level and the MT for monitoring wells in the MMA and for the four benchmark KRGSA monitoring wells are shown in Table 5-30.

Table 5-30. Recommended Water Quality MOs for MO1 and MO2

Water Quality MOs			
Monitoring Well ID	**Historic High Water Elevation (ft msl)**	**Recommended MT (ft msl)**	**Recommended MO (ft msl, ft bgs)**
M01	155	-10	72.5 ft msl (223.5 ft bgs)
M02	141	-3	69.0 ft msl (226.0 ft bgs)
RMW-037	202	9	105.5 ft msl (196.5 ft bgs)
RMW-042	191	-45	73.0 ft msl (217.0 ft bgs)
RMW-200	170	8	89.0 ft msl (203.5 ft bgs)
RMW-038	200	47	123.5 ft msl (193.4 ft bgs)

5.11.3 Margin of Operational Flexibility

The margins of operational flexibility for the water quality SMCs are defined in Table 5-31 for the BVGSA's monitoring wells in the MMA and for the KRGSA monitoring wells used as benchmarks. This operating zone is not expected to play an important role in management of groundwater quality.

Table 5-31. Margin of Operational Flexibility

Operating Zone Based on MTs and MOs				
Monitoring Well ID	**Ground Surface (msl)**	**MT (msl)**	**MO (msl)**	**Operating Zone (MO-MT) (ft)**
MO1	296	-10	72.5	82.5
MO2	295	-3	69.0	72.0
RMW-037	302	9	105.5	96.5
RMW-042	290	-45	73.0	118.0
RMW-200	293	8	89.0	81.0
RMW-038	317	47	123.5	76.5

5.11.4 Representative Monitoring

Monitoring of water quality SMCs in the MMA will be performed by bi-annual monitoring of groundwater levels in MO1 and MO2 and compliance with water quality-related regulatory programs such as the Irrigated Lands Regulatory Program.

5.12 Subsidence

KRGSP Section 3.3.5.1 Historical Land Subsidence 1900-1970 notes that in the southern KRGSA Agricultural MA, the area that contains the MMA, historical subsidence between one and nine feet has been documented, occurring over a period of about 1926 to 1970 with most of the subsidence occurring in the 1950s and 1960s. More recent JPL mapping between May 2015 and December 2016 indicates ground surface displacements of 4 to 8 inches, which are associated with the recent water level declines. As in other areas of the KRGSA, no damage to critical infrastructure has been identified and undesirable results do not appear to be occurring as of January 2015.

5.12.1 Minimum Thresholds

The SGMA regulations define the minimum threshold metric for significant and unreasonable land subsidence to be the "rate and the extent of land subsidence".

Avoidance of unreasonable subsidence is directly related to management of groundwater elevations and pumping rates. Unlike other sustainability indicators, the harmful effects of subsidence result from the damage it may cause to critical infrastructure and the costs of repairing or mitigating those damages. The MMA is small and not located near critical infrastructure. Nevertheless, the MMA adheres to the same management principal as the larger BMA of discouraging groundwater extraction from beneath the E-clay to avoid inducing subsidence.

As the MMA is located in the southwestern portion of the KRGSA's Agricultural MA, the MT for land subsidence in the MMA will be set following the guidelines applied for wells in the neighboring KRGSA management area. These MTs serve as a transition between the MTs set to the north in the KRGSA and those set to the south in the Wheeler Ridge Maricopa Water Storage District (WRMWSD). This transition is accomplished using by setting the MTs 20 feet below the historic low water levels as shown in KRGSP Table ES5-2: Summary Table of Undesirable Results Definition for the KRGSA. The numeric values for subsidence MTs at the MMA's representative monitoring wells and at the four KRGSA wells used as benchmarks are presented in Table 5-32.

Table 5-32. Recommended Subsidence MTs for MO1 and MO2 and Nearby Wells

Subsidence MTs		
Monitoring Well ID	**Recommended MT Elevation (ft msl, ft bgs)**	**Difference from Historic Low Water Level (ft)**
M01	20 ft msl (276 ft bgs)	-20
M02	27 ft msl (275 ft bgs)	-20
RMW-037	39 ft msl (263 ft bgs)	-20
RMW-042	-15 ft msl (305 ft bgs)	-20
RMW-200	38 ft msl (255 ft bgs)	-20
RMW-038	77 ft msl (240 ft bgs)	-20

In the KRGSA's Agricultural Management Area, the undesirable result for subsidence will be triggered when groundwater levels in 40 percent or more of the representative monitoring wells in the MA remain below the MT over a period of 2 years. Because of its location within the Agricultural Management area, this standard will be applied to the MMA with the result that an exceedance in either of the two monitoring wells will trigger an undersirable result.

5.12.2 Measurable Objectives and Interim Milestones

The MO for subsidence is defined in KRGSP Section 5.8.4.2 Southern and Eastern Agricultural MA as the average of the high groundwater elevation during the historical Study Period and the MT.Using this definition, the numeric values for subsidence MOs at the MMA's representative monitoring wells and at the four KRGSA benchmark monitoring wells are presented in Table 5-33.

Table 5-33. Recommended Subsidence MOs for MO1 and MO2

Subsidence MOs			
Monitoring Well ID	**Historic High Water Elevation (ft msl)**	**Recommended MT (ft msl)**	**Recommended MO (ft msl, ft bgs)**
M01	155	20	87.5 ft msl (208.5 ft bgs)
M02	141	27	84.0 ft msl (211 ft bgs)
RMW-037	202	39	120.5 ft msl (181.5 ft bgs)
RMW-042	191	-15	88.0 ft msl (202.0 ft bgs)
RMW-200	170	38	104.0 ft msl (188.5 ft bgs)
RMW-038	200	77	138.5 ft msl (178.4 ft bgs)

5.12.3 Margin of Operational Flexibility

No margin of operational flexibility has been established for subsidence due to the lack of observed subsidence in the MMA and of any established correlation between changes in groundwater elevation and inelastic subsidence. Should a correlation be developed that is applicable to the hydrogeologic conditions of the MMA, this may provide a basis for introducing a margin of operational flexibility.

5.12.4 Representative Monitoring

Subsidence monitoring in the MMA will be based on groundwater levels observed by the BVGSA at MO1 and MO2 supported by observations from other sources include data available from DWR's subsidence monitoring program. As noted above, the monitoring program will be refined based on final definition of the subbasin-wide objectives to be achieved and undesirable results to be avoided with respect to subsidence.

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6. Water Supply Accounting – Water Budget

6.1 Accounting for Total Water Use in SGMA

Careful accounting of water use is critical for developing a water budget of the accuracy needed to support sustainable groundwater management. While some elements of water use within the BVGSA are measured and can be used in a water budget with confidence, others are estimates that must be applied with care due to their uncertainty. The BVWSD has taken steps to reduce uncertainties related to quantification of water usage by installing magnetic flow meters on all production wells within the District and is also in the process of converting portions of its open ditch delivery system to pipelines, with magnetic flow meters being installed at each turnout. Both steps will improve water measurement within the District and will increase the accuracy with which flow paths fed by these deliveries, such as consumptive use by crops and wildlife refuges, can be estimated.

Water use is often grouped into two general categories: 1) consumptive use, and 2) non-consumptive use. These categories are discussed in Sections 6.2 and 6.3, below.

6.2 Consumptive Use

Consumptive uses, such as evapotranspiration (ET), remove water from the BVGSA and the Subbasin making it unavailable for other uses. This stands in contrast to non-consumptive uses, such as indoor domestic use, which may alter water quality but do not reduce the volume of available water.

6.2.1 Agricultural Use

By far, the greatest water use in the BVGSA is irrigated agriculture. Unlike measured water uses, agricultural consumption is estimated or inferred using a combination of two general methodologies described briefly below.

- Climate-based methods. These methods rely on measured evaporation (pan evaporation) or computed estimates of evapotranspiration based on factors such as temperature, solar radiation and wind speed to arrive at values for reference evapotranspiration (ETo), a parameter that represents consumption by a well-watered reference crop.

  Climate-based techniques then adjust ETo estimates by applying crop coefficients to arrive at evapotranspiration rates for individual crops (ETc) within a study area. ETc values can be computed on a seasonal basis or to target specific stages of crop development, and additional coefficients can be applied to further refine ETc estimates to represent a range of crops and growing conditions.

The climate-based approach is well documented in publications such as FAO Irrigation and Drainage Paper 56 (Allen, 1998, and is widely used in California where climatic data from the California Irrigation Management Information System (CIMIS) is frequently relied on as the foundation for ETc estimates. The method is subject to error introduced both in estimation of ETo and in adjusting ETo to ETc values representative of particular crops and growing conditions.

- Energy balance methods. These methods compute the actual volume of water evaporated from land surfaces and transpired by crops (ETa for ET actual) by sensing conditions that are surrogates for evapotranspiration. In the case of methods such as METRIC (Mapping EvapoTranspiration at high Resolution with Internalized Calibration), Basin-wide Remote Sensing of Actual Evapotranspiration and Its Influence on Regional Water Resources Planning (Howes, 2012) and Surface Energy Balance System (SEBS), (Zu, 2002), which compute ETa from thermal spectrum satellite imagery, the surface energy balance equation is used to compute latent heat flux (LE) which is then converted to ETa.

The energy balance method was used to estimate consumptive use in the BVGSA water budget and is described in greater detail in Section 6.5 - Water Budget Overview. Section 357.4 of the final regulations on Groundwater Sustainability Plans (GSPs) requires neighboring agencies to coordinate to ensure that the data and analysis methodologies used within a basin are compatible. To this end, GSAs within the Kern County Subbasin agreed to use ITRC-METRIC provided under a contract with the County of Kern as a common standard for estimation of evapotranspiration. The METRIC files contain monthly ETa estimates in the form of raster files that were used to determine monthly ETa within the boundaries of the BVGSA.

6.2.2 Environmental Use

As is the case with agricultural water use, environmental water use is largely consumptive, however, a greater proportion of environmental water use is evaporation from free water surfaces. Because the coefficients used to convert ETo values to plant-specific estimates of ETc for native vegetation are less thoroughly researched than for major agricultural crops, techniques that compute ETa directly, such as those relying on satellite imagery, are well-suited to determining water uses in refuges, duck clubs and other environmental settings.

6.2.3 Municipal, Domestic, and Industrial Use

For the purposes of the historical water budget, flow measurements from industrial users for 2013-2014 were averaged and these volumes used to estimate annual deliveries to be approximately 1,500 AF. As described below, a large proportion of this use is consumptive due partly to evapotranspiration of land applied wastewater.

Outdoor domestic and municipal water uses within BVGSA consist principally of landscape irrigation at homes, commercial properties, and parks. The sources of this water are the Buttonwillow County Water District (BCWD) and private wells. The evapotranspiration resulting from these consumptive uses is included in the evapotranspiration totals estimated using ITRC METRIC.

The amount of municipal and domestic water delivered by BCWD was estimated based on per capita consumption statistics in Kern County and census totals in the community of Buttonwillow. From 1991 through 2016, the average annual delivery was estimated to be 257 AF. Pumping data provided by the BCWD for 2017 and 2018 show groundwater production during those years to have been 298 AF and 210 AF respectively. Wastewater is collected by the BCWD for treatment at their wastewater treatment facility, a process that generates about 150 acre-feet of wastewater per year[4]. Data provided by the BCWD for 2018 shows a decline in the volume of treated wastewater to 105 AF for that year. The treated wastewater is applied to an adjacent 50-acre alfalfa field at a rate of 3 AF per acre. Because of the land application of wastewater and the use of municipal and domestic water for landscape irrigation, most municipal and domestic use is consumptive.

6.3 Non-consumptive Use

Non-consumptive uses, such as in-door domestic use, may alter water quality but do not reduce the volume of water available to the GSA or the Subbasin.

6.3.1 Municipal, Domestic, and Industrial Use

Non-consumptive uses include municipal, industrial, domestic, and commercial users, and standard coefficients can be applied to apportion water for each of these uses into consumptive and non-consumptive fractions. While indoor uses are often non-consumptive, this is not the case in the BVGSA due to the high proportion of the wastewater generated by indoor use that is consumed through application to land. Therefore, for the purposes of water use accounting, the volume of water attributed to non-consumptive uses is negligible.

