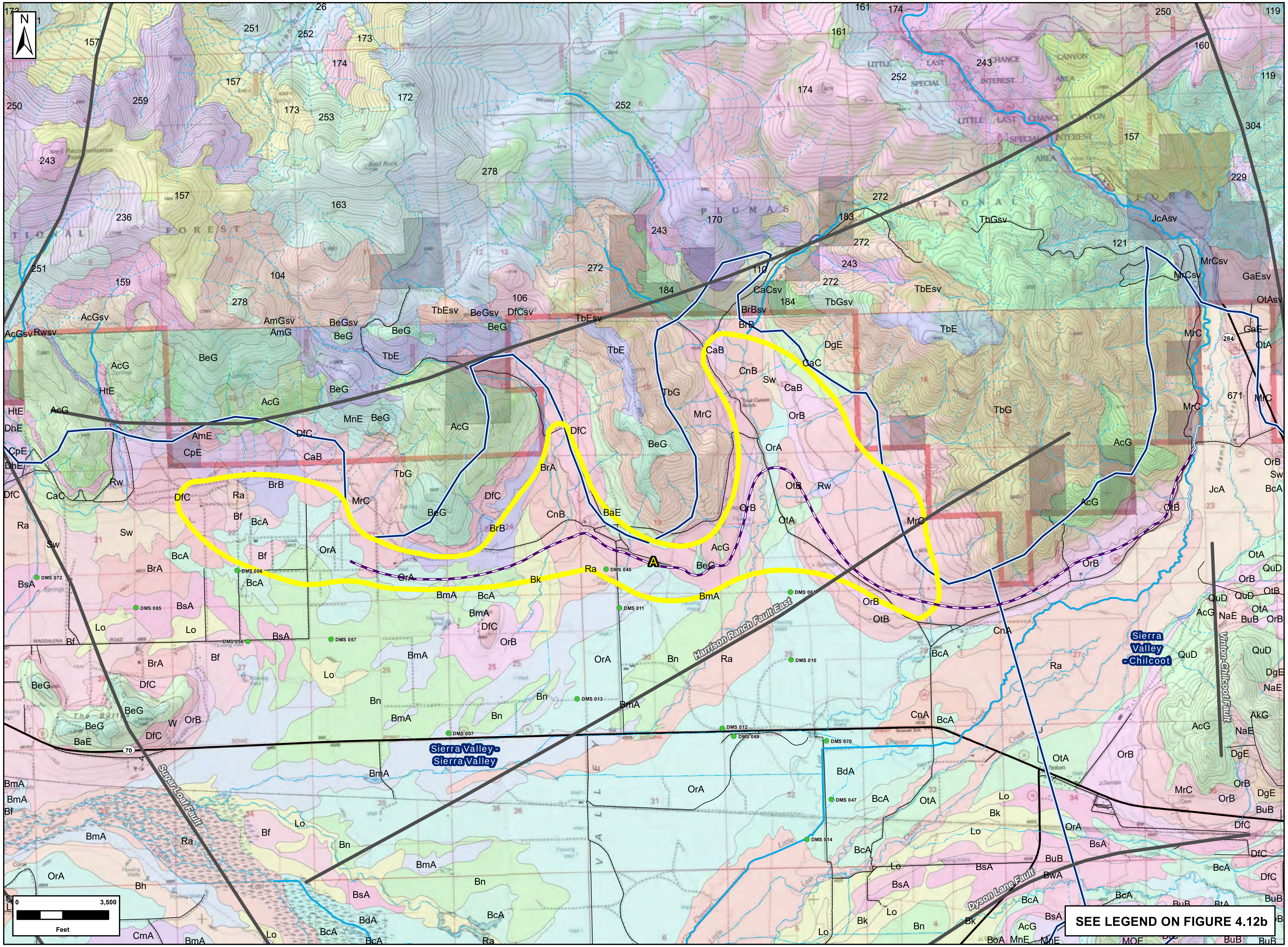

FIGURE 4.12a

TITLE:

SITE MAP
-SHOWING-
NRCS Soils Mapped in Opportunity Area A Sierra Valley, California

JOB NO.: **SVGMD001**

DATE: **11/23/2022**

FILE: Figure 4.12a – NRCS Soils Mapped in Opportunity Area A

COORDINATE SYSTEM: **NAD 1983 UTM Zone 10N**

REF.

DESIGNED	HC
DRAWN	HC
CHECKED	DS
APPROVED	DS

REVISION: --

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R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.12a – NRCS Soils Mapped in Opportunity Area A.mxd

- Agricultural Well,
- MAR Opportunity Area
- Sierra Valley Groundwater Basin
- Fault
- Local Road
- State Highway
- Conceptual Conveyance

NHD Drainages

- Intermittent Stream
- Perennial Stream
- Ephemeral Stream
- Artificial Path

NRCS Soils

- 104, Aiken-Josephine families association 2 to 50 percent slopes
- 106, Bonta-Toiyabe families complex 30 to 50 percent slopes
- 110, Calpine family 2 to 30 percent slopes
- 119, Chaix-Wapi families complex 2 to 30 percent slopes
- 121, Chaix-Wapi families complex 50 to 70 percent slopes
- 157, Fopiano-Franktown families complex 0 to 30 percent slopes
- 159, Fopiano-Franktown families complex 50 to 70 percent slopes
- 160, Fopiano family-Rubble land complex 0 to 30 percent slopes
- 161, Fopiano family-Rubble land complex 30 to 50 percent slopes
- 163, Fopiano-Sattley families complex 30 to 70 percent slopes
- 165, Fopiano-Trojan families-Rock outcrop complex 30 to 50 percent slopes
- 170, Franktown-Fopiano families complex 15 to 45 percent slopes
- 172, Franktown family-Rubble land complex 2 to 30 percent slopes
- 173, Franktown family-Rubble land complex 30 to 70 percent slopes
- 174, Franktown-Sattley families complex 10 to 50 percent slopes
- 183, Goodlow-Haplaquolls complex 0 to 10 percent slopes
- 184, Green Bluff-Waterman-Felton families complex 30 to 70 percent slopes
- 229, Mottsville-Quincy families association 0 to 30 percent slopes
- 236, Portola family 10 to 70 percent slopes
- 243, Rock outcrop-Rubble land complex
- 250, Sattley-Fopiano families complex 0 to 30 percent slopes
- 251, Sattley-Fopiano families complex 30 to 50 percent slopes
- 252, Sattley-Franktown families complex 0 to 30 percent slopes
- 253, Sattley-Franktown families complex 30 to 50 percent slopes
- 259, Sattley-Shepan-Trojan families complex 30 to 50 percent slopes
- 26, Keddie loam channeled 2 to 4 percent slopes
- 272, Toiyabe-Bonta families complex 30 to 50 percent slopes
- 278, Trojan-Sattley families complex 0 to 30 percent slopes
- 304, Wind River-Grove-Waterman families complex 25 to 70 percent slopes
- 671, Galeppi sandy loam 8 to 15 percent slopes
- AcG, Acidic rock land
- AcGsv, Acidic rock
- AkG, Aldax-Rock outcrop complex 15 to 75 percent slopes
- AmE, Aldax-Millich complex 5 to 30 percent slopes
- AmG, Aldax-Millich complex 30 to 75 percent slopes
- AmGsv, Aldax-Millich complex 30 to 75 percent slopes
- BaE, Badenaugh very cobbly sandy loam 2 to 30 percent slopes
- BcA, Balman loam 0 to 2 percent slopes
- BdA, Balman-Ramelli complex 0 to 2 percent slopes
- BeG, Basic rock land
- BeGsv, Basic rock land
- Bf, Beckwourth loamy coarse sand
- Bh, Beckwourth loamy coarse sand clayey substratum
- Bk, Beckwourth sandy loam
- BmA, Beckwourth-Loyalton complex saline-alkali 0 to 2 percent slopes
- Bn, Beckwourth-Ormsby loamy coarse sands complex
- BoA, Bellavista loam 0 to 2 percent slopes
- BrA, Bidwell sandy loam 0 to 2 percent slopes
- BrB, Bidwell sandy loam 2 to 5 percent slopes
- BrBsv, Bidwell sandy loam 2 to 5 percent slopes
- BsA, Bidwell sandy loam sandy substratum 0 to 2 percent slopes
- BtA, Bidwell loam 0 to 2 percent slopes
- BuB, Bieber gravelly sandy loam 0 to 5 percent slopes
- BwA, Bieber sandy loam moderately deep 0 to 2 percent slopes
- CaB, Calpine coarse sandy loam 2 to 5 percent slopes
- CaC, Calpine coarse sandy loam 5 to 9 percent slopes
- CaCsv, Calpine coarse sandy loam 5 to 9 percent slopes
- CmA, Calpine coarse sandy loam clayey variant 0 to 2 percent slopes
- CnA, Coolbrith silt loam 0 to 2 percent slopes
- CnB, Coolbrith silt loam 2 to 5 percent slopes
- CoB, Correco sandy loam 2 to 5 percent slopes
- CoD, Correco sandy loam 5 to 15 percent slopes
- CpE, Correco very cobbly sandy loam 2 to 30 percent slopes
- DfC, Dotta sandy loam 2 to 9 percent slopes
- DfCsv, Dotta sandy loam 2 to 9 percent slopes
- DgE, Dotta gravelly sandy loam 9 to 30 percent slopes
- DhE, Dotta cobbly sandy loam 2 to 30 pecent slopes
- GaE, Galeppi loamy coarse sand 5 to 30 percent slopes
- GaEsv, Galeppi loamy coarse sand 5 to 30 percent slopes
- HtE, Haypress-Toiyabe loamy coarse sands 2 to 30 percent slopes
- JcA, James Canyon silt loam 0 to 2 percent slopes
- JcAsv, James Canyon silt loam 0 to 2 percent slopes
- LaB, Lovejoy loam 0 to 5 percent slopes
- Lo, Loyalton fine sandy loam
- MOE, Franktown-Aldi-Rock outcrop complex 2 to 30 percent slopes
- MnE, Martineck very stony sandy loam 2 to 30 percent slopes
- MrC, Mottsville loamy sand 2 to 9 percent slopes
- MrCsv, Mottsville loamy sand 2 to 9 percent slopes
- NaE, Newlands-Rock outcrop complex 2 to 30 percent slopes
- OrA, Ormsby loamy coarse sand 0 to 2 percent slopes
- OrB, Ormsby loamy coarse sand 2 to 5 percent slopes
- OtA, Ormsby coarse sandy loam poorly drained 0 to 2 percent slopes
- OtAsv, Ormsby coarse sandy loam poorly drained 0 to 2 percent slopes
- OtB, Ormsby coarse sandy loam poorly drained 2 to 5 percent slopes
- QuD, Quincy sand 2 to 15 percent slopes
- Ra, Ramelli clay
- Rw, Riverwash 1 to 25 percent slopes
- Rwsv, Riverwash
- Sw, Smithneck sandy loam 0 to 2 percent slopes
- TbE, Toiyabe-Bonta loamy coarse sands 2 to 30 percent slopes complex
- TbEsv, Toiyabe-Bonta loamy coarse sands 2 to 30 percent slopes
- TbG, Toiyabe-Bonta loamy coarse sands 30 to 75 percent slopes complex
- TbGsv, Toiyabe-Bonta loamy coarse sands 30 to 75 percent slopes
- W, Areas under water in ponds and reservoirs complex