6.4 Total Water Use

As detailed above, water used within the BVGSA is almost entirely delivered to meet the consumptive demands of agricultural, environmental, domestic and municipal uses. Deliveries originate from surface water supplied from the State Water Project and the Kern River and pumping from the principal aquifer system underlying the GSA.

Under the BVWSD's water rights to the Kern River, the District has diverted an average of 149,829 AF/yr[5], and the District's contract with the Kern County Water Agency (KCWA) entitles it to receive 21,300 AF/YR of Table A water from the State Water Project via the California Aqueduct. It should be noted that the volumes of water delivered to the District from its rights on the Kern River and its contract with the KCWA varies greatly depending on factors including water year type and has been decreasing in recent years. Table 6.1 provides the average deliveries, by location, for each of five water year types between 1993 and 2015.

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[4] https://www.waterboards.ca.gov/centralvalley/board decisions/tentative orders/0912/buttonwillow/buttonwillow wwtf wdr.pdf

[5] 156,000 AF/yr flow at 2nd Point x 96.044% BVWSD portion of 2nd Point flow

Table 6-1. Average Surface Water Deliveries by Water Year Type [1993-2015]

Source	Wet	Above Normal	Below[1] Normal	Dry	Critically Dry
California Aqueduct Turnouts	84,417	77,204	74,728	61,403	45,376
East Side Intake Canal	97,427	63,848	28,363	36,669	20,169
Total Surface Deliveries	181,843	141,052	103,091	98,072	65,546

[1] Within the period of record only two years were characterized as Below Normal. For one of these years, 2009, a flow of only 18,418 AF was recorded in the East Side Intake Canal. This single low value and the small number of years available to compute an average explains why the average Below Normal flow in the East Side Intake Canal is lower than the Dry year average.

The BVWSD is now in the process of improving the accuracy with which deliveries for all uses are measured. In parallel to improved measurement, the BVWSD has leveraged maturing technologies for measurement of ETa with ITRC-METRIC, as discussed in previous sections. The combination of increasingly accurate metering of deliveries to agricultural and environmental uses and increasingly accurate estimation of ETa will yield better estimates of consumptive uses.

6.5 Water Budget Overview

Section 354.18 – (Water Budget) of the Groundwater Sustainability Plan Emergency Regulations, states,

> Each Plan (GSP) shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.

To respond to the language of the regulations and to provide tools useful for management, this GSP includes a detailed water budget that describes the physical movement of water across GSA boundaries, accounts for changes in storage within the GSA and assesses factors that may affect flow paths captured in the water budget and resulting estimates of groundwater storage.

The BVGSA water budget covers an area that corresponds to the Buttonwillow Management Area (BMA). This area of 43,460 acres lies within the Kern River watershed and is characterized by heavy clay soils formed in the historic swamp and overflow lands on the northern fringe of Buena Vista Lake.

The water budget includes flow paths that represent surface water and groundwater flows within the GSA and across the GSA's boundaries. Historical BVWSD water budgets, together with other information on aquifer characteristics developed in Section 2.2 - Hydrogeologic Conceptual Model were used to quantify subsurface fluxes across the GSA boundaries.

6.5.1 Water Budget Structure

The water budget developed for the BVGSA uses a structure consistent with that recommended by DWR for basin-wide budgets and follows the basic water budget equation that is well suited to assessing historical, current and projected conditions:

Inflow - Outflow = Change in Storage

In accordance with SGMA Regulations and guidance provided in the Water Budget BMP (DWR, 2017), the BVGSA's water budget accounts for the total annual volume of groundwater and surface water entering and leaving the BVGSA by grouping inflows and outflows into four main categories:

- Total Surface Inflow;
- Total Groundwater Inflow;
- Total Surface Outflow; and
- Total Groundwater Outflow.

The water budget is based on historical water use within the BVGSA over a period extending from 1993 to 2015. This period captures a range of hydrologic conditions and aligns with the period of data available both from the ITRC-METRIC evapotranspiration data used to estimate ETa over the Kern County Subbasin and the groundwater modeling performed using the C2VSim platform (Todd Groundwater, 2019).

Selection of an analysis period represents one boundary condition for the water budget. A second boundary condition is the physical extent of the study area. In the case of the BVGSA, the water budget boundary conforms to that of the Buttonwillow Management Area because surface water inflows and outflows cross the BMA's boundaries at well-defined points of measurement while precipitation and evapotranspiration enter and leave the BMA from the land surface within the Agency's boundaries. As explained in Section 5 – Minimum Thresholds, Measurable Objectives and Interim Milestones, the BVGSA's second, smaller Management Area, the Maples Management Area (MMA), lies within the Kern River GSA, and the water budget of the MMA aligns with that of the larger KRGSA.

The water budget consists of two basic elements:

- A GSA water budget describing movement of water into and out of the boundaries of the BMA (GSA Component), and
- A groundwater budget describing movement of water into and out of the principal aquifer system underlying the BMA (Groundwater Component).

The objectives of accounting for inflows, outflows and changes in storage are to:

- Show whether the GSA is in surplus or deficit;

- Reveal flow paths important to achieving balance or that contribute to imbalances;
- Identify data gaps that compromise the accuracy or utility of the budget, and
- Aid in quantifying changes in groundwater storage.

Regardless of their complexity, water budgets are constructed as assemblages of flow paths with each path representing an inflow to or an outflow from the area being studied. Each flow path contains data that is subject to error. Therefore, understanding the uncertainty associated with both measured and calculated inflows and outflows is fundamental to constructing a reliable budget that can aid in achieving the objectives noted above. Table 6-2 presents the level of uncertainty associated with flow paths central to the two budget components.

Table 6-2. Selected Water Budget Flow Paths and Representative Levels of Uncertainty

Parameter	Source	Location	Uncertainty
Surface water inflows	Measured	Kern River, SWP	+/-5%
Landowner pumping	Closure term (now metered)	BMA irrigated area	+/- 25% (5%)
Reclamation/District/Landowner Pumping (to distribution system)	Metered	BMA area	+/- 5%
Precipitation	CIMIS data	BMA surface area	+/- 15%
Canal seepage	Calculated by District	Canal prisms	+/- 20%
Evapotranspiration	ITRC Metric	BMA area	+/- 15%
Deep percolation	District Estimates, Soil Moisture Analysis	BMA area	+/- 10%
Subsurface inflows and outflows (flux)	Closure term	BMA boundaries	+/- 25%
Change in storage	Calculated	BMA area	+/- 25%

The BVWSD has taken steps to reduce the uncertainty of inputs to future water budgets by installing magnetic flow meters on all wells within the District and on turnouts as the District converts portions of its open ditch delivery system to pipelines. It should be noted that the water budget for this GSP does not include measured discharges from privately-owned wells, as meter data from these wells is not available for the period from 1993 to 2015. However, this data will be available for updates of this GSP and will be particularly valuable as pumping from landowner wells is typically not metered or reported. Thus, unlike many areas, the BVGSA's access to metered values for both district-owned wells and private pumping will enable these flow paths to be input explicitly into the water budget rather than being approximated based on power usage or inferred from other data.

As the period of record for metered groundwater pumping and surface water delivery data increases, the error associated with these flow paths will decline. Similarly, use of groundwater modeling and continuing analysis of hydrogeologic data is expected to improve understanding of hydrogeologic parameters and increase the accuracy of estimated changes in groundwater storage and volumes of subsurface flux across GSA boundaries.

A parallel process to assessing the uncertainty of input flow paths is selection of the closure term, the flow path used to balance water budgets. The closure term is the term where measured or calculated inputs are either unavailable or have the greatest level of uncertainty. Therefore, water budgets typically have one of the two following structures:

- Budgets where all inflows and outflows are known with reasonable confidence have a conventional structure where inflow – outflow = change in storage and the budget closes on change in storage.
- Budgets where it is assumed there is no long-term change in storage or where change in storage can be estimated with greater confidence than one of the inflow or outflow parameters can be structured so that change in storage becomes an input and the budget closes on the most uncertain inflow or outflow term. For this type of budget, typical closure terms include subsurface cross boundary flow, or groundwater pumping from unmetered wells.

In the case of the BVGSA, due to the uncertainties associated with quantifying both groundwater fluxes and changes in storage, two estimation methods were compared as described in Appendix G - Closure Terms for Buena Vista GSA Water Budget:

- Method 1: uses data from various sources to estimate inflows to and outflows from the principal aquifer. The result of these computations (closure term) is an estimate of change in groundwater storage
- Method 2: uses data including changes in groundwater elevations to explicitly compute change in storage. The result of this series of computations is an estimate of net groundwater flux.

The two approaches yield similar average annual values for change in storage and groundwater flux which were compared with output from the C2VSim model under development for the Kern County Subbasin. However, Method 1, estimation of change of storage as a closure term, was determined to provide the most realistic water budget structure.

In addition to use in evaluating the water budget structure, results from C2VSim modeling have been applied to analyze how conditions such as climate change, operation of groundwater banks and introduction of new recharge facilities may affect future groundwater conditions.

6.6 Water Budget – GSA Component

Following SGMA regulations and the Water Budget BMP (DWR, 2017), the GSA Component of the water budget is divided into the following elements: surface inflows, subsurface inflows, surface outflows, subsurface outflows, and change in storage. This section will explain the methods used to develop the GSA component and summarize the annual volumes for each element of the GSA Component of the component. A schematic diagram for the GSA Component is shown below in Figure 6-1.

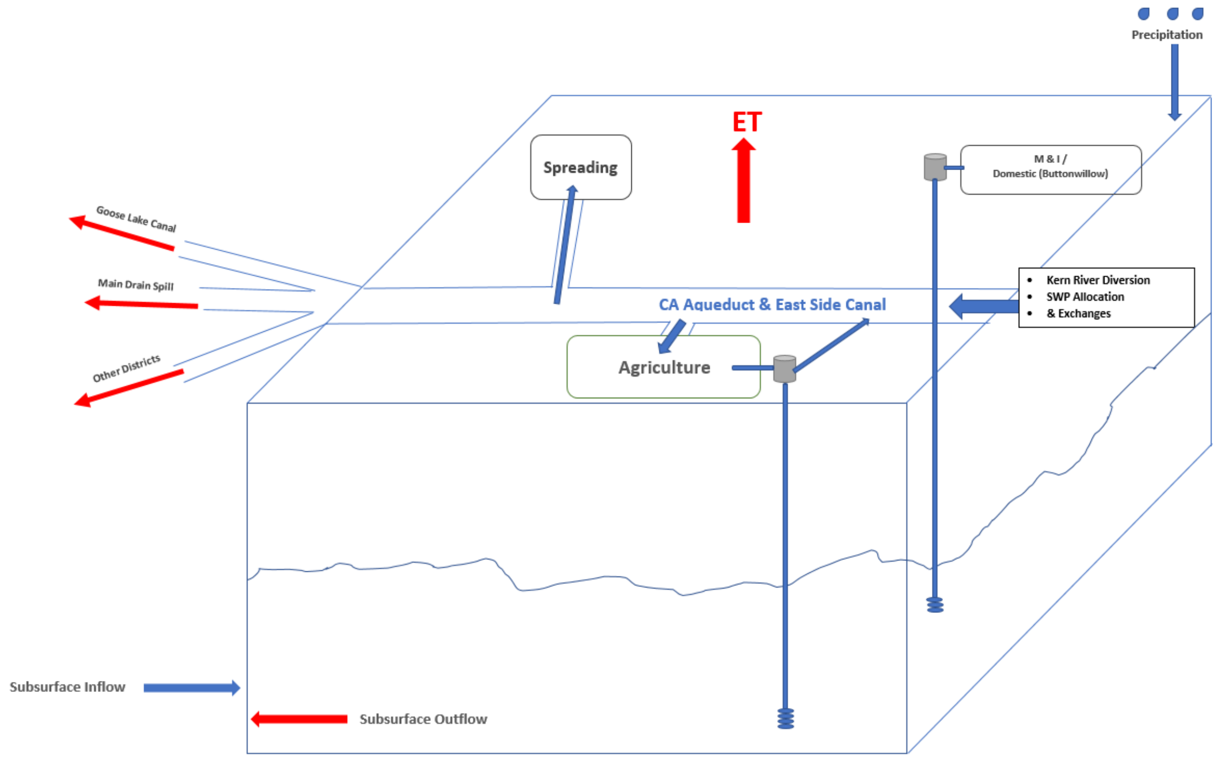

Figure 6-1. Water Budget Schematic – GSA Component

As noted above, historical data from 1993 through 2015 were used to develop the GSA Component. Whenever available, water budget inputs were drawn from direct measurements of flow paths leading to or from the BMA. For parameters that are not directly measured, estimates or inferences were made based on previous studies or deduction.