Sources:
NRCS Web Soil Survey
US Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/

U.S. Geological Survey, National Geospatial Program, 20220920, USGS National Hydrography Dataset Best Resolution (NHD) for Hydrological Unit (HU) 8 - 18020123 (published 20220920) Shapefile: U.S. Geological Survey, accessed October 7, 2022 at URL https://www.usgs.gov/national-hydrography/access-national-hydrography-products

FIGURE 4.12b

TITLE:

LEGEND
-SHOWING-
NRCS Soils Legend in Opportunity Area A Sierra Valley, California

JOB NO.: **SVGMD001**

DATE: **11/23/2022**

FILE: Figure 4.12b – NRCS Soils Legend in Opportunity Area A

COORDINATE SYSTEM: **NAD 1983 UTM Zone 10N**

REF.

DESIGNED	HC
DRAWN	HC
CHECKED	DS
APPROVED	DS

REVISION: --

McGinley & Associates
A Universal Engineering Sciences Company

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.12b – NRCS Soils Legend in Opportunity Area A.mxd

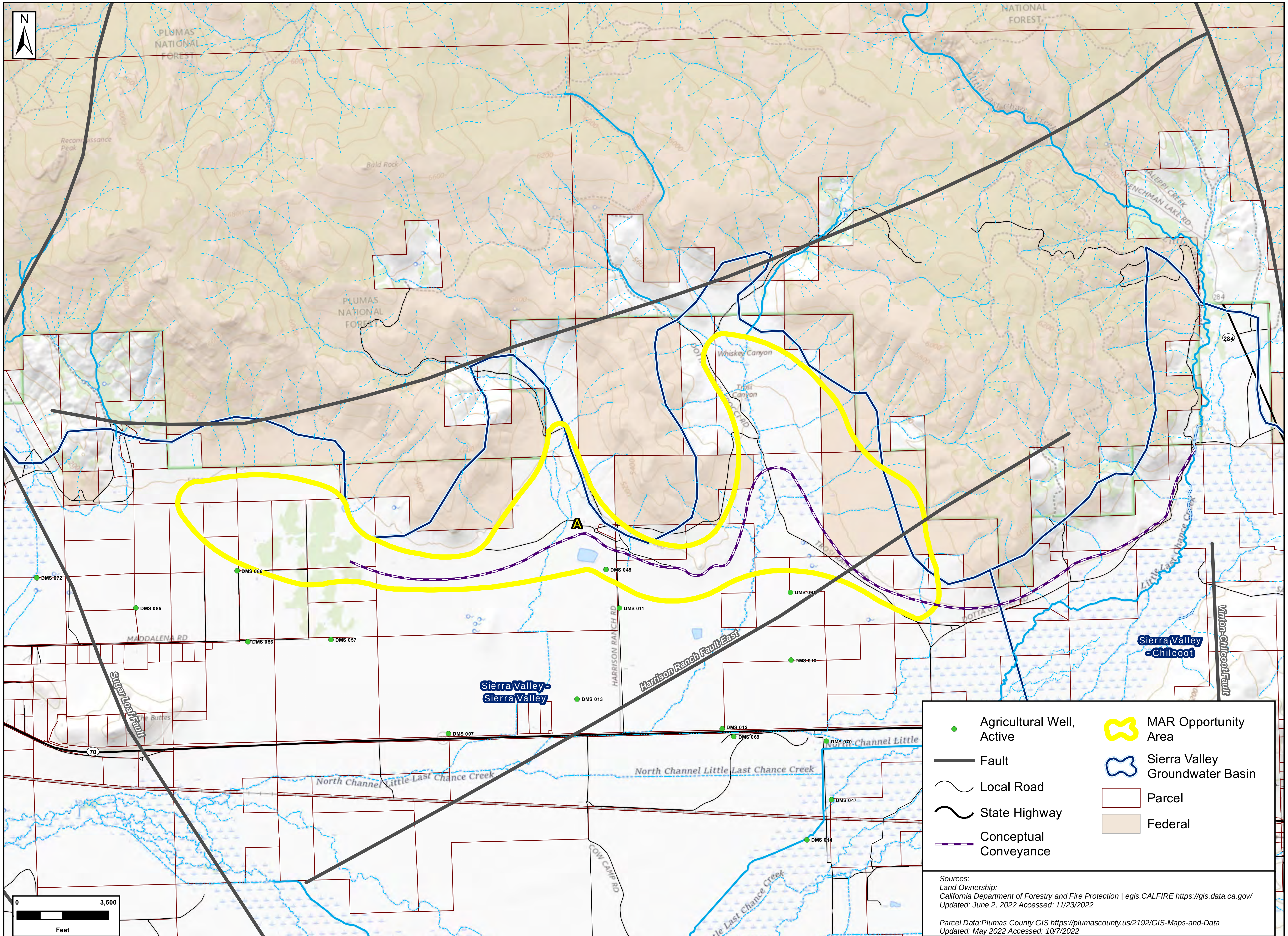

FIGURE 4.13

TITLE:

SITE MAP
-SHOWING-
Land Ownership in Opportunity Area A
Sierra Valley, California

JOB NO.:
SVGMD001

DATE:
11/23/2022

FILE:
Figure 4.13 – Land Ownership in Opportunity Area A

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

REF.

DESIGNED	HC
DRAWN	HC
CHECKED	DS
APPROVED	DS

REVISION:
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McGinley & Associates
A Universal Engineering Sciences Company

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.13 – Land Ownership in Opportunity Area A.mxd

4.2.7.3 Eastern Ephemeral Drainages

As a possible small-scale MAR opportunity, ephemeral drainages (including Correco Canyon) along the eastern alluvial fans could be targeted for seasonal runoff and storm runoff infiltration (Opportunity Area B). A concept drawing is presented as **Figure 4.14**, NRCS soils mapping is shown in **Figure 4.15**, and land ownership (public and private parcels) is shown in **Figure 4.16**. Land ownership consists primarily private, large parcels, with only a couple of land owners in this Opportunity Area.

Further watershed runoff modeling is needed to estimate potential runoff yields, but would likely produce no greater than 20 to 30 AFA, as a long-term average. However, the relatively low cost for construction of small in-channel infiltration basins may provide a viable cost-benefit option to increase recharge to the eastern part of the basin, if private property owners are willing to implement projects or grant easements.

Further concept validation would be needed, including runoff computations, infiltration testing, and confirmation of suitably permeable soils at depth to the water table. Since this concept does not involve perennial or intermittent streams, decreed surface water rights are not involved, and obtaining a water right permit to operate a MAR should be much simpler.

4.2.7.4 Mapes Creek Watershed

Another possible smaller-scale MAR opportunity area is identified in the northwest side of the valley, straddling the Grizzly Valley Fault (Opportunity Area D). This geographic area was examined for opportunities to support northern aquifer water levels, and northern wetland areas. A concept map is presented as **Figure 4.17**, NRCS soils mapping is **Figure 4.18**, and land ownership is **Figure 4.19**. The Mapes Creek Opportunity Area consists of lands held by the California Department of Fish and Wildlife and by private landowners.

PRMS modeling of runoff from the watershed indicates a 90th percentile flow of 10.0 cfs. Under a diversion criterion of not greater than 20% diversion for the months of December through March, and a facility sized to convey and infiltrate 10 cfs, the estimated potential MAR infiltration is approximately 72 AFA over the long-term. The annual range in recharge is predicted to be zero to 280 AF in any given year. A stream flow gage should be installed on Mapes Creek to provide data to refine runoff computations, if this MAR concept is advanced. Environmental considerations would need to be reviewed, as the diversion of a portion of Mapes Creek flow could have detrimental impacts to down-stream wetlands and habitat.

Land elevations of the alluvial fan in this possible MAR Opportunity Area do not support importing Big Grizzly Creek water for recharge of the deep aquifer, a concept that was initially considered because Plumas County holds some water rights to Lake Davis. Big Grizzly Creek enters the Sierra Valley basin at too low of an elevation to be conveyed to the alluvial fan via a gravity ditch. Preliminary review to divert water up-stream at a higher elevation ended up far up-stream, with a topographic ridge to work around on the south. The preliminary review suggests that gravity conveyance of Big Grizzly Creek water to the nearest northern Sierra Valley alluvial fan (Mapes Creek alluvial fan) does not appear feasible. A pump lift station and pipeline could technically accomplish water conveyance but would have significant construction and operation costs. At this time, importation of the Big Grizzly Creek water to the Mapes Creek alluvial fan is not considered an economically viable opportunity given expected infrastructure requirements and associated costs. The

Big Grizzly Creek water source could be assessed at some future time, and would require some preliminary engineering to enable technical and economic feasibility evaluations. Possible Plumas County Lake Davis water rights could be available for this diversion concept, but would have additional water right acquisition costs.

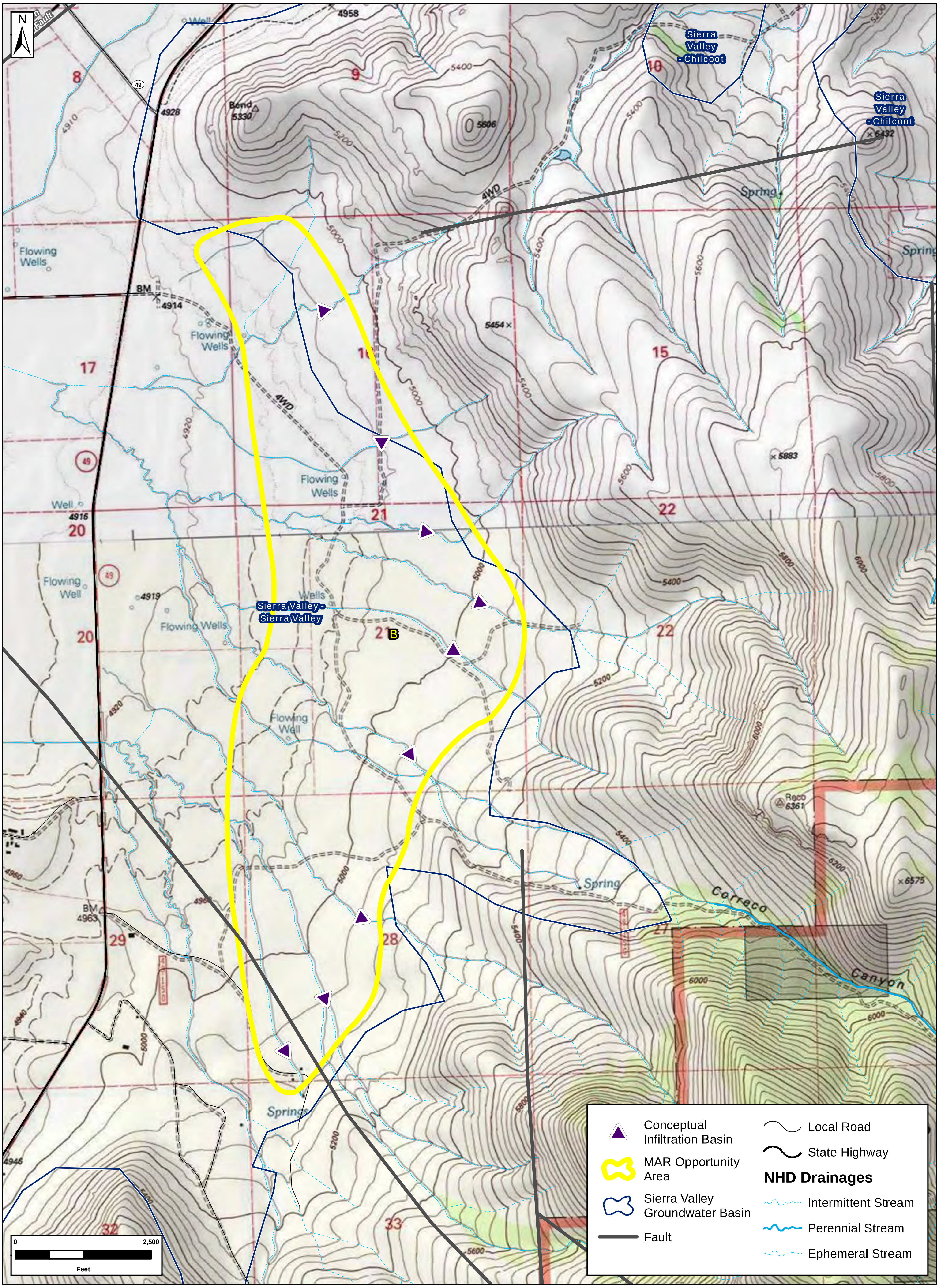

FIGURE 4.14

TITLE:

SITE MAP
-SHOWING-
Topography and Conceptual MAR Layout in Opportunity Area B
Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

FILE: Figure 4.14 - Topography and Conceptual MAR Layout in Opportunity Area B

COORDINATE SYSTEM: NAD 1983 UTM Zone 10N

JOB NO.	DATE	REF.					REVISION
SVGMD001	11/23/2022	DESIGNED	HC	CHECKED	DS		-
		DRAWN	HC	APPROVED	DS		

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.14 - Topography and Conceptual MAR Layout in Opportunity Area B.mxd

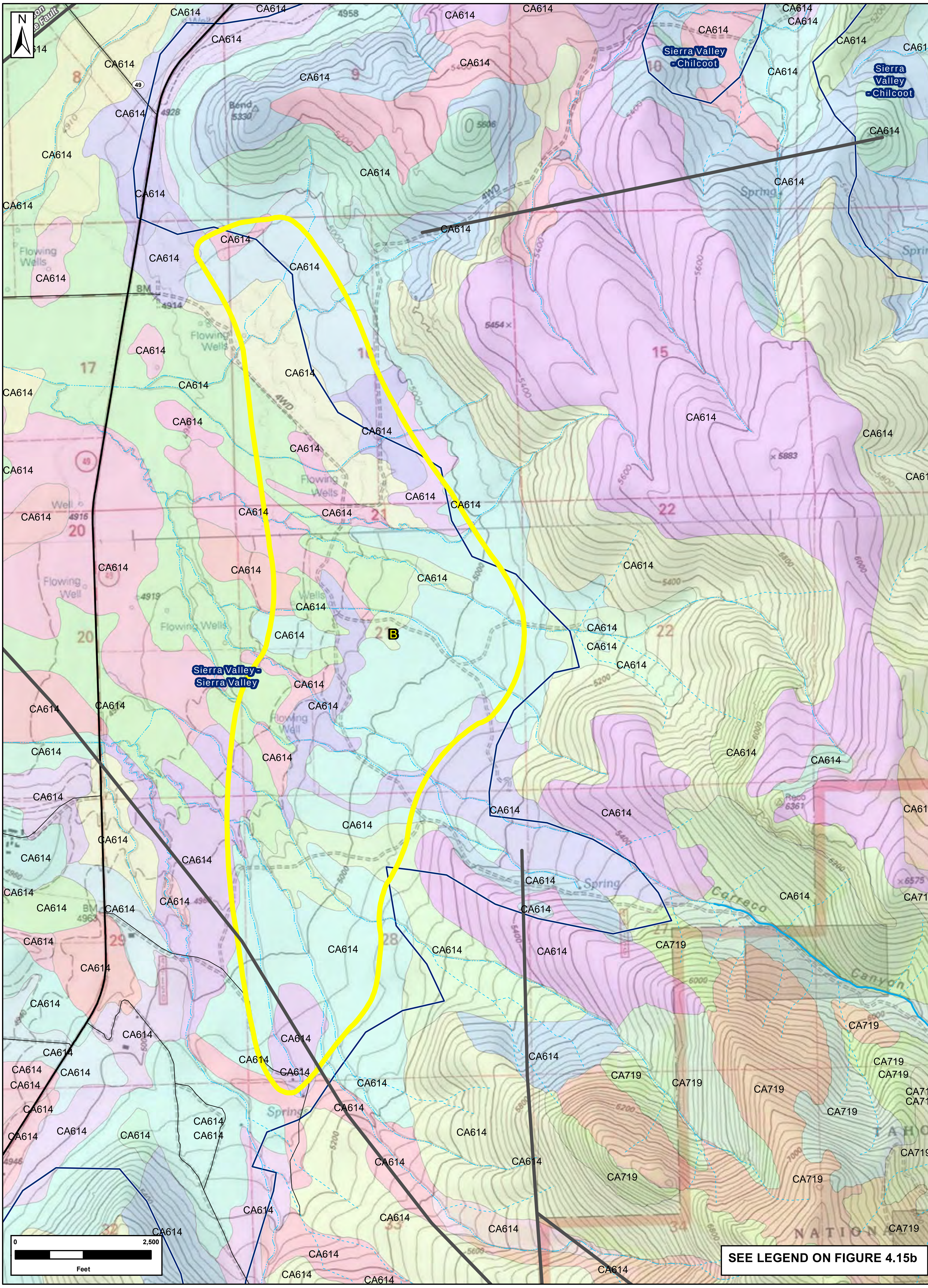

FIGURE 4.15a

TITLE:

SITE MAP
-SHOWING-
NRCS Soils Mapped in Opportunity Area B
Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

FILE:
Figure 4.15a – NRCS Soils Mapped in Opportunity Area B

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

JOB NO.:	DATE:	REF.					REVISION:
SVGMD001	11/23/2022		DESIGNED	HC	CHECKED	DS	-
			DRAWN	HC	APPROVED	DS	

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Fault
Local Road
State Highway
MAR Opportunity Area
Sierra Valley Groundwater Basin

NHD Drainages

Intermittent Stream
Perennial Stream
Ephemeral Stream

NRCS Soils

AcG, Acidic rock land
AmE, Aldax-Millich complex 5 to 30 percent slopes
AmG, Aldax-Millich complex 30 to 75 percent slopes
BME, Badenaugh-Martineck-Dotta association 2 to 30 percent slopes
BaE, Badenaugh very cobbly sandy loam 2 to 30 percent slopes
BcA, Balman loam 0 to 2 percent slopes
BcB, Balman loam 2 to 5 percent slopes
BeG, Basic rock land
Bf, Beckwourth loamy coarse sand
Bk, Beckwourth sandy loam
Bn, Beckwourth-Ormsby loamy coarse sands complex
BoA, Bellavista loam 0 to 2 percent slopes
BoB, Bellavista loam 2 to 5 percent slopes
BrA, Bidwell sandy loam 0 to 2 percent slopes
BrB, Bidwell sandy loam 2 to 5 percent slopes
BsA, Bidwell sandy loam sandy substratum 0 to 2 percent slopes
BuB, Bieber gravelly sandy loam 0 to 5 percent slopes
BwA, Bieber sandy loam moderately deep 0 to 2 percent slopes
CoB, Correco sandy loam 2 to 5 percent slopes
CoD, Correco sandy loam 5 to 15 percent slopes
CpE, Correco very cobbly sandy loam 2 to 30 percent slopes
DfA, Dotta sandy loam 0 to 2 percent slopes
DfC, Dotta sandy loam 2 to 9 percent slopes
FTF, Fugawee-Tahoma complex 30 to 50 percent slopes
FUF, Kyburz-Trojan complex 30 to 50 percent slopes
KME, Kyburz-Aldi complex 2 to 30 percent slopes
KMF, Kyburz-Aldi complex 30 to 50 percent slopes
KRG, Aldi-Kyburz-Rock outcrop complex 30 to 75 percent slopes
KRG2, Aldi-Kyburz-Rock outcrop comlex 30 to 75 percent slopes eroded
Lo, Loyalton fine sandy loam
MOE, Franktown-Aldi-Rock outcrop complex 2 to 30 percent slopes
MOG, Franktown-Aldi-Rock outcrop complex 30 to 75 percent slopes
MRE, Shallow andic haploxeralfs-Fugawee complex 2 to 30 percent slopes
MnE, Martineck very stony sandy loam 2 to 30 percent slopes
RAG, Rock outcrop-Franktown- Kyburz complex 50 to 75 percent slopes