6.6.1 GSA Component Inflows

Inflows to the BMA include any water that enters the BMA either above or below the ground surface. Inflows include surface water from the Kern River and the California Aqueduct, precipitation and subsurface groundwater inflows from neighboring areas in the Kern County Subbasin.

6.6.1.1 Surface Water Inflows

Surface water inflows include:

- Kern River water delivered directly via the East Side Canal and indirectly by exchange via California Aqueduct turnouts;
- State Water Project water delivered to the BMA from California Aqueduct turnouts;

- CVP Friant-Kern Unit, transfer or exchange water delivered via either the East Side Canal or CA Aqueduct turnouts, and
- Precipitation – average annual precipitation of 6.85 inches according to nearby CIMIS stations.

As no rivers or streams cross the boundaries of the BVGSA, surface water inflows are restricted to water delivered from the sources listed above.

The BVGSA receives surface water from the Kern River (delivered at the East Side Canal), from the State Water Project via the California Aqueduct (diversions at turnouts; BV-1B , BV-2, BV-6, BV-8, B-3, HM-1 and the turnout to a 120” pipeline conveying water through the BVGSA to the Semitropic WSD) and occasionally through exchanges or transfers from neighboring districts conveyed across the GSA boundaries via the East Side Canal and the California Aqueduct. The two main sources of surface water are Kern River and SWP Table A water, with average annual diversion and contract allocations summarized in Table 6-3.

Table 6-3. Kern River Diversions and State Water Project Allocations

Type	Source	Diversion or Allocation
Local Surface Water	Kern River	158,000 AF/YR
Imported Surface Water	SWP – Table A	21,300 AF/YR
Imported Surface Water	SWP – Article 21	3,750 AF/YR
Total Diversion or Allocation	Kern River / SWP	183,050 AF/YR

Although the BVWSD diverts an average of 158,000 AF/YR from the Kern River and is entitled to receive 25,050 AF/YR of combined Table A and Article 21 water from the California Aqueduct, diversions from the Kern River fluctuate due to hydrologic conditions and allocations of SWP water seldom meet contracted entitlements. For this reason, annual deliveries measured and reported by the BVWSD were used as inputs for the water budget. All deliveries from the Kern River and the California Aqueduct are measured at the points of delivery. Table 6-4 below shows surface water inflows from 2006 - 2015. Figure 6-2 shows longer-term trends in surface water deliveries (1993 through 2015).

Table 6-4. Measured Surface Water Deliveries to BMA [2006-2015]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
California Aqueduct (AF)	74,465	59,668	53,085	72,020	60,975	78,631	62,642	47,857	12,799	10,957
East Side Canal (AF)	97,955	47,914	34,549	18,418	66,441	98,416	45,173	-	-	-

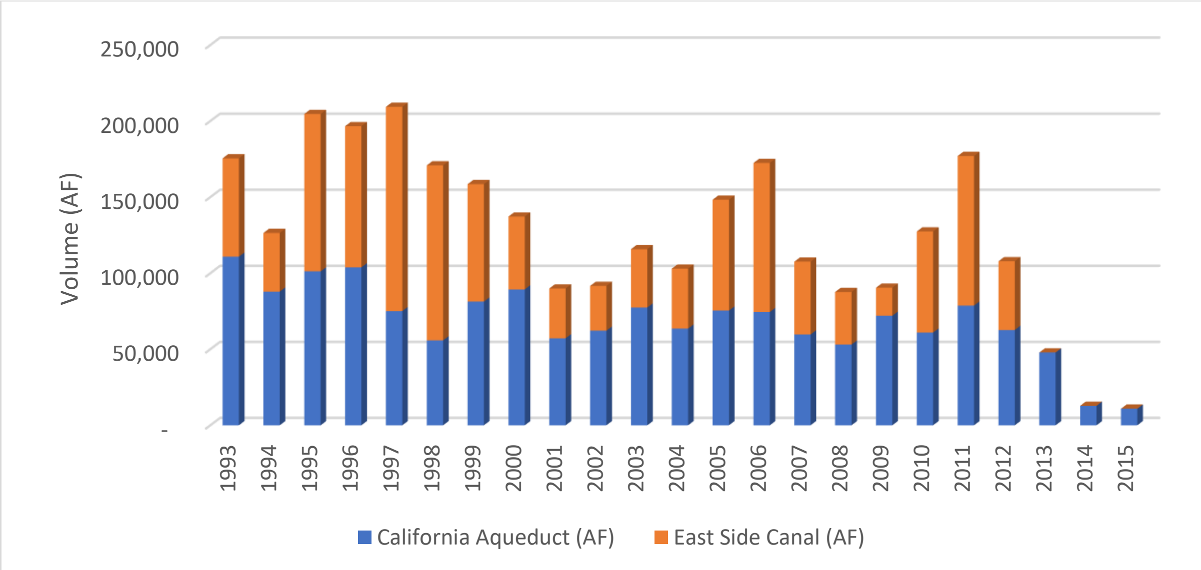

Figure 6-2. Measured Surface Water Deliveries to the BMA [1993-2015]

In addition to measured deliveries from the Kern River and the California Aqueduct, the BVGSA's other source of surface inflow is precipitation. Precipitation data was taken from the nearest operating California Irrigation Management Information System (CIMIS) station for each year. The closest CIMIS station to the BVGSA is Belridge (Station #146), and data from this site was used for the period extending from 1999 through 2015. Precipitation data for the remaining years (1993 through 1998) was taken from the second closest station, Shafter (Station # 5). CIMIS data provided yearly precipitation (inches), and the acreage of the BMA was used to convert these values to the equivalent volume of water in acre-feet. Table 6-5 presents a summary of precipitation to the BMA from 1993 through 2015.

Table 6-5. Precipitation Inflows to the BMA [1993 - 2015]

Year	BMA Precipitation (AF)	Station
1993	26,450	Shafter
1994	27,566	Shafter
1995	38,269	Shafter
1996	30,608	Shafter
1997	22,138	Shafter
1998	52,707	Shafter
1999	23,639	Belridge
2000	16,093	Belridge
2001	26,796	Belridge
2002	18,365	Belridge
2003	30,762	Belridge
2004	24,910	Belridge
2005	28,683	Belridge
2006	27,759	Belridge
2007	12,628	Belridge
2008	22,215	Belridge
2009	20,598	Belridge
2010	41,118	Belridge
2011	41,426	Belridge
2012	18,827	Belridge
2013	10,126	Belridge
2014	10,395	Belridge
2015	21,291	Belridge

Precipitation and temperature data recorded for the Community of Buttonwillow at Western Regional Climate Center NOAA Cooperation Station 041244 are presented below.

- Average annual precipitation - 5.64 inches
- Minimum monthly precipitation - 0.02 inches (July)
- Maximum monthly precipitation -1.07 inches
- Minimum monthly temperature - 34.5^{o} F
- Maximum monthly temperature - 98.4^{o} F

6.6.1.2 Groundwater Inflows

Groundwater inflows to the BMA include deep percolation from precipitation, managed recharge, canal seepage, and deep percolation from irrigated agriculture in addition to subsurface groundwater inflow from neighboring locations in the Kern County Subbasin. The methods used to estimate the sources of groundwater inflows rely on District data and water budgets, groundwater modeling, and spreadsheet models.

Of these groundwater inflows, the greatest uncertainty surrounds the lateral inflow and outflow of groundwater (flux). Due to this uncertainty, two approaches for estimating subsurface inflows and outflows were applied and the results of the approaches were then compared. As discussed in the introduction of Section 6.5 – Water Budget Overview, the technical memo "Closure Terms for Buena Vista GSA Water Budget", found in the Appendix G, discusses the two approaches in detail.

Table 6-6 provides a summary of the results from the methods used to estimate subsurface flux. Positive values correspond with net groundwater inflow and negative values correspond with net groundwater outflow. The period considered for this analysis is 1995 – 2014, the same range as the C2VSim groundwater modeling effort.

Table 6-6. Subsurface Flux in BMA [1995 - 2014]

	GEI	Todd GW Model	Sierra Scientific
1995	(5,449)	(75,981)	(32,364)
1996	(5,226)	(65,329)	(32,364)
1997	636	(68,939)	(32,364)
1998	(22,835)	(73,279)	(32,364)
1999	11,552	(39,992)	(32,364)
2000	(30,029)	(19,811)	(32,364)
2001	31,258	(15,408)	(32,364)
2002	(7,828)	(9,289)	(32,364)
2003	(7,714)	(5,362)	(32,364)
2004	(20,191)	(2,598)	(32,364)
2005	44,044	(17,192)	(32,364)
2006	1,075	(24,574)	(32,364)
2007	(39,935)	(4,940)	(32,364)
2008	(82,443)	5,493	(32,364)
2009	(10,578)	1,598	(32,364)
2010	5,388	(22,553)	(32,364)
2011	(65,097)	(47,420)	(32,364)
2012	10,626	(18,922)	(32,364)
2013	35,782	15,709	(32,364)
2014	(6,051)	31,474	(32,364)
total [1995-2011]	(203,371)	(485,576)	(550,188)
total [1995-2014]	(163,014)	(457,316)	(647,280)
avg [1995-2011]	(11,963)	(28,563)	(32,364)
avg [1995 - 2014]	(8,151)	(22,866)	(32,364)
maximum [1995 – 2014]	44,044	31,474	NA
minimum [1995 – 2014]	(82,443)	(75,981)	NA
Difference [1995 – 2014]	126,487	107,455	NA
standard deviation [1995 – 2014]	30,721	30,233	NA

****** Assumes specific yield of 0.15 applied in GEI estimate of flux***

Note that subsurface flux can either be subsurface inflow (positive) or subsurface outflow (negative). Figure 6-3 shows total inflows to the BMA portion of the BVGSA by source.

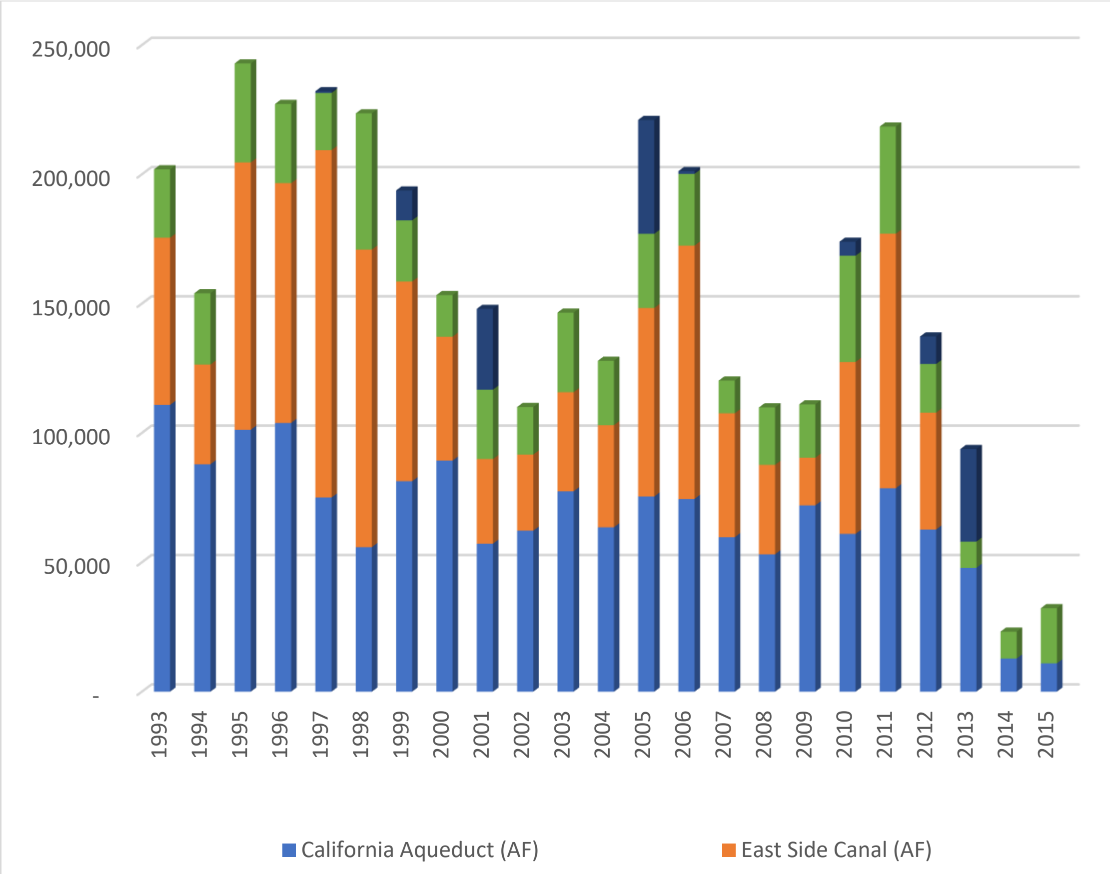

Figure 6-3. Total Inflows to the BMA by Source [1993 - 2015]

6.6.2 GSA Component Outflows

Outflows from the BMA include any water that leaves the boundaries of the Management Area either above or below the ground surface. Outflows include surface water flow paths such as canals and drains, subsurface groundwater outflow to neighboring areas in the Kern County Subbasin and evapotranspiration.

6.6.2.1 Surface Water Outflows

Surface water outflows include:

- Goose Lake Canal (deliveries to Kern National Wildlife Refuge),
- Main Drain Canal north of Hwy 46, and
- Surface flows that leave the BVGSA through defined channels (Semitropic Canal, West Side Canal) for delivery to neighboring districts.

Historically, the BVWSD has historically had large surface water outflows in both the Kern River Flood Channel Canal and in the Main Drain Canal. However, there have been no outflows in the Main Drain Canal since 2013 due to the following:

- reduction in drainage water due to conversion from row crops irrigated using gravity methods to permanent crops irrigated using low-volume drip irrigation;
- compliance with the ILRP encouraged reuse of drainage water, and
- compliance with SB7x7 caused the District to introduce volumetric water pricing in 2013. This action has achieved its intended purpose by encouraging growers to conserve water by reducing applications.

In spite of the extremely wet conditions in 2017 and 2019 and a reduction in storage capacity in Isabella Dam, no water flowed to the Kern River/SWP Intertie and none was carried in the Kern River Flood Channel Canal north of Highway 46. This was the result of:

- capture of Kern River water by water banking facilities within the BVWSD, and
- capture of Kern River water by banking facilities operated by other districts.

Surface water outflow data was taken from measurements reported in the BVWSD's annual Water Distribution Summaries for the years 1993 through 2015. Figure 6-4 provides a summary of surface water outflows by source. The average annual surface water outflow for this period from all BVGSA sources is estimated to be 37,740 AFY.

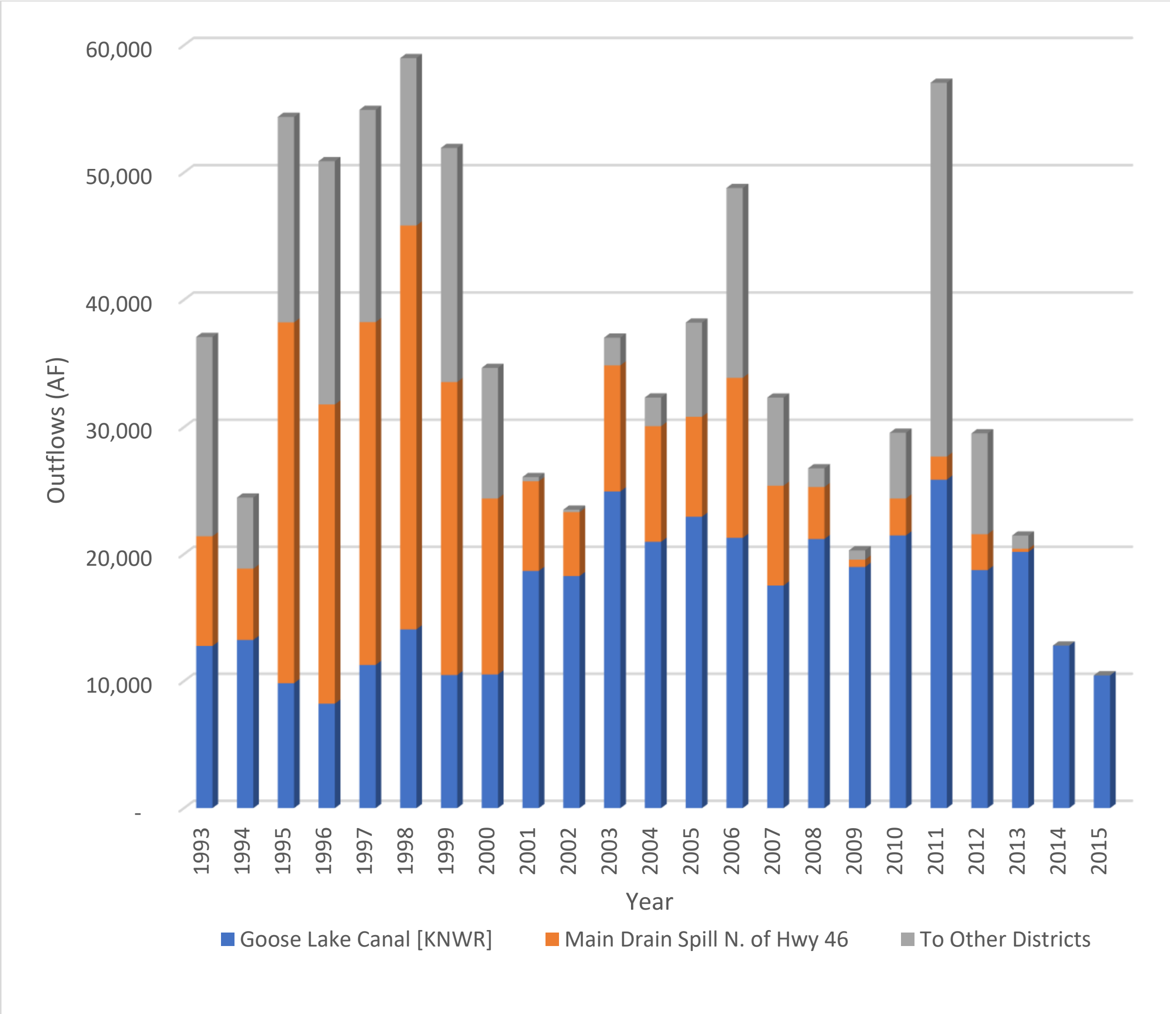

Figure 6-4. Surface Water Outflows from the BMA by Destination [1993 - 2015]

6.6.2.2 Groundwater Outflows

Groundwater outflows are either

- Pumping for agricultural, municipal, domestic and industrial uses, or
- Subsurface groundwater outflow.

Due to the recent installation of meters on all production wells, historical pumping was estimated using a water budget that considered known values for supply and demand to close on unmetered pumping. Subsurface fluxes across the boundaries of the BMA were estimated as the water budget closure term with negative fluxes designating outflows.

6.6.2.3 Evapotranspiration

By far the greatest flow path for water to leave the BVGSA is evapotranspiration by irrigated lands, native vegetation and open water surfaces. This consumptive use is fueled by both surface water and groundwater inflows into the BMA. Elements of evapotranspiration include:

- Consumptive use of surface water by agricultural and environmental users including managed habitat and duck clubs;
- Consumptive use of groundwater by agricultural and environmental users including managed habitat and duck clubs. Consumptive use of groundwater by the Buttonwillow County Water District and other domestic and M&I users

Evapotranspiration from the BMA was estimated using a combination of the climate-based and the energy balance methods introduced in Section 6.2. The surface energy balance equation can be expressed as:

$$LE = Rn - G - H$$

where Rn is net radiation at the surface; G is the soil heat flux; H is the sensible heat flux; and LE is calculated as a residual of the energy balance and then converted to ETa as a rate (typically mm/hour).

Satellite imagery-based energy balance methods require accurate satellite mapping of Rn from zones of the thermal radiation spectrum characteristic of vegetative activity and an understanding of the agronomic variables in a region. LandSAT Thermal Mapper images are the most common source of this imagery.

For the Buena Vista GSP, ITRC-METRIC, developed by the California Polytechnic State University's Irrigation Training and Research Center (ITRC), was used to estimate evapotranspiration. This method combines the climate-based and energy balance methods which allows ETa estimates from LandSAT imagery to be corrected with hourly climate data collected from surrounding CIMIS stations. This combined dataset is then refined with cloud masking techniques, QA/QC of hourly weather data, digital elevation maps, corrected grass reference ETo maps, and DWR land use data. In addition, land use data from the National Agricultural Statistics Service (NASS) was used to refine crop canopy aerodynamic resistance.

The temporal component of the water budget analysis for BVGSA is confined to the period for which ITRC-METRIC evapotranspiration data is available: 1993 through 2015. It should be noted that no data was available for 2012 due to a gap between the decommissioning of LandSAT 5 and the launch of LandSAT 8. To fill this gap, METRIC outputs from 2011 and 2013 were averaged and applied as a surrogate for the 2012 data based on the assumption that cropping patterns for 2011 and 2013 were representative of those for 2012.

The Buena Vista GSP also relies on ITRC-METRIC evapotranspiration data to estimate non-agricultural evapotranspiration using the same combined climate and energy balance approach applied to agricultural lands. The BVGSA has approached the ITRC to serve as a consultant to compare METRIC estimates of ETa with metered deliveries beginning in 2017 when the BVWSD completed metering of all production wells in the GSA.

Figure 6-5 summarizes the amount of evapotranspiration by all land uses within the BVGSA.

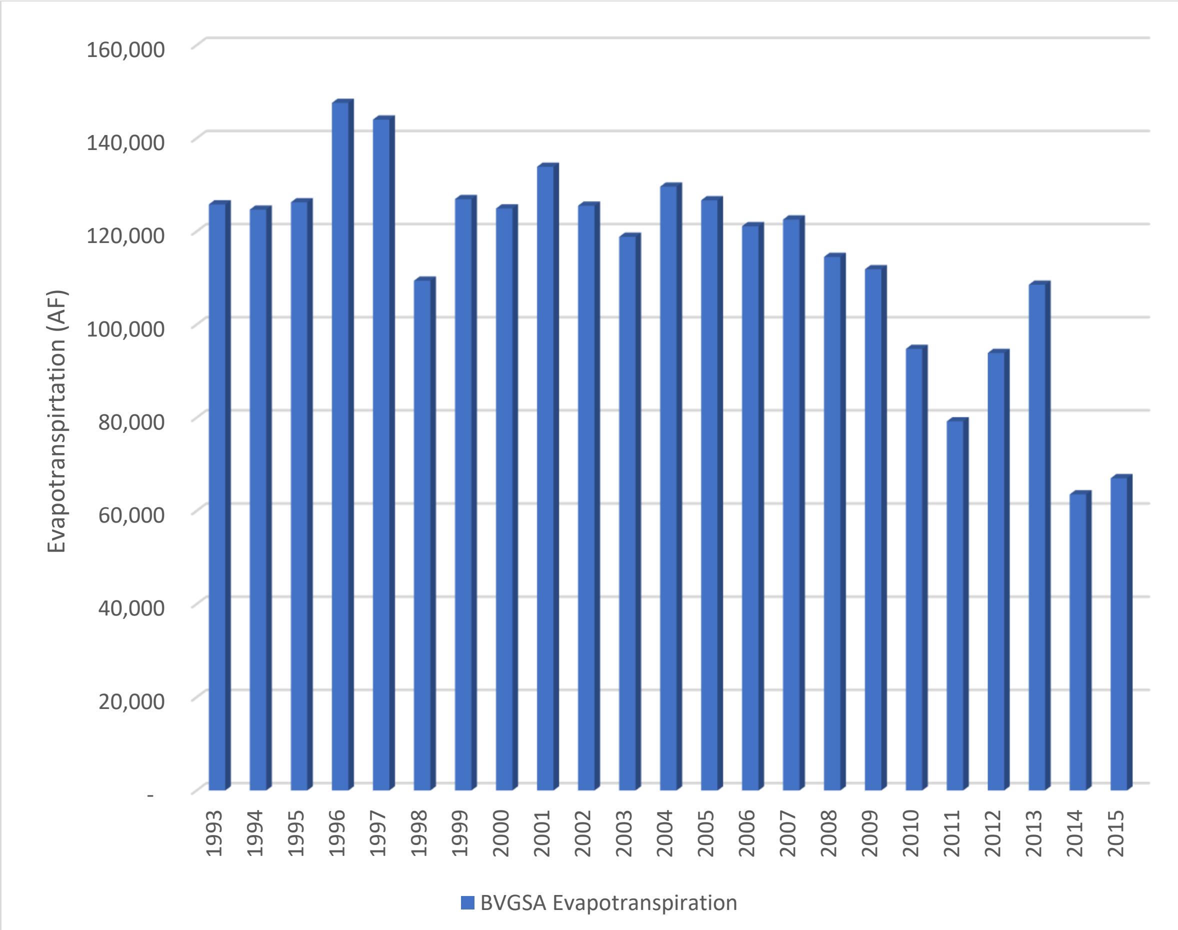

Figure 6-5. Evapotranspiration from the BMA [1993 - 2015]