Sources:
NRCS Web Soil Survey
US Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/

U.S. Geological Survey, National Geospatial Program, 20220920, USGS National Hydrography Dataset Best Resolution (NHD) for Hydrological Unit (HU) 8 - 18020123 (published 20220920) Shapefile: U.S. Geological Survey, accessed October 7, 2022 at URL https://www.usgs.gov/national-hydrography/access-national-hydrography-products

FIGURE 4.15b

TITLE:
LEGEND
-SHOWING-
NRCS Soils Legend in Opportunity Area B
Sierra Valley, California

JOB NO.:	DATE:
SVGMD001	**11/23/2022**

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FILE:
Figure 4.15b – NRCS Soils Legend in Opportunity Area B

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

REF:					REVISION:
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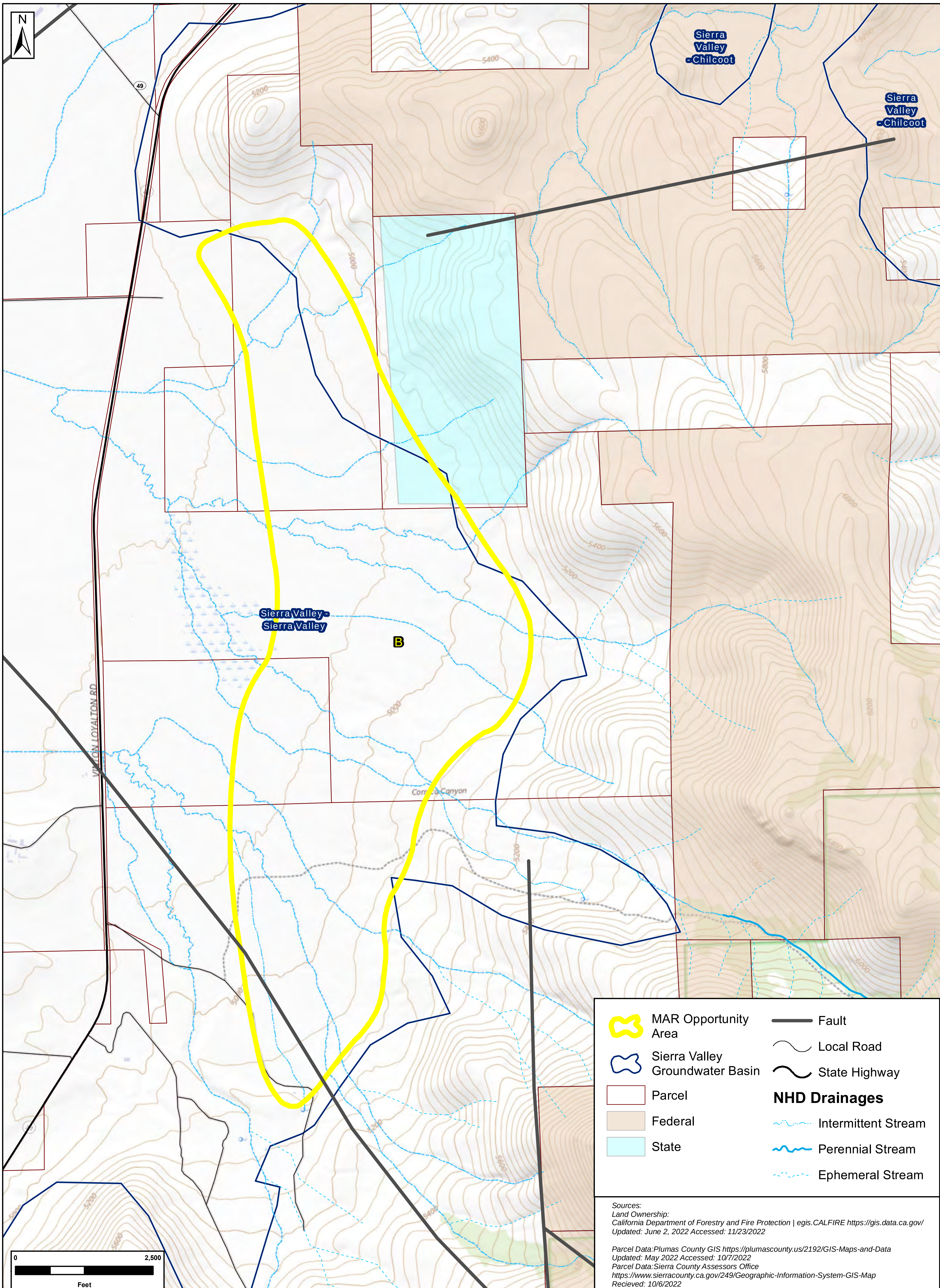

FIGURE 4.16

TITLE:

SITE MAP

-SHOWING-

Land Ownership in Opportunity Area B

Sierra Valley, California

McGinley & Associates
A Universal Engineering Sciences Company

JOB NO.: SVGMD001	DATE: 11/23/2022

FILE: **Figure 4.16 – Land Ownership in Opportunity Area B**

COORDINATE SYSTEM: **NAD 1983 UTM Zone 10N**

REF.	DESIGNED	HC	CHECKED	DS	REVISION: -
	DRAWN	HC	APPROVED	DS	

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.16 – Land Ownership in Opportunity Area B.mxd

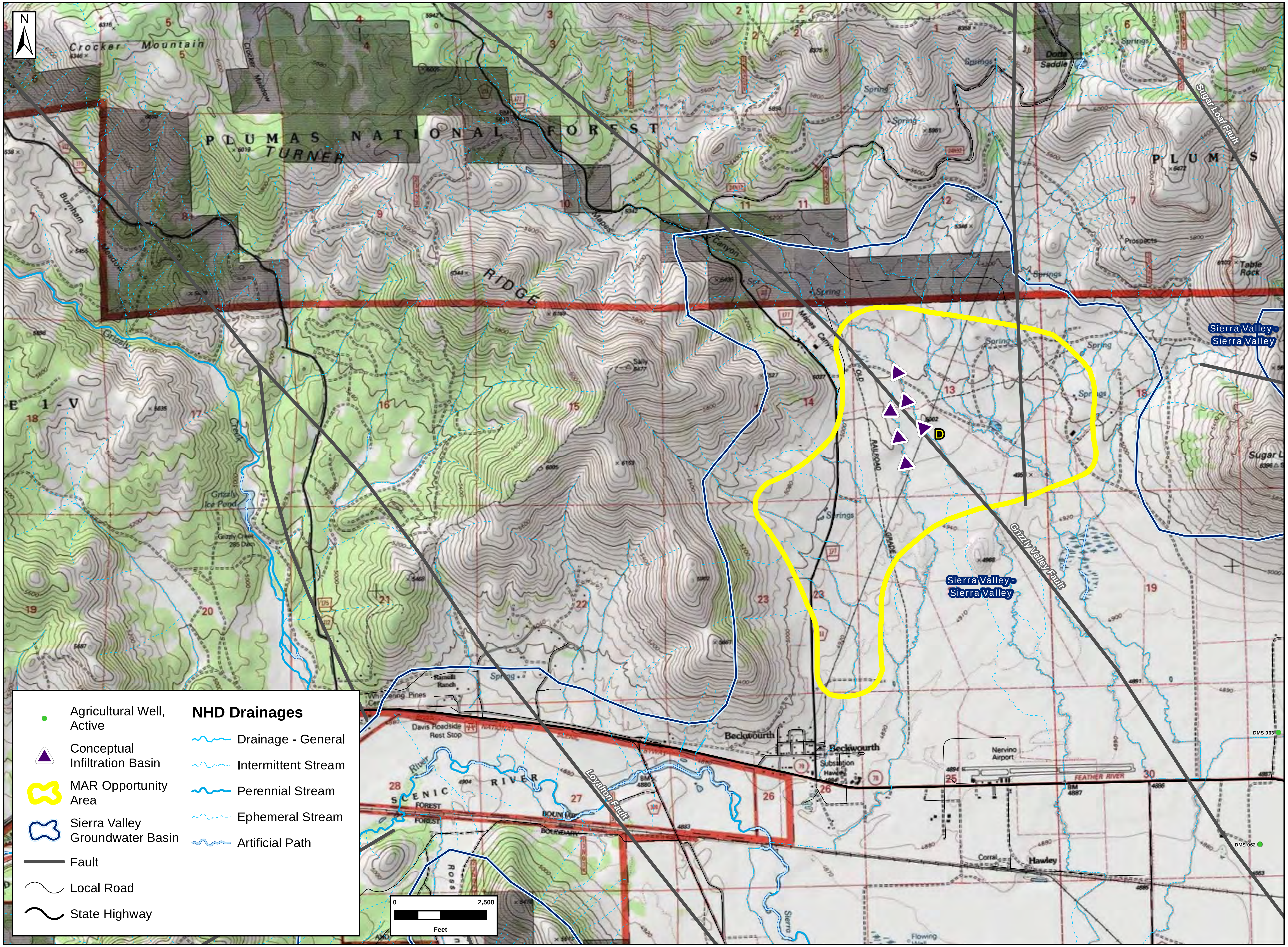

FIGURE 4.17

TITLE:

SITE MAP
-SHOWING-
Topography and Conceptual MAR Layout in Opportunity Area D
Sierra Valley, California

JOB NO.:
SVGMD001

DATE:
11/23/2022

FILE:
Figure 4.17 - Topography and Conceptual MAR Layout in Opportunity Area D

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

REF.