The ITRC-METRIC data shows high ETa values in 1996 and 1997 and a decline in ETa from 2009 forward. The patterns observed in the annual ETa estimates are addressed in the report *1993-2015 ITRC-METRIC ETc for Kern County (*Irrigation and Training Research Center, July 2017), which was prepared for the Kern Groundwater Authority. The following is an excerpt from the report:

> Visually, significantly more non-cropped fields can be seen in 2015 than in 1993. Portions of Lost Hills Water District and Buena Vista WSD show much lower ET in 2015 than 1993. These areas were fallowed or not cropped during the drought. In other areas, young permanent crop plantings may be the cause of lower ET.
>
> While there is no definitive explanation for the variation in ETa values, a plausible reason stems from changes in cropping patterns (particularly new plantings of pistachios having very low water demands) and variations in weather. For example, 2011 had a cool growing season while 2013-2015 were drought years associated with higher levels of fallowing, delayed planting, low consumptive use by young orchards, deficit irrigation and less evapotranspiration from weeds than would be found in wetter years.

Figure 6-6 provides a summary of all BMA outflows by destination. This includes water that leaves via a defined channel, as evapotranspiration, or laterally as subsurface outflow. It should be noted that net outflow via the Goose Lake Canal is now zero.

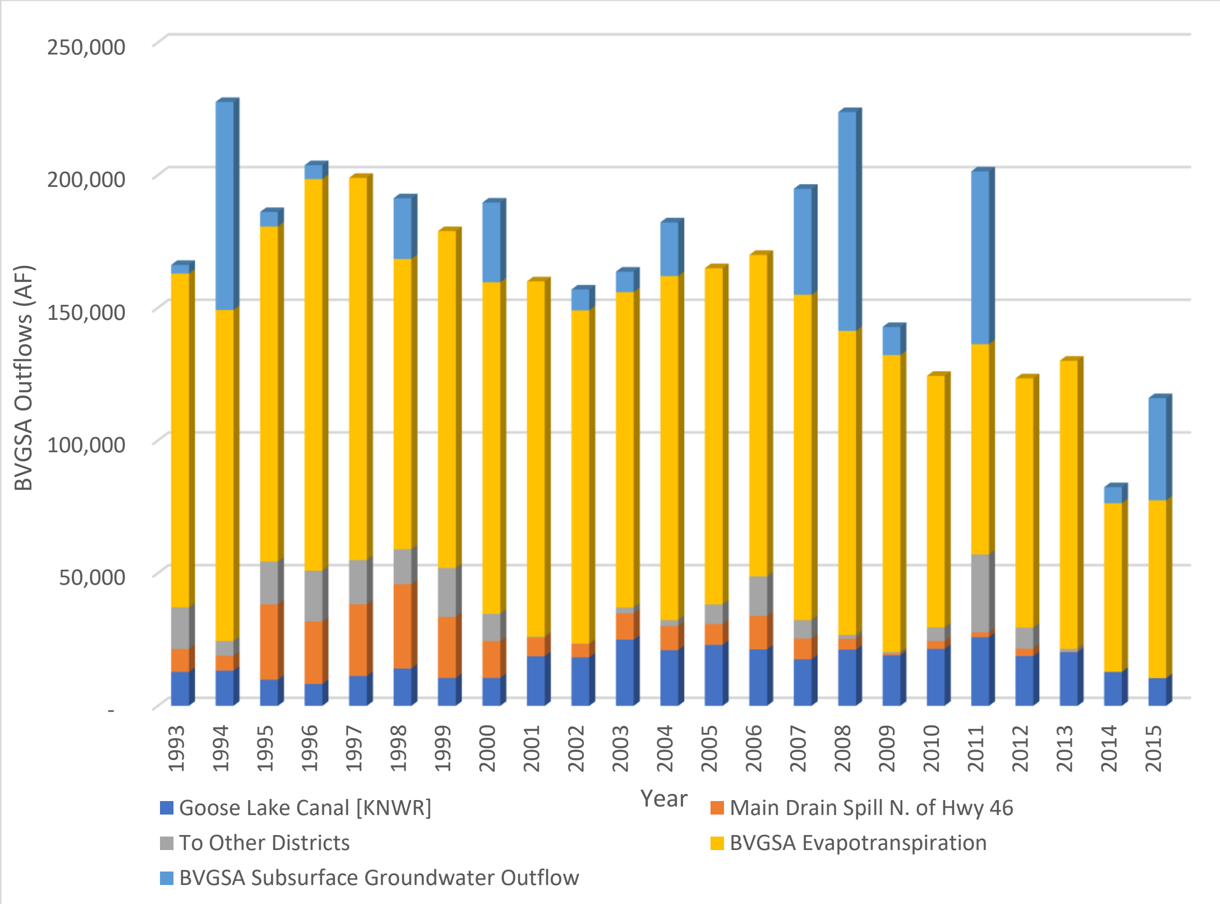

Figure 6-6. Total Outflows from the BMA by Destination [1993 - 2015]

6.6.3 Change in Storage

Because there is no surface water storage available to the BVGSA, all changes in storage occur in the aquifers underlying the GSA. Change in storage was estimated based on groundwater elevations observed in the BMA and an estimated average specific yield of the principal aquifer system of 0.15. Appendix G – Closure Terms for Buena Vista GSA Water Budget describes the methodology used to estimate change in storage. C2VSim modeling of the Kern County Subbasin (Todd, 2019) is available to refine estimated changes in groundwater storage, and included in Appendix H.

6.7 Water Budget – Groundwater Component

The Groundwater Component of the water budget is nested within the GSA Component and is designed to capture movement of water into and out of the aquifer system underlying the BMA. Figure 6-7 is a schematic diagram of the Groundwater Component.

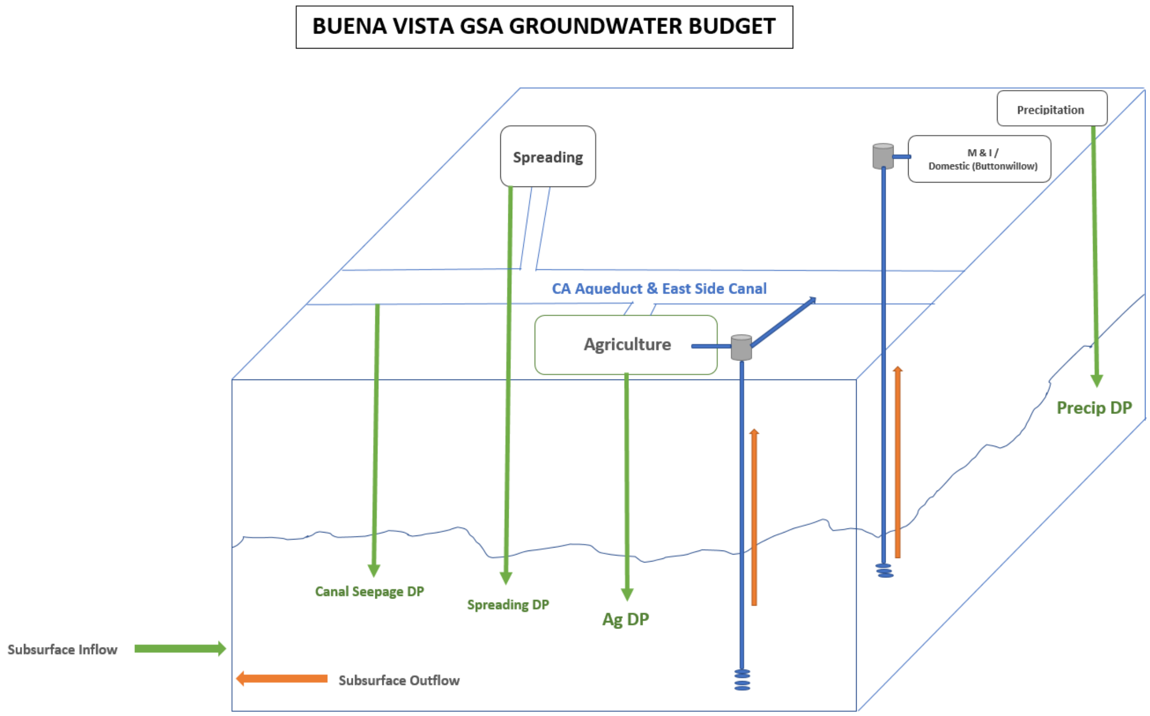

Figure 6-7. Water Budget Schematic – Groundwater Component

6.7.1 Groundwater Component Inflows

Inflows to the aquifer system underlying the BVGSA include both lateral subsurface inflows from neighboring areas and inflows that originate from infiltration of surface water that has entered the GSA via precipitation and surface water from the Kern River and the California Aqueduct. The flow paths taken by surface water to reach groundwater include: seepage from unlined canals, recharge from dedicated recharge facilities, and deep percolation of precipitation and applied irrigation water.

The period from 1993 through 2015 spans a range of hydrologic conditions which are reflected in the range of annual volumes of precipitation and deliveries of surface water captured in the GSA Component. This period also spans a time of changing farming practices as cropping patterns shifted from row crops to permanent crops. The shift in cropping was accompanied by a change in irrigation practices from surface irrigation techniques typical of row crops such as cotton and forage crops to low-volume drip and micro-spray techniques typical of permanent crops such as pistachios and grapes. Although the soils characteristic of the BMA restricts deep percolation of applied irrigation water, the change in irrigation practices has further reduced the proportion of applied water that leaves the field as deep percolation, a change represented in the Groundwater Component.

6.7.1.1 Surface Water Inflows

Two methods were evaluated to estimate the volume of deep percolation from precipitation, one based on Kern County Water Agency (KCWA) data and a second, analytical approach used to verify the KCWA method.

- KCWA approach: This approach applies estimates of historical effective precipitation presented in the KCWA's most recent published Water Supply Report (KCWA, 2011). Table 15 of this report presents annual values for effective precipitation over a period from 1970 through 2011 with an average of these annual values of 2.36 inches per acre. One third of the effective precipitation, 0.78 inches, was then assumed to percolate to groundwater giving an average annual contribution of approximately 3,000 AF.
- Analytical approach: The analytical approach consists of the following steps.
  - Assume 10 percent runoff for all rain events
  - Because most rain events occur outside of the irrigation season, a 35 percent Available Moisture Content was assumed for the end of the irrigation season.
  - NRCS soil mapping (Figure 6.8) was used to determine prominent soil types and develop estimates of the soil moisture holding capacity per foot of rooting depth. This assessment yielded an Available Moisture Holding Capacity of 2.2 inches per foot of rooting depth.
  - Cropping data provided by the BVWSD for 2013, 2014 and 2015 was used to estimate the average rooting depth of the cropping patterns. This analysis resulted in an average rooting depth of 4.5 feet
  - The average rooting depth and the average Available Moisture Holding Capacity were used to estimate an average Available Water Holding Capacity of the typical crop root zones of 9.85 inches.
  - Deep percolation of precipitation was calculated based on the assumption that precipitation exceeding the available root zone storage would flow to deep percolation. Table 6.7 shows the table used for this analysis, and Figure 6-9 displays these annual deep percolation values which average 2,687 AF per year (approximately 0.74 inches/acre).

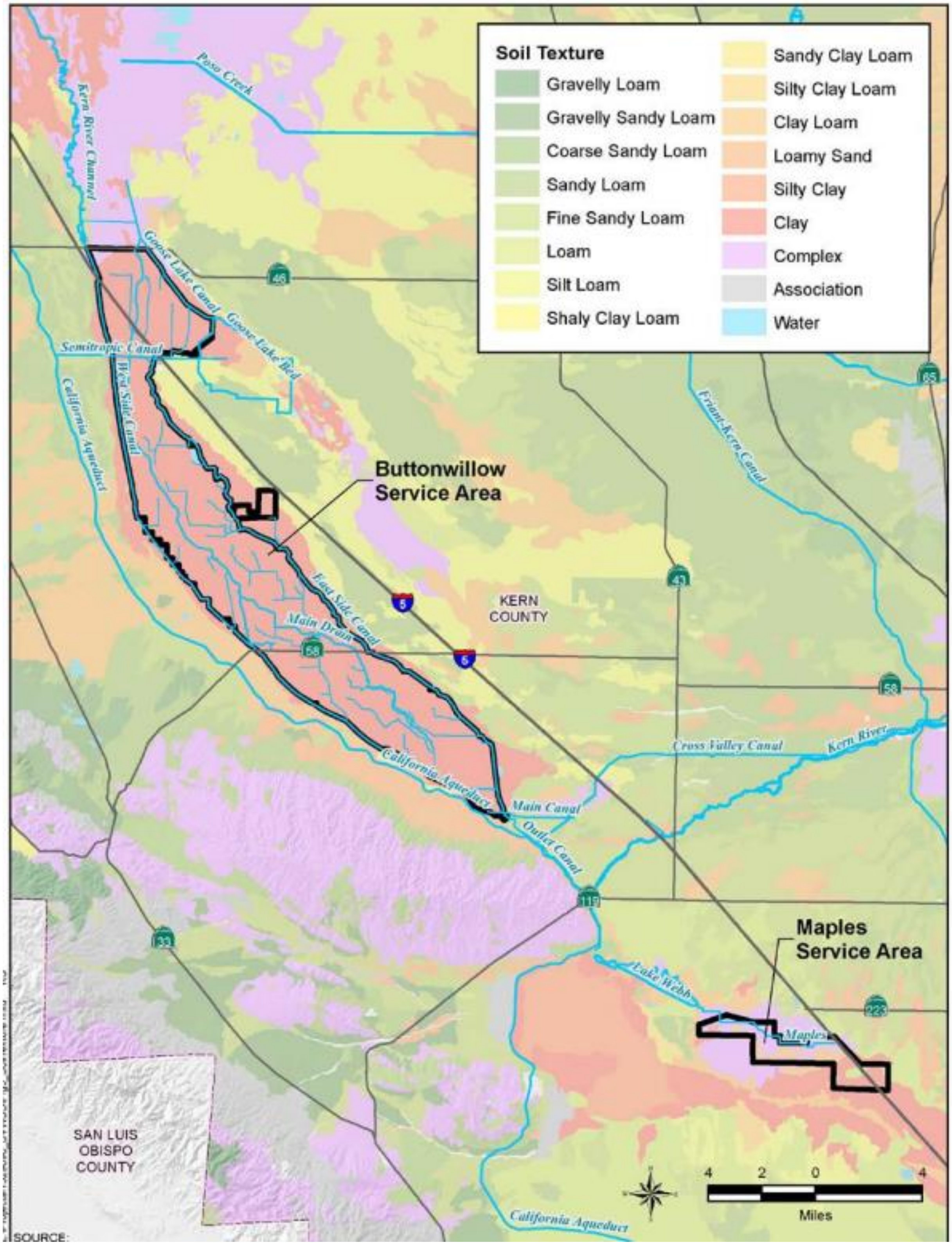

Figure 6-8. Soils Map for BVGSA

Table 6-7 Deep Percolation of Precipitation Analysis

Year	Root Zone AWHC (inches)	Available Storage @ MAD (inches)	Precipitation (inches)	Precipitation (less runoff) (inches)	Deep Percolation [Precipitation - Average Storage] (inches)	Remove Negatives (inches)	Estimated DP (AF)
1991	9.85	6.40	7.42	6.68	0.28	0.28	1,004
1992	9.85	6.40	7.35	6.62	0.21	0.21	774
1993	9.85	6.40	6.87	6.18	-0.22	0.00	-
1994	9.85	6.40	7.16	6.44	0.04	0.04	151
1995	9.85	6.40	9.94	8.95	2.54	2.54	9,265
1996	9.85	6.40	7.95	7.16	0.75	0.75	2,741
1997	9.85	6.40	5.75	5.18	-1.23	0.00	-
1998	9.85	6.40	13.69	12.32	5.92	5.92	21,558
1999	9.85	6.40	6.14	5.53	-0.88	0.00	-
2000	9.85	6.40	4.18	3.76	-2.64	0.00	-
2001	9.85	6.40	6.96	6.26	-0.14	0.00	-
2002	9.85	6.40	4.77	4.29	-2.11	0.00	-
2003	9.85	6.40	7.99	7.19	0.79	0.79	2,872
2004	9.85	6.40	6.47	5.82	-0.58	0.00	-
2005	9.85	6.40	7.45	6.71	0.30	0.30	1,102
2006	9.85	6.40	7.21	6.49	0.09	0.09	315
2007	9.85	6.40	3.28	2.95	-3.45	0.00	-
2008	9.85	6.40	5.77	5.19	-1.21	0.00	-
2009	9.85	6.40	5.35	4.82	-1.59	0.00	-
2010	9.85	6.40	10.68	9.61	3.21	3.21	11,691
2011	9.85	6.40	10.76	9.68	3.28	3.28	11,953
2012	9.85	6.40	4.89	4.40	-2.00	0.00	-
2013	9.85	6.40	2.63	2.37	-4.04	0.00	-
2014	9.85	6.40	2.70	2.43	-3.97	0.00	-
2015	9.85	6.40	5.53	4.98	-1.43	0.00	-
2016	9.85	6.40	9.08	8.17	1.77	1.77	6,445
Average							2,687

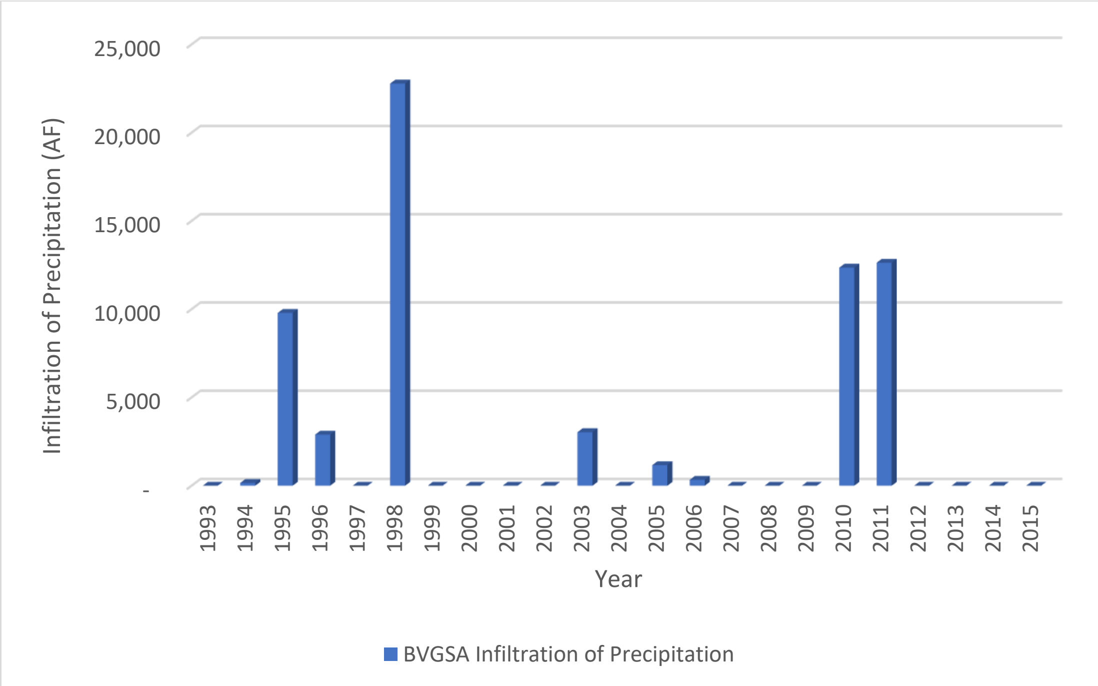

Figure 6-9. Annual Infiltration of Precipitation to Groundwater in BMA

6.7.1.2 Groundwater Inflows

As noted above, in addition to the contribution of precipitation to the groundwater system, there are other flow paths that convey surface water entering the BVGSA to groundwater. These flow paths are essential for operation of the BVWSD's conjunctive management program and include seepage from unlined canals, deep percolation of irrigation water applied to fields, and infiltration from dedicated groundwater recharge facilities.

Canal seepage

Canal seepage totals are based on data from the Water Distribution Summaries (Appendix I) provided by the BVWSD from 1993 through 2015. The District's estimates of canal seepage rates are supported by an audit performed in 2017 by the U.S. Bureau of Reclamation on the Angelo Canal, Water Conservation Verification of BVWSD Canal Piping Project (USBR, 2017), which determined that the method used for estimating seepage by the District was reliable at a 90 per percent level of confidence. Figure 6-10 displays the annual distribution of canal seepage within the BVGSA. As shown in Figure 6-10, seepage from unlined canals varies with hydrologic conditions ranging from 55,360 AF in 1995 to zero in 2014 and 2015, two years when the BVWSD received no Kern River water and relied on stored groundwater to satisfy irrigation demands. The average annual rate of canal seepage is 31,140 AF.