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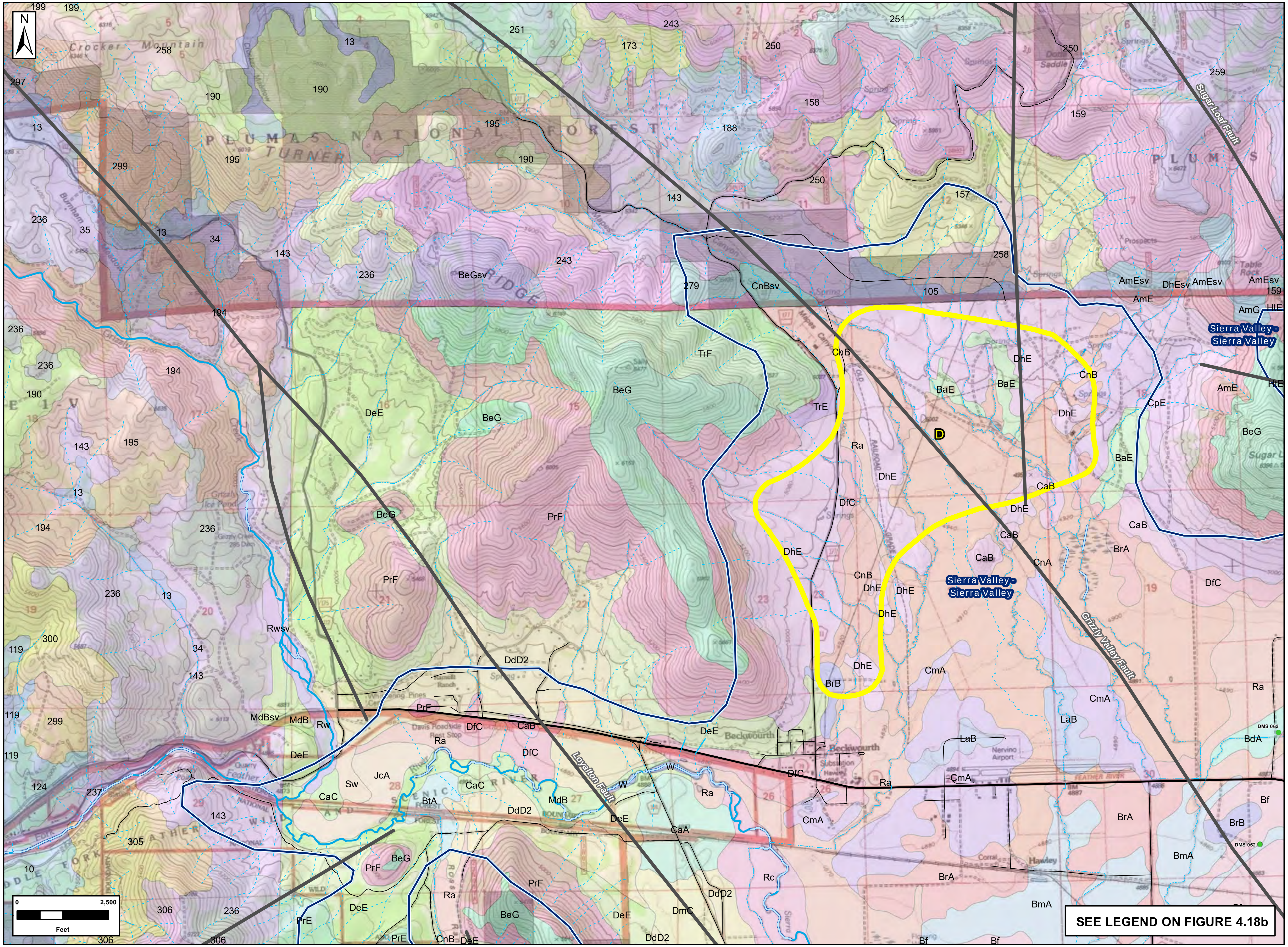

FIGURE 4.18a

TITLE:

SITE MAP
-SHOWING-
NRCS Soils Mapped in Opportunity Area D
Sierra Valley, California

JOB NO.:
SVGMD001

DATE:
11/23/2022

FILE:
Figure 4.18a – NRCS Soils Mapped in Opportunity Area D

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

REF.

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R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.18a – NRCS Soils Mapped in Opportunity Area D.mxd

- Agricultural Well,
- MAR Opportunity Area
- Sierra Valley Groundwater Basin
- Fault
- Local Road
- State Highway

NHD Drainages

- Drainage - General
- Intermittent Stream
- Perennial Stream
- Ephemeral Stream
- Artificial Path

NRCS Soils

- 10, Badenaugh very gravelly loam 2 to 5 percent slopes
- 105, Bonta-Toiyabe families complex 2 to 30 percent slopes
- 119, Chaix-Wapi families complex 2 to 30 percent slopes
- 124, Chaix-Wapi families- Haplaquolls complex 2 to 30 percent slopes
- 13, Dotta loam 2 to 5 percent slopes
- 143, Delleker-Fugawee families- Rubble land complex 10 to 70 percent slopes
- 157, Fopiano-Franktown families complex 0 to 30 percent slopes
- 158, Fopiano-Franktown families complex 30 to 50 percent slopes
- 159, Fopiano-Franktown families complex 50 to 70 percent slopes
- 173, Franktown family-Rubble land complex 30 to 70 percent slopes
- 188, Haypress-Bonta families complex 30 to 50 percent slopes
- 190, Haypress-Bucking families complex 10 to 70 percent slopes
- 194, Haypress-Toiyabe families complex 30 to 50 percent slopes
- 195, Haypress-Toiyabe families- Rock outcrop complex 2 to 50 percent slopes
- 199, Holland family basic 2 to 50 percent slopes
- 236, Portola family 10 to 70 percent slopes
- 237, Riverwash-Fluvents complex 0 to 5 percent slopes
- 243, Rock outcrop-Rubble land complex
- 250, Sattley-Fopiano families complex 0 to 30 percent slopes
- 251, Sattley-Fopiano families complex 30 to 50 percent slopes
- 258, Sattley-Shepan-Trojan families complex 0 to 30 percent slopes
- 259, Sattley-Shepan-Trojan families complex 30 to 50 percent slopes
- 279, Trojan-Sattley families complex 30 to 70 percent slopes
- 297, Wapi family 10 to 50 percent slopes
- 299, Wapi-Chaix families complex 10 to 50 percent slopes
- 300, Wapi-Chaix families complex 50 to 85 percent slopes
- 305, Woodseye-Waca families-Rock outcrop complex 10 to 50 percent slopes
- 306, Woodseye-Waca families-Rock outcrop complex 50 to 70 percent slopes
- 34, Ramelli silty clay loam 0 to 2 percent slopes
- 35, Ramelli clay 0 to 1 percent slopes
- AmE, Aldax-Millich complex 5 to 30 percent slopes
- AmEsv, Aldax-Millich complex 5 to 30 percent slopes
- AmG, Aldax-Millich complex 30 to 75 percent slopes
- BaE, Badenaugh very cobbly sandy loam 2 to 30 percent slopes
- BdA, Balman-Ramelli complex 0 to 2 percent slopes
- BeG, Basic rock land
- BeGsv, Basic rock land
- Bf, Beckwourth loamy coarse sand
- BmA, Beckwourth-Loyalton complex saline-alkali 0 to 2 percent slopes
- BrA, Bidwell sandy loam 0 to 2 percent slopes
- BrB, Bidwell sandy loam 2 to 5 percent slopes
- BtA, Bidwell loam 0 to 2 percent slopes
- CaA, Calpine coarse sandy loam 0 to 2 percent slopes
- CaB, Calpine coarse sandy loam 2 to 5 percent slopes
- CaC, Calpine coarse sandy loam 5 to 9 percent slopes
- CmA, Calpine coarse sandy loam clayey variant 0 to 2 percent slopes
- CnA, Coolbrith silt loam 0 to 2 percent slopes
- CnB, Coolbrith silt loam 2 to 5 percent slopes
- CnBsv, Coolbrith silt loam 2 to 5 percent slopes
- CpE, Correco very cobbly sandy loam 2 to 30 percent slopes
- DdD2, Delleker sandy loam 2 to 15 percent slopes eroded
- DeE, Delleker cobbly sandy loam 2 to 30 percent slopes
- DfC, Dotta sandy loam 2 to 9 percent slopes
- DhE, Dotta cobbly sandy loam 2 to 30 pecent slopes
- DhEsv, Dotta cobbly sandy loam 2 to 30 pecent slopes
- DmC, Dotta-Lovejoy complex 0 to 9 percent slopes
- HtE, Haypress-Toiyabe loamy coarse sands 2 to 30 percent slopes
- JcA, James Canyon silt loam 0 to 2 percent slopes
- LaB, Lovejoy loam 0 to 5 percent slopes
- MdB, Mixed alluvial land
- MdBsv, Mixed alluvial land
- PrE, Portola cobbly coarse sandy loam 9 to 30 percent slopes
- PrF, Portola cobbly coarse sandy loam 30 to 50 percent slopes
- Ra, Ramelli clay
- Rc, Ramelli clay very poorly drained channeled
- Rw, Riverwash 1 to 25 percent slopes
- Rwsv, Riverwash
- Sw, Smithneck sandy loam 0 to 2 percent slopes
- TrE, Trojan stony sandy loam 2 to 30 percent slopes
- TrF, Trojan stony sandy loam 30 to 50 percent slopes
- W, Areas under water in ponds and reservoirs complex

Sources:
NRCS Web Soil Survey
US Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/

U.S. Geological Survey, National Geospatial Program, 20220920, USGS National Hydrography Dataset Best Resolution (NHD) for Hydrological Unit (HU) 8 - 18020123 (published 20220920)
Shapefile: U.S. Geological Survey, accessed October 7, 2022 at URL https://www.usgs.gov/national-hydrography/access-national-hydrography-products

FIGURE 4.18b

TITLE:

LEGEND
-SHOWING-
NRCS Soils Legend in Opportunity Area D
Sierra Valley, California

JOB NO.: **SVGMD001**

DATE: **11/23/2022**

FILE: Figure 4.18b – NRCS Soils Legend in Opportunity Area D

COORDINATE SYSTEM: **NAD 1983 UTM Zone 10N**

REF.