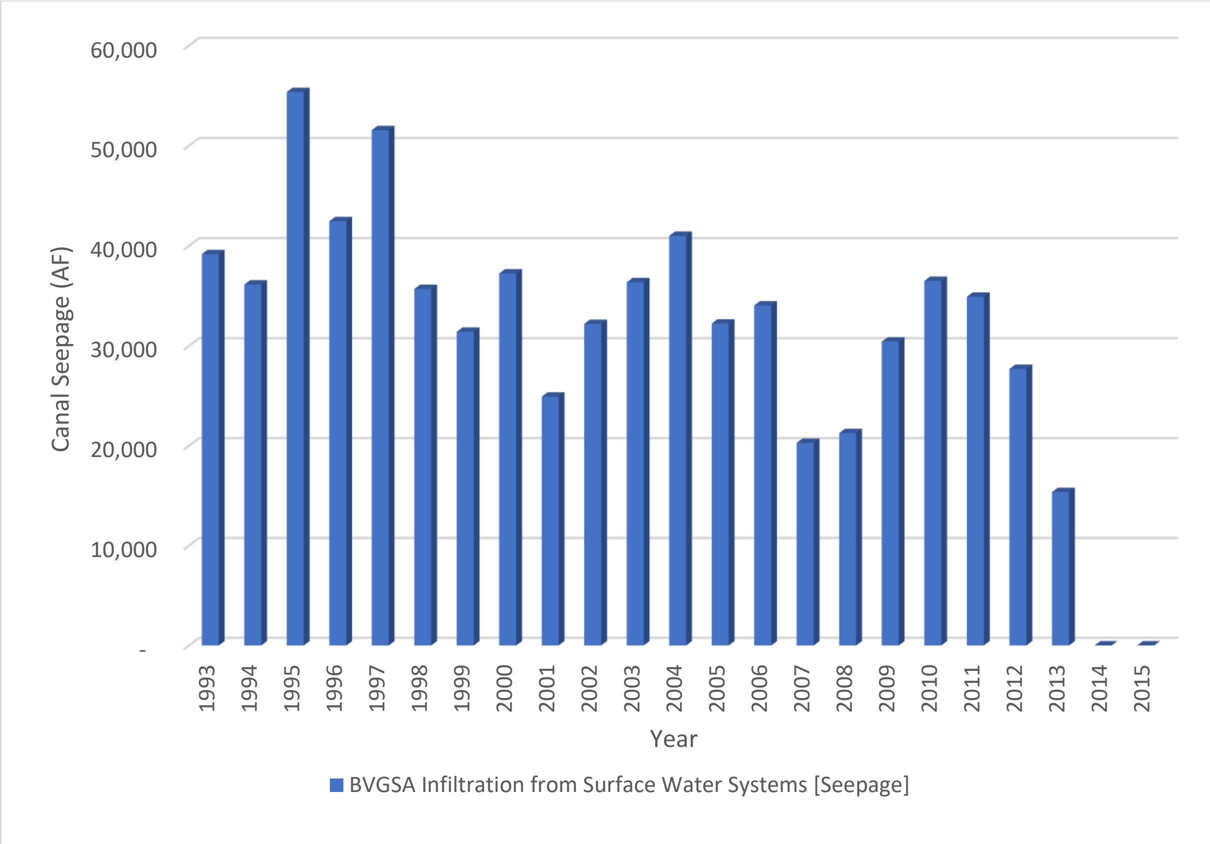

Figure 6-10. Canal Seepage in the BVGSA

Past analyses for agricultural deep percolation have been conducted (2015 AWMP) within the District for 2013 through 2015. Table 6-8, below, shows that deep percolation is estimated to be roughly 5 percent of the total volume of applied water, a value based on total crop ETa from ITRC-METRIC and an assumed irrigation application efficiency of 80 percent.

Table 6-8. Deep Percolation in Relation to Crop Evapotranspiration

	2013	2014	2015
Total ETa (AF)	108,567	63,557	67,015
Total Irrigation Demand (AF)	130,280	76,268	80,418
Deep Percolation	6,514	3,813	4,021

Using this methodology, the average agricultural deep percolation for the period from 1993 through 2015 is estimated to be 4,780 AFY.

Throughout its history, the BVWSD has practiced conjunctive management and continues to add infrastructure to recharge surface water supplies. Water Distribution Summaries for 1993 through 2015 were consulted to obtain annual gross spreading within the BVGSA. Average annual spreading (managed recharge) from 1993 through 2015 is estimated to be 24,350 AFY.

Subsurface groundwater inflow is an element common to both the GSA Component and the Groundwater Component. Therefore, the annual value for subsurface groundwater inflow presented previously for the GSA Component is also applied to this component. Figure 6-11 summarizes the total groundwater inflow to the aquifer(s) beneath the BVGSA.

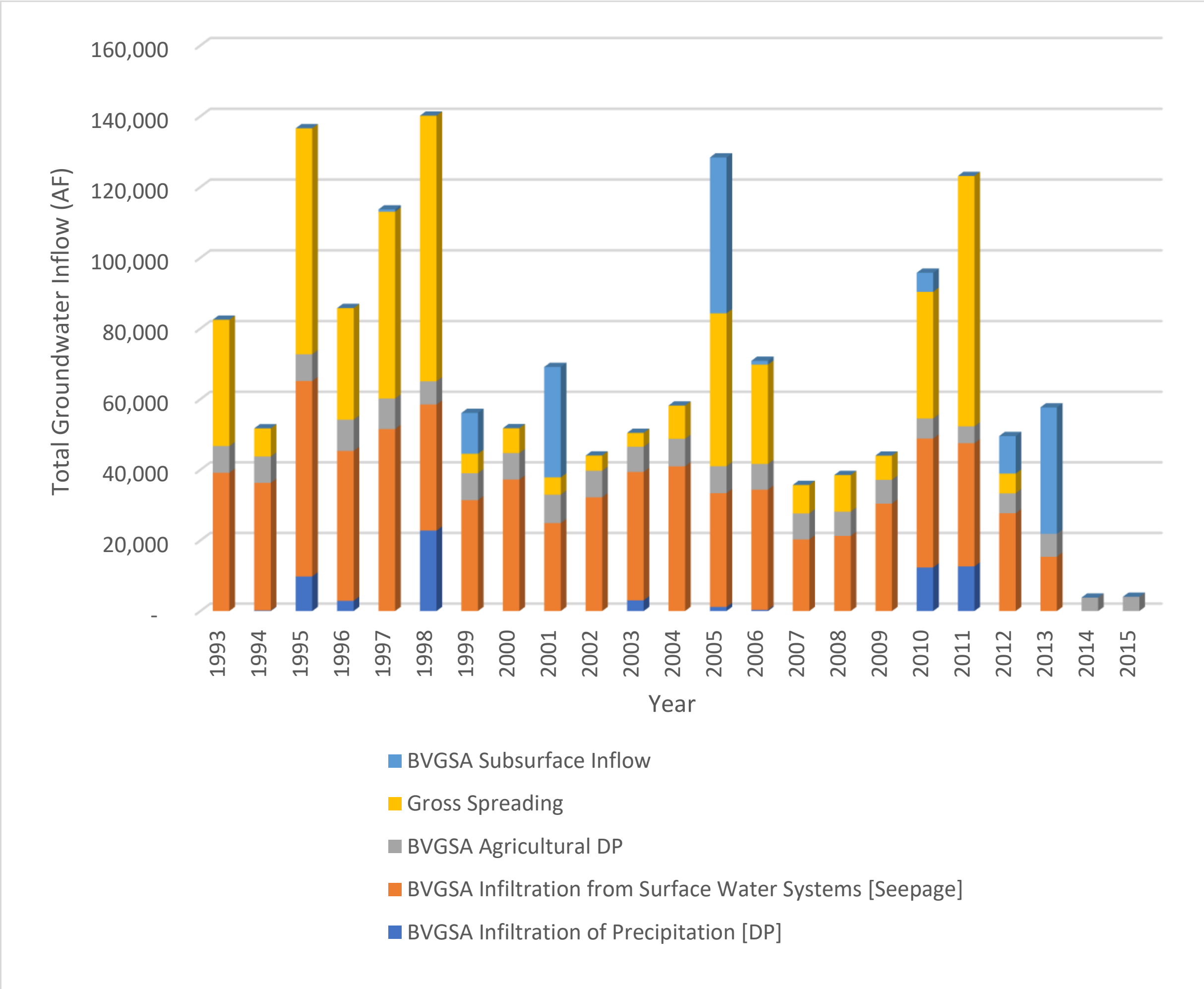

Figure 6-11. Groundwater Component Inflows by Source [1993 - 2015]

6.7.2 Groundwater Component Outflows

In addition to the subsurface outflows estimated in the GSA Component, a flow path common to both components, groundwater also leaves the GSA through extractions for domestic, agricultural, and M&I uses, flow paths captured only in the Groundwater Component. Groundwater extractions that return to the principal aquifer system through canal seepage, deep percolation of applied water and recharge from spreading basins are captured in the flow paths described above for these inflows to the Groundwater Component.

M&I Outflows

Municipal groundwater extraction is based on the per capita water usage of 179 gallons per capita per day in the Community of Buttonwillow. Based on 1990, 2000, and 2010 census data this per capita average is then used to arrive at an average annual requirement for municipal pumping of 257 AFY from 1993 through 2015. In addition, the District pumps 1,500 AF for industrial use. The totals for individual industrial and municipal uses are then combined into the M&I flow path of the Groundwater Component (see Figure 6-12). Given the small proportion of groundwater pumping devoted to domestic and M&I uses, and evapotranspiration of land applied wastewater from the Community of Buttonwillow and from irrigation of landscaping, the water budget assumes that all groundwater extracted for these purposes is consumed and becomes unavailable for future use.

Agricultural Outflows

Groundwater extraction from District wells has been reported by the BVWSD since 1981 but metering of private pumping by landowners has only been in place only since 2016. As a result, the best estimates of historical private pumping are derived by assuming that water demands are met by a combination of surface supply and groundwater pumping. Private pumping becomes the residual or "closure term" of the budget where inflow (supply) is assumed to equal outflow (demand). Inflows and outflows for this approach are defined below:

- Inflows: surface water deliveries, precipitation, metered pumping, and private pumping (closure term – now metered)
- Outflows: evapotranspiration, surface outflows, deep percolation (spreading/recharge, canals, agricultural)

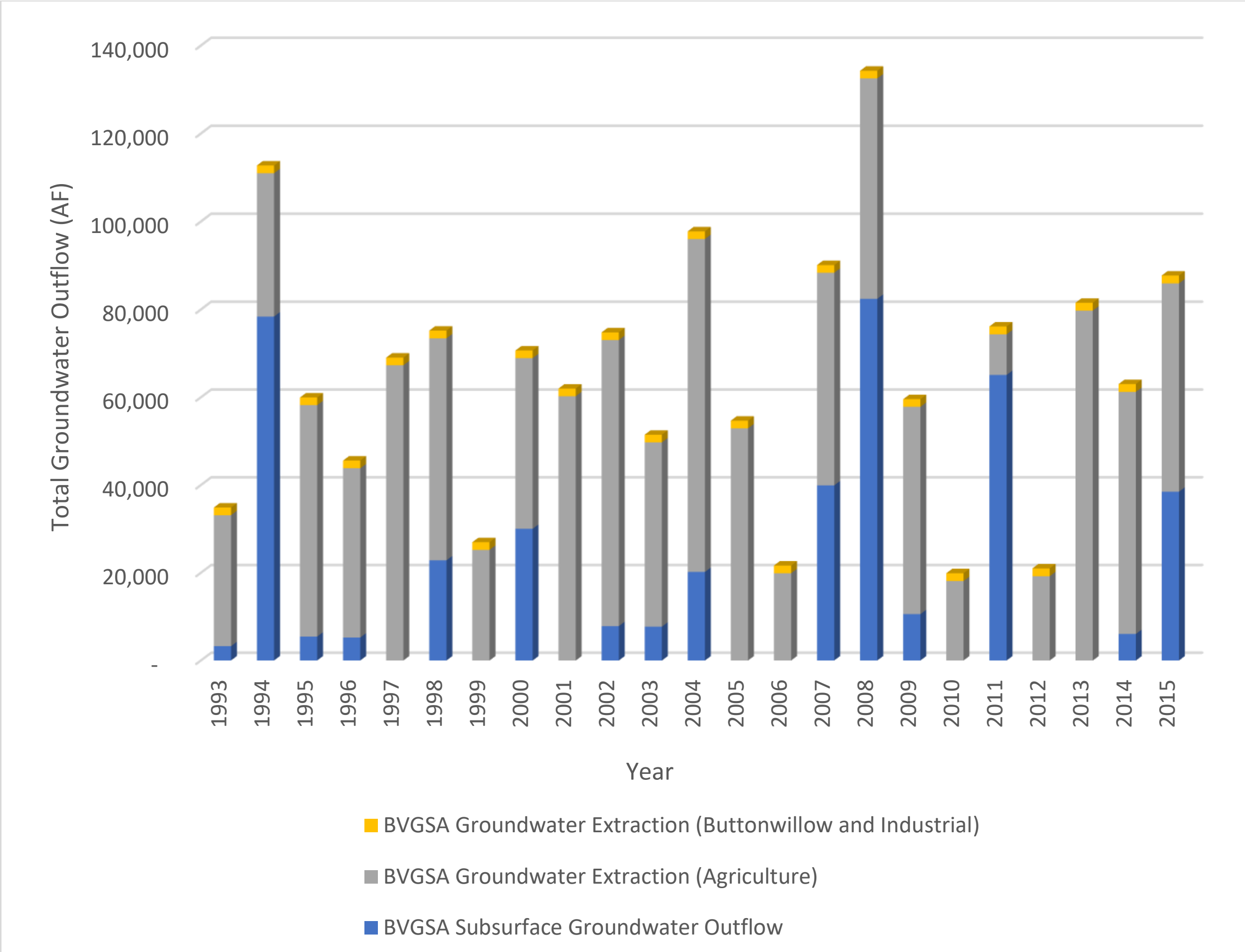

Figure 6-12. Groundwater Component Outflows by Destination [1993 - 2015]

6.7.3 Change in Storage

The change in the annual volume of groundwater in storage between seasonal high conditions, typically spring, has been computed by the three following methods:

- Estimate of change in groundwater storage as the "closure term" in both the groundwater budget and the BVGSA water budget. [Δ Storage = Inflows – Outflows]. This relies on estimates of other uncertain budget components.
- Comparing groundwater elevations between seasonal high conditions and using observed changes in elevations combined with data on specific yield to estimate changes in storage.
- Apply outputs of the C2VSim model for the Kern County Subbasin (Todd Groundwater, 2019). Outputs from this model for an area having boundaries that approximate those of the BMA, were used in Appendix G - Closure Terms for Buena Vista GSA Water Budget to compare charge of storage estimates from C2VSim modeling to those computed using the methods described above.