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APPROVED	DS

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R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.18b – NRCS Soils Legend in Opportunity Area D.mxd

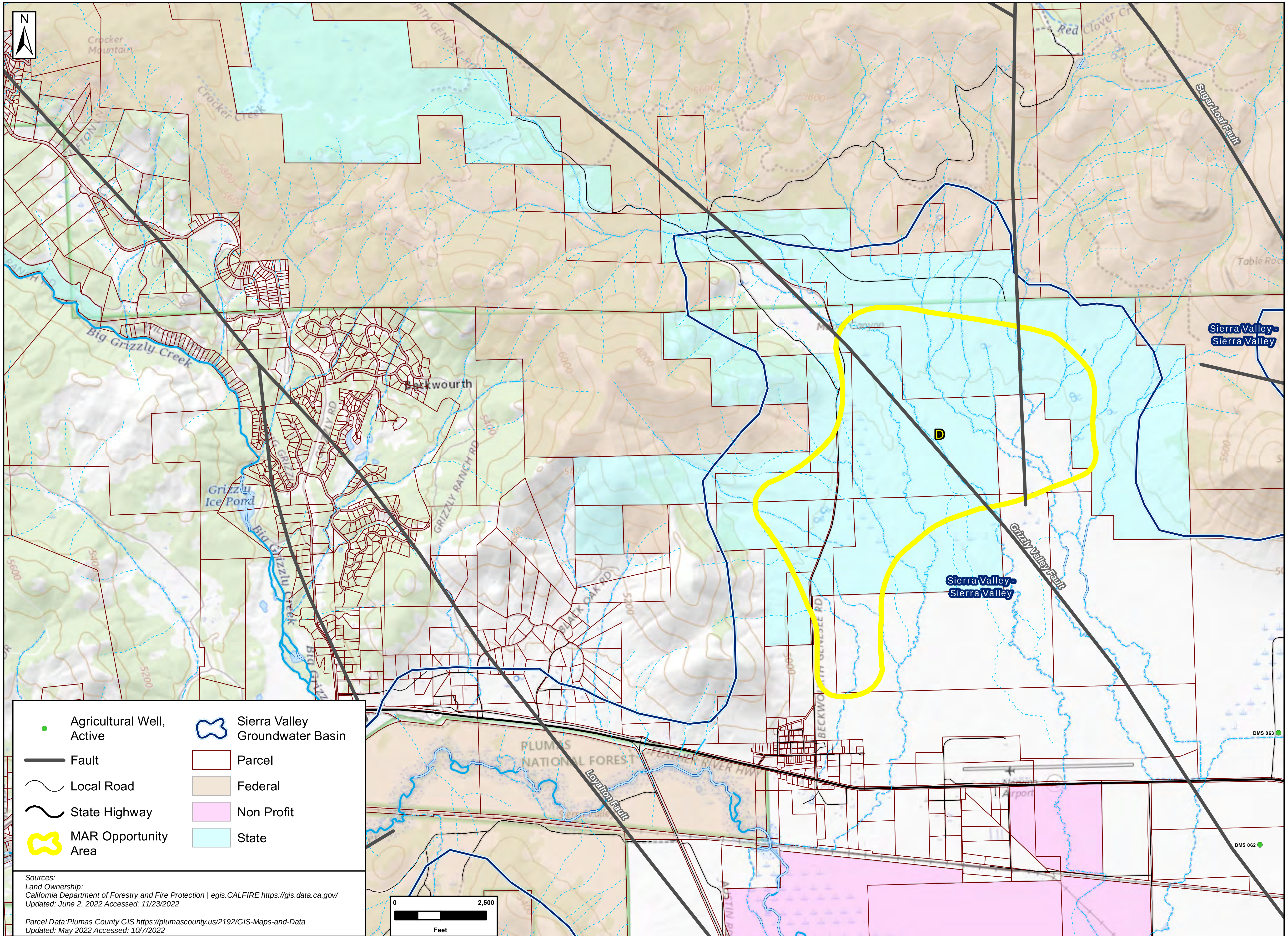

FIGURE 4.19

TITLE:

SITE MAP
-SHOWING-
Land Ownership in Opportunity Area D Sierra Valley, California

JOB NO.:
SVGMD001

DATE:
11/23/2022

FILE:
Figure 4.19 – Land Ownership in Opportunity Area D

COORDINATE SYSTEM:
NAD 1983 UTM Zone 10N

REF.

DESIGNED	HC
DRAWN	HC
CHECKED	DS
APPROVED	DS

REVISION:
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A Universal Engineering Sciences Company

R:\Projects\SVGMD\SVGMD001 - Task 7 Pumping Reduction\GIS\ReviewofSurfaceWaterMgmtFigs\Figure 4.19 – Land Ownership in Opportunity Area D.mxd

4.3 MAR Example: Vicee Canyon Terraced Infiltration Basins

The following example of an operating infiltration basin used for MAR is presented for information purposes. The location is geographically nearby, in Carson City, Nevada, and is an alluvial fan operated facility, similar to that conceptually proposed for Sierra Valley in this report.

4.3.1 Background

Long-term groundwater level decline of up to 50 feet was noticed in a portion of the Eagle Valley aquifer near some of Carson City's municipal wells. Carson City is located south of Reno, Nevada and is geographically situated at the base of the Sierra Nevada. The Vicee Canyon managed aquifer recharge concept was proposed in 1983 by the Carson City Public Works Department (CCPW) to potentially mitigate the groundwater declines. A large storm event in 1982 caused the incising of the Vicee Canyon drainage into the alluvial fan, less than 2,000 feet upstream of a CCPW municipal well. The incising of the canyon led to the idea of building terraced infiltration basins to slow down runoff and increase groundwater recharge via the alluvial fan. Technical studies were initiated to: characterize the soils comprising the alluvial fan, determine infiltration rates of soils, quantify anticipated runoff and a potential imported water source from the Marlette Lake water system, and assess the potential effectiveness of the conceptualized terraced infiltration basins MAR concept to recharge the targeted down-stream aquifer in which municipal wells were completed. The USGS was commissioned to complete hydrogeologic evaluations which supported the technical feasibility of the MAR concept.

Excess water from the Marlette Lake water source was a significant component of the proposed water source to the Vicee Canyon MAR. The Marlette Lake and Hobart reservoir system is a primary water source to Virginia City and a supplemental water source to Carson City. Marlette Lake and Hobart Reservoir are in the Carson Range which bounds the east side of Lake Tahoe. The system includes a pipeline with booster pump station, and incorporates spring water sources from the eastern slopes of the Carson Range.

Studies completed by the USGS (Maurer and Fischer, 1988) found that water impounded in terraced basins, on the alluvial fan, increased infiltration to the aquifer and could alleviate the long-term decline in groundwater levels at the municipal wells. Conclusions from the Maurer and Fischer (1988) study were as follows:

> *Measurements of infiltration rates, percolation rates, and hydraulic conductivity indicate that the area could be suitable for artificial recharge through infiltration of augmented streamflow. Direct runoff from storms or snowmelt creates natural infiltration beds on the floor of Vicee Canyon; however, subsequent base runoff causes channelization and armoring of the stream channel, reducing infiltration rates. A water balance of the total streamflow in Vicee Canyon indicates that 60 to 70 percent becomes recharge and that the remainder is lost to evaporation from a nearby gravel pit and evapotranspiration on the canyon floor. Estimates of recharge from measurements in the unsaturated and saturated zones account for about 45 percent of the total streamflow. Application of a ground-water flow model indicates that, at present pumping rates, water levels below Vicee Canyon and at a nearby municipal well may rise about 15 to 30 feet after 5 years as a result of infiltration from additional streamflow of about 1 cubic foot per second (720 acre-feet per year).*

Based on the technical information, the Nevada State Engineer granted an Aquifer Storage & Recovery (ASR) permit to CCPW to construct and maintain basins for managed aquifer recharge. The terms of ASR Permit R-004 allow for recharge of up to 700 AFA of water from natural runoff and diverted water to the Vicee Canyon drainage from the Marlette/Hobart system. The permit was recently amended with an increase in annual recharge from 700 AFA to 1,400 AFA. The Vicee Canyon terraced MAR basins were subsequently constructed and have been in operation for approximately 3 decades. **Figures 4.20 and 4.21** show Vicee Canyon and the terraced infiltration basins.

Figure 4.20 - Vicee Canyon and the terraced MAR infiltration basins, oblique Google Earth view facing west toward the Carson Range

Figure 4.21 - Areal view of the Vicee Canyon MAR Infiltration Basins

Photograph 4.1 – Ground view of an infiltration basin on the Vicee Canyon alluvial fan


Photograph 4.2 – Ground view of an infiltration basin on the Vicee Canyon alluvial fan

4.3.2 Operations & Use

Surface waters from Marlette Lake and Hobart Reservoir that meet the CCPW's water treatment plant standards are piped directly to the plant for use in the municipal water system. However, in the spring and early summer months (March to July), due to turn-over in the reservoirs and increased sediment load from runoff, the water exceeds water treatment plant's allowable turbidity. The turbid waters are instead routed via pipeline to the Vicee Canyon drainage to supply the infiltration basins.

There are eight impounded and terraced infiltration basins from which the water either infiltrates or flows downhill until reaching an abandoned gravel pit. The eight basins have a surface area totaling approximately 1.3 acres and the gravel pit has a surface area of 3.9 acres for a total surface area of 5.2 acres (not including the drainages connecting the basins).

The total recharged amount through the Vicee Canyon infiltration basin system for the calendar years 2007 to 2017 varied between 94 AFA to 679 AFA (Nevada Division of Water Resources, 2022, basin inventory records) (**Figure 4.22**). Groundwater levels during and after infiltration basin recharge are observably higher according to the CCPW's water utilities manager, indicating the effectiveness of the infiltration basins to recharge the aquifer through the alluvial fan materials. An example of nearby groundwater level increase is presented in **Figures 4.23**.

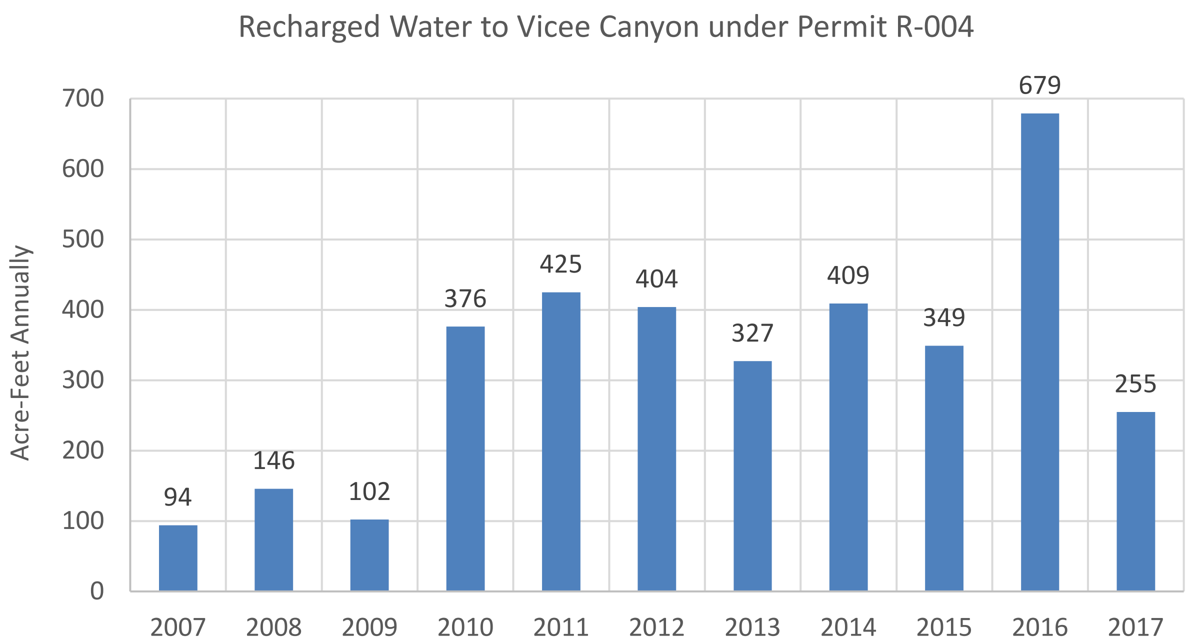

Figure 4.22 – Vicee Canyon MAR infiltrated water reported to NDWR for 2004 to 2017

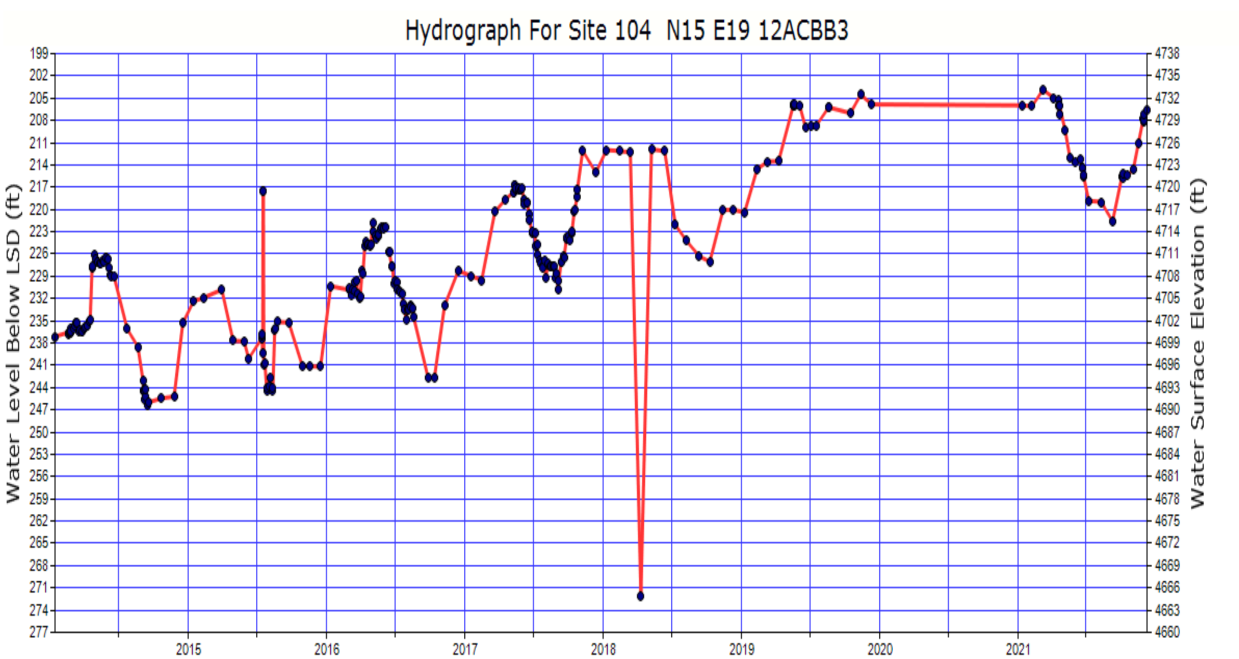

Figure 4.23 – Groundwater Hydrographs for a Monitoring Well near Vicee Canyon MAR (NDWR, 2022 water level data; note red data in 2018 flagged as probably inaccurate)

5. RECOMMENDATIONS AND NEXT STEPS

5.1 Water Rights – Opportunities & Limitations

Two tiers of water rights will be need to be addressed to successfully secure a temporary or permanent water right to operate a MAR program: 1.) the decreed water rights in valley, and 2.) regional implications for the State Water Project. Applications will need to filed with the Division of Water Rights, and favorable determinations will need to be issued, finding that there are no conflicts with the adjudicated and pre-existing water rights. A pilot MAR project could be initiated and operated under a temporary permit.

The State Water Board has developed a special program to facilitate the acquisition of water right permits for groundwater recharge (underground storage), including temporary permits that may be used for a pilot study. The GSA may qualify for a streamlined processing for standard groundwater recharge water rights, which may be particularly relevant for a pilot MAR program on Smithneck Creek (Opportunity Area C). To be eligible for the streamlined process, the application must meet the following (DWR website, 2022):

The applicant proposes diversions during high flow events between December 1 and March 31 with a minimum bypass or diversions in accordance with flood control operations, as follows:

- *Diversions during high flows with bypass when streamflow at the point of diversion is above the 90th percentile, calculated on a daily basis from the gage data during the period-of-record;*
- *The diversion rate is limited to 20% of the total streamflow; and*
- *Diversions only when flows in the source waterbody at or near the point of diversion exceed thresholds that trigger flood control actions necessary to mitigate threats to human health or safety, according to established written flood management protocols adopted by a flood control agency.*
- *The application includes the information required by Water Code section 1260 and the Underground Storage Supplement to the Application to Appropriate Water by Permit.*
- *The application is submitted by a Groundwater Sustainability Agency (GSA) or local agency as defined by the Sustainable Groundwater Management Act (SGMA).*
- *The application proposes to divert water to underground storage in a groundwater basin identified in Bulletin 118.*
- *The applicant has completed any environmental documents required under the California Environmental Quality Act (CEQA).*

The water right permitting process is as follows (DWR website, 2022):

- *Review Program Criteria and Limitations. Determine if the project meets the criteria of the program.*
- *File an Application. The application should specifically describe the proposed project's source, place of use, purpose, point(s) of diversion and quantity to be diverted.*
- *Acceptance of Application. Applicants that submit applications that are accepted for initial review will be notified within 30 days of the date the application is received.*
- *Environmental Review. Consideration of environmental effects is required by the California Environmental Quality Act before a permit can be issued.*
- *Water Availability Analysis. Before granting a permit, the Board must find that there is unappropriated water available to supply the applicant.*

- *Compliance with Applicable Policies. Projects located in certain geographic areas must comply with applicable State Board Policies relevant to processing a water right application.*
- *Public Notice and Protest Resolution. The State Water Board is required by law to publish a notice of the application and any person may file a protest to the application.*
- *Permit Issuance. Two initial Board findings are required before a permit can be issued: (1) unappropriated water is available to supply the applicant, and (2) the applicant's appropriation is in the public interest, a concept that is an overriding concern in all Board decisions.*

The underlined items above will be important items to successfully secure a permit for any MAR project:

1. CEQA must be completed, with a favorable finding before a permit may be issued,
2. The State Water Board must arrive a finding that there is unappropriated water to grant to the permit.

There is no assurance that these items can be successfully addressed, especially considering the adjudicated surface waters in Sierra Valley, and the environmental awareness and potential sensitivities to wetlands down-gradient in the valley. Technical work will be needed to adequately review and consider these variables for the water right application process. A water availability analysis will be needed, and in the case of Smithneck Creek, stream gage data will be needed to complete an adequate analysis.

Other water right options might be present, such as conversion of existing winter storage rights to recharge rights. There is an existing decreed water right for the mill pond on Smithneck, with winter diversion of 50 AF. It is possible that through petition to the court to amend the decree, the mill pond storage right could be changed to recharge rights. This possibility would need to be approved by the property / water right owner. The last petition to amend the decree was approximately 20 years ago, so this is not a common path taken for adjudicated rights in Sierra Valley.

5.2 Land Ownership – Opportunities & Limitations

For any next steps for MAR, land owner permissions for access and data collection must be secured by the GSA. Willing property owners will have to be identified for the points of diversion, conveyance routes, and infiltration facilities. This may prove to be difficult where permissions from multiple property owners would be necessary to implement a MAR project, notable for Opportunity Area A on Little Last Chance Creek. Discussion with potential property owners would need to occur as an initial step for any pilot project, and prior to any application for water rights.

5.3 Environmental Considerations and CEQA Permitting

The State has issued Executive Order N-7-22 Action 13: California Environmental Quality Act (CEQA) Relief for Groundwater Recharge Projects, which is intended to provide some streamlining of the CEQA process for recharge projects. As written in program documentation (DWR, 2022): *The purpose of Executive Order Action 131 is to help mitigate drought impacts by suspending CEQA and expediting the process to construct groundwater recharge projects that have State grant funding or technical assistance support, so as to increase the ability to capture high flows when available.* However, it is unclear if any proposed Sierra Valley MAR projects, including a possible pilot project, would be eligible for this exemption. As indicated by DWR: *DWR will review and concur if the project is eligible based on the documentation in the Self-Certification Form and will notify the project proponent once concurrence is complete.*

For planning purposes, and due to environmental sensitivities associated with wetlands within Sierra Valley, it may be prudent to plan to complete the CEQA process for any proposed MAR projects, including a pilot study.

5.4 Technical Evaluations and Pilot Testing

The review of potential MAR for Sierra Valley presented herein is a preliminary step to identify possible options and convey general information for taking next steps, if the GSA decides to advance a MAR opportunity in Sierra Valley. For each Opportunity Area, specific on-the-ground information is required to determine the technical feasibility, existing water uses and preliminary designs required for water right permitting, CEQA, and advancing landowner agreements. The CEQA evaluations need to consider the trade-offs of additional surface water diversion with existing hydrologic and environmental conditions, and potential environmental impacts.

Common next steps, once property owner access is established, are to conduct soils investigations by digging test pits, conducting soil permeability analyses, and conducting small test pit infiltration tests. This will help establish that suitable near-surface soils conditions are present for accomplishing recharge infiltration in open basins, galleries, or in dry wells.

As geographic locations for possible MAR are refined, borings should be conducted through the unsaturated soils and down to the water table. Piezometers may be installed in the borings to track depth to groundwater at potential infiltration sites. Soils samples should be carefully logged and classified, with particular attention to presence of fine-grained sediments (clays and silts) that could cause perching of infiltrated water.

If the depth to groundwater at a site is too shallow, groundwater mounding to the base of the infiltration basin, gallery or dry well will flood out the facility, and present a limit to volumes that can be effectively recharged. A mounding analysis should be conducted to determine if mounding will be a constraint at the site.

Once site conditions are defined, the numerical flow model prepared for the GSA, and updated with new information relating to localized conditions, can be used to assess potential long-term effectiveness of a proposed MAR project.

While preliminary estimates of water source availability, frequency and flow rates are provided in this report, more exact quantifications are needed - for economic feasibility review, preliminary engineering design, water right permitting, and CEQA. This will require installation and operation of stream flow gages, and more sophisticated modeling of runoff and watershed yield.

Preliminary engineering designs will be needed to advance a MAR project, including diversion structures, conveyance ditches or piping, and infiltration structures (basin, gallery, or dry well concept). The preliminary engineering will likely require surveying and additional geotechnical information. A 30% design level is recommended to advance water right permitting and CEQA compliance. Preliminary cost-benefit analyses require a 10% design level to develop construction cost estimates.

At this time, it appears that the Smithneck Opportunity Area (C) is a favorable area to proceed with additional feasibility evaluations and to advance a pilot study concept, possibly supported by a 5-year temporary water right permit. Advancement will of course depend on securing access agreements with property owners.

5.5 Prioritization

The GSA will need to prioritize any MAR actions, which will require undertaking the next level of technical feasibility evaluations, conducting necessary data collection such as stream gaging to enable preparation of water right applications, filing water right applications, and initiating and completion of CEQA. Advancement of any MAR project will undoubtedly depend on the GSA securing grant funding to advance a project. In consideration of advancing MAR concepts, the rate-of-return also needs to be carefully considered, i.e., the infrastructure and O&M costs versus magnitude of benefit in achieving additional aquifer recharge.

As a preliminary recommendation, the Smithneck Creek Opportunity Area (C) could be prioritized to advance at the feasibility evaluation and pilot program level. Discussions and initial steps are also recommended for the next level of reviews for the Little Last Chance Opportunity Area (A).

6. FUNDING & PRELIMINARY BUDGET ESTIMATES FOR MAR PROJECTS IMPLEMENTATION

The following surface water management projects and management actions focus on advancing feasibility evaluations for additional Frenchman Reservoir water rights through a conveyance of Plumas County owned Lake Davis water rights, and a project MAR on Smithneck Creek (Opportunity Area C) in the southern portion of the valley, and/or Little Last Chance Creek (Opportunity Area A) in the north. Preliminary estimated funding requirements and potential implementation timing, subject to funding, are outlined in **Table 6.1**. It is hoped that Sierra Valley GSA can secure primary funding for this component of GSP implementation from a DWR GSP Round 2 implementation grant.

As summarized in **Table 6.1**, costs for advancing the Plumas County water right conveyance concept to Frenchman Reservoir would include environmental analyses and a water right application to the State Water Board, along with multi-agency coordination to advance the concept. Estimated cost for these tasks are approximately $300,000.

Advancement of MAR feasibility evaluations, pilot MAR project design, water right permitting, CEQA, and construction and operation of a pilot MAR project on Smithneck Creek (Opportunity Area C) is estimated at approximately $1.1 million. It is envisioned that, subject to funding availability and obtaining necessary land-owner agreements and permits, a pilot MAR program on Smithneck Creek could be initiated in water-year 2026 (October 2026).

Preliminary costs to advance MAR in Little Last Chance Opportunity Area A are estimated to require $575,000 This potential project is proposed to advance to a technical level sufficient to prepare a water right application, pending satisfactory land owner access and outcome of technical feasibility data collection.

Table 6.1 – Surface Water Management Proposed Project Tasks and Preliminary Budget Estimates

Proposed Project / Management Action	Components	Implementation Years	Preliminary Budget Estimate Equipment or Contractor	Preliminary Budget Estimate Professional Services	SVGMD and Plumas County Administration
Plumas County Lake Davis – Frenchman Lake Water Right Conveyance & Lease / Sale up to 1,100 AFA					
Task 1 – Refine the Transfer Concept	Technical evaluations of potential water yield to agriculture from the Frenchman Lake for the portion of County rights available (water-year variations, long-term dependability)	2023	NA	$50,000	$5,000
Task 2 – Water Right Application, Including Environmental / CEQA	Water Right Application a) Draft application b) Environmental Reviews Filing and hearing technical support	2023-2024	NA	$200,000	$20,000
Task 3 – Facilitate Lease or Sale (not including purchase cost of rights)	SVGMD Acquire Rights, for release	2024-2025	NA	$10,000	$10,000
Smithneck Watershed – Development and Implement of a Pilot MAR Program					
Task 1 - Preliminary Design and Permitting of Pilot AR	Landownership Discussions and Establish Land Access / Utilization Agreements for: a) Stream gages b) Water conveyance routes c) Infiltration sites d) Monitoring well sites e) Legal descriptions	2023	NA	$20,000	$2,000
	Smithneck Stream Gage Installation at Water Master Point of Measurement: a) Installation of equipment	2023 (Oct 1 for start of WY)	$15,000	$10,000	$2,500

Proposed Project / Management Action	Components	Implementation Years	Preliminary Budget Estimate Equipment or Contractor	Preliminary Budget Estimate Professional Services	SVGMD and Plumas County Administration
	Smithneck Stream Gage Maintenance and Operation (4 water-years)	2023 (WY2024 – 2027)	$2,000	$20,000 per year $80,000	$8,000
	Updated Hydrogeologic Characterizations for Siting Potential Infiltration Facilities a) Update numerical flow model, to include AEM data for extent of clays b) Area-specific geophysics to identify prospective infiltration sites c) Phase I borings to determine/confirm lithologies at prospective locations d) Refined modeling for mounding assessment (volume limitations) and predicted effectiveness of MAR	2023-2024	$50,000	$80,000	10,000
	Geotechnical Investigations at Proposed Locations for Infiltration: a) Upper soils profiles (backhoe test pits, soil gradation, plasticity indices at prospective infiltration sites b) Phase 2 borings to water table to characterize unsaturated zone soils at planned infiltration sites (vibrating wire piezometer completions) c) Small basin flooded infiltration tests measurements at planned bottom depths of infiltration basins, galleries, or dry wells.	2024	$50,000	$40,000	$8,500

Proposed Project / Management Action	Components	Implementation Years	Preliminary Budget Estimate Equipment or Contractor	Preliminary Budget Estimate Professional Services	SVGMD and Plumas County Administration
	Refined Hydrology at Planned Pilot MAR Site(s) a) Determine 1-yr, 10-yr and 100-yr runoff event flows using HEC-RAS b) Update PRMS model based on preliminary Smithneck stream gage data.	2024	NA	$20,000	1,500
	Preliminary Design of Pilot AR Infiltration System, sufficient to advance water right application and CEQA for project implementation (anticipated 30% design) a) Stream diversion, conveyance and basin(s) – galleries - dry wells design b) Surveying for site plans c) Potential wetlands mapping (avoidance) d) Preliminary involved agency coordination e) Engineering estimate for construction	2024	NA	$120,000	$10,000
	Water Right Application c) Draft application d) Filing and hearing technical support	2024-2025	NA	$40,000	$4,000
	CEQA for Pilot MAR Program	2024-2025	NA	$40,000	$4,000

Proposed Project / Management Action	Components	Implementation Years	Preliminary Budget Estimate Equipment or Contractor	Preliminary Budget Estimate Professional Services	SVGMD and Plumas County Administration
Task 2 - Construction of Pilot AR Facilities at Smithneck Creek Watershed	Construct All Facilities, including diversion works, conveyance, and infiltration facilities, including diversion gaging, and water table and vadose zone monitoring network at infiltration facilities a) Complete engineering design to 100% b) Secure construction permits (County, ACE possible) c) Bid project and select contractor d) Construction with inspection services e) Start-up testing and documentation of constructed facilities	2025	$300,000	$120,000	$20,000
Task 3 - Pilot AR Performance Monitoring	Assume Two Years of Monitoring and Reporting after Construction of Pilot MAR facility (through end of grant funding period) a) Bi-weekly monitoring during diversion period (assumed 4 months – Dec 1 through March 31) b) Reporting c) Assumes minor basin and infrastructure maintenance required each year	WY 2026 - 2027	$10,000	$30,000 / yr $60,000	$7,000

Proposed Project / Management Action	Components	Implementation Years	Preliminary Budget Estimate Equipment or Contractor	Preliminary Budget Estimate Professional Services	SVGMD and Plumas County Administration
Little Last Chance Watershed – Opportunity Area A – Refinement of Potential MAR Project (Only to Water Right Application Step)					
Task 1 **Initiate Discussions with Landowners**	Working with the Little Last Chance Irrigation District – determine possibilities and/or major obstacles.	2024		$20,000	$10,000
Task 2 **Advance a Preliminary MAR Concept (assuming successful in Task 1)**	a) Drilling to evaluate soils and depth to groundwater b) Infiltration testing at potentially suitable locations for infiltration c) Modeling of proposed project(s) effects d) Initial design report (10% design level) e) Engineering estimates for permitting, complete design, construction and operation f) Potential funding structure for AR use of surface water rights	2025-2026	$100,000	$250,000	$30,000
Task 3 **File Water Right Application**	Prepare and file a water right application using Task 2 information, provide support through application review process	2026	NA	$50,000	$5,000
Task 4 **CEQA Permitting**	Initiate and complete CEQA, assuming favorable outcome for water right application	2027	NA	$100,000	$10,000

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