6.8 Water Budget Summary

The California Department of Water Resources maintains the chronological Reconstructed Sacramento and San Joaquin Valley Water Year Hydrologic Classification Indices. Water year type is determined based on measured unimpaired runoff and indexed to one of five classifications: wet, above normal, below normal, dry, and critically dry. Table 6-9 summarizes the total number of years that correspond with each classification from 1993 through 2015. In general, surface water deliveries and evapotranspiration decrease and groundwater pumping increases when dry years occur. The opposite phenomenon is noticed when wet years occur. It should be noted that the distribution of year types shown in Table 6-9 is weighted at the extremes as opposed to a bell-shaped normal distribution where values cluster in the center. As shown in Table 6-9, the skewed distribution of water year types exhibited in the analysis period used for the GSP is similar to the distributions for the complete series for both the Sacramento River (1906 through 2018) and the San Joaquin River (1901 through 2018).

Table 6-9. Frequency Distribution of Water Year Types (percentage)

Index	Wet	Above Normal	Below Normal	Dry	Critically Dry
GSP (23 years)	34.8	13.0	8.7	17.4	26.1
Sacramento River (113 years)	32.3	18.1	16.1	14.4	18.6
San Joaquin River (118 years)	31.9	13.3	19.5	21.2	24.2

Table 6-10 summarizes the water budget for the BVGSA from 1993 through 2015, by water year. It should be noted that unmetered groundwater pumping was determined as described in Section 6.7.2 and subsurface flux as the closure term in the BVGSA Water Budget, as described in Appendix G - Closure Terms for Buena Vista GSA Water Budget.

Table 6-10. Water Budget Summary Results with Corresponding Water Year Type

BVGSA WATER YEAR ANNUAL AVERAGES [1993-2015] (AF)					
INFLOWS	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critically Dry**
Surface Water Inflow					
California Aqueduct (diversions)	84,417	77,204	74,728	61,403	45,376
East Side Canal	97,427	63,848	28,363	36,669	20,169
Precipitation	33,505	26,950	25,680	22,224	17,370
Subsurface Groundwater Inflow	5,719	5,647	-	10,471	5,964
Total GSA Component Inflow	**221,067**	**73,649**	**128,770**	**130,767**	**88,879**
Subsurface Groundwater Inflow	5,719	5,647	-	10,471	5,964
Infiltration of Precipitation [DP]	6,201	4,119	1,518	-	27
Infiltration from Surface Water Systems [Canal Seepage]					
Canals within BSA	40,677	35,049	33,395	31,454	15,511
Outlet Canal [conveys water from diversion to BSA][1]	13,018	8,382	3,929	5,984	4,433
Infiltration of Applied Water					
Agriculture DP (Based on BVWSD estimate of 5%)	7,351	6,933	6,922	7,245	6,009
Gross Spreading	50,180	16,132	5,399	6,060	6,598
Total Groundwater Component Inflow	**110,128**	**67,880**	**47,233**	**55,229**	**31,909**
OUTFLOWS	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critically Dry**
Surface Water Outflow					
Goose Lake Canal [KNWR] (inflow = outflow)	15,783	14,160	21,964	19,169	15,899
Main Drain Spill N. of Hwy 46 (now zero)	17,700	13,275	5,244	6,004	2,970
To Other Districts	16,554	11,278	1,456	2,677	2,506
Evapotranspiration	122,524	115,558	115,370	120,745	100,156
Subsurface Groundwater Outflow	12,733	10,010	9,146	7,005	40,883
Total GSA Component Outflow	**185,295**	**164,280**	**153,179**	**155,599**	**162,414**
Subsurface Groundwater Outflow	(7,014)	(4,363)	(9,146)	3,466	(34,920)
Groundwater Extraction (Unmeasured Grower Wells)	46,362	31,536	46,166	55,131	52,276
Groundwater Extraction (BVWSD and Measured Grower Wells)	195	512	3,597	4,064	3,075
Groundwater Extraction (BVWSD and Grower Reclamation)	13,314	14,694	10,991	12,108	7,443
Groundwater Extraction (Buttonwillow and Industrial)	1,752	1,760	1,742	1,754	1,767
Total Groundwater Component Outflow	**74,356**	**58,512**	**71,642**	**80,062**	**105,444**
CHANGE IN GROUNDWATER STORAGE	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critically Dry**
GSA Component: [inflow - outflow]	35,772	9,368	(24,409)	(24,833)	(73,535)
Groundwater Component: [inflow - outflow]	35,772	9,368	(24,409)	(24,833)	(73,535)

[1] Outlet Canal seepage occurs outside of BVGSA boundaries. Shown in this table for reference, but not included in calculations.

6.9 Impacts of Climate Change Projections

6.9.1 Overview of Regulations (§ 354.18 Water Budget)

The SGMA regulations that apply to the projected water budget are presented below:

> *(a)* ***Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including*** *historical, current and* ***projected water budget conditions****, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.*
>
> *(b)* ***Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components****. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:*
>
>> *(A)* ***Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition*** *for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.*
>>
>> *(B)* ***Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition*** *for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.*
>>
>> *(C)* ***Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply****. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.*

6.9.2 Components of Projected Water Budget

The flow paths for the projected water budget, illustrated below in Figure 6-13, are the same as those shown in previous figures for the historical water budget and include projected values for the following flow paths:

- Kern River Diversions;
- SWP Allocations;
- Precipitation, and
- Evapotranspiration.

Projected values of other flow paths, such as subsurface inflow and subsurface outflow will be influenced by future conditions in neighboring areas. However, these uncertainties are likely to be resolved as water budgets for the Kern County Subbasin are refined during the course of SGMA implementation. Projections for each of the four water budget components listed above are discussed in the following section.

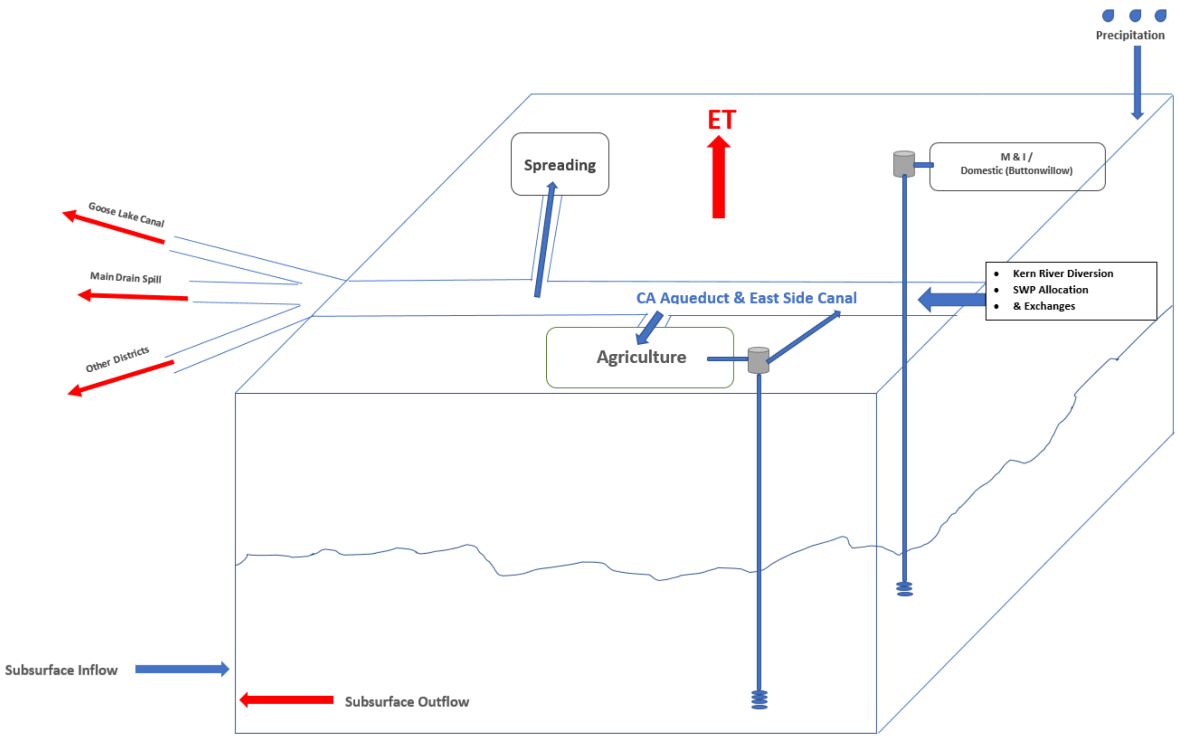

Figure 6-13. BVGSA Water Budget Flowpaths

6.9.2.1 Kern River Diversions

GEI has applied future climate scenarios to 55 years of historical data to predict the volume and timing of flows in the Kern River. For the 2030 and 2070 projections, the GEI analysis presents a decrease in runoff volume of 1.5% and 2.8%, respectively. The more important finding is the timing of Kern River flow is anticipated to change with peak flows occurring earlier resulting in a gap between the occurrence of peak flows and peak irrigation demands.

A separate investigation was conducted by Todd Groundwater as part of development of the C2VSim groundwater model produced for the Kern County Subbasin. Todd's analysis was based on a shorter period of record (20 years; 1995-2014) to match the historical water budget period for their analysis and found a lesser impact from climate change. Todd estimated the 2030 and 2070 flow volumes to decrease by 0.4% and 0.6%, respectively from their historical baseline.

Because of the longer period of record used in the GEI analysis and the more conservative results, this analysis has been applied for projection of Kern River flows. The decreases in flow of 1.5% (2030) and 2.8% (2070) and the shift in timing estimated for the Kern River were then applied to historical diversions by the BVWSD to project future diversions by the District.

As discussed in Section 7 – Projects, Management Actions and Adaptive Management Actions, one mechanism that may be applied to address projected reductions in Kern River diversions will be to reduce the volume of water available under the BVWSD's right to Kern River water that is now exchanged with or sold to other agencies and not used within the District.

6.9.2.2 SWP Diversions

Projected reductions in SWP diversions were based on analyses performed by Todd Groundwater that utilized "change factors" developed as inputs to the C2VSim groundwater model of the Kern County Subbasin. Among the "change factors" were values used to project Table A and Article 21 allocations for 2030 and 2070 to KCWA member agencies. Additional analyses were performed by the Provost & Prichard Consulting Group to estimate SWP allocations for three scenarios:

- under current contracts;
- under current contracts with 2030 climate change projections, and
- under current contracts with 2070 climate change projections.

Figures 6-14 and 6-15 illustrate the impact of the projections described above on SWP allocations to the BVWSD. Table 6-11 shows the annual average reduction in Table A supply. Figures 6-14 and 6-15 analyze both Table A and Article 21 allocations.

Table 6-11. Annual Average Reduction in Table A Supply (AF)

Baseline Climate Scenario	2030 Climate Scenario	2070 Climate Scenario
1,765	2,155	2,800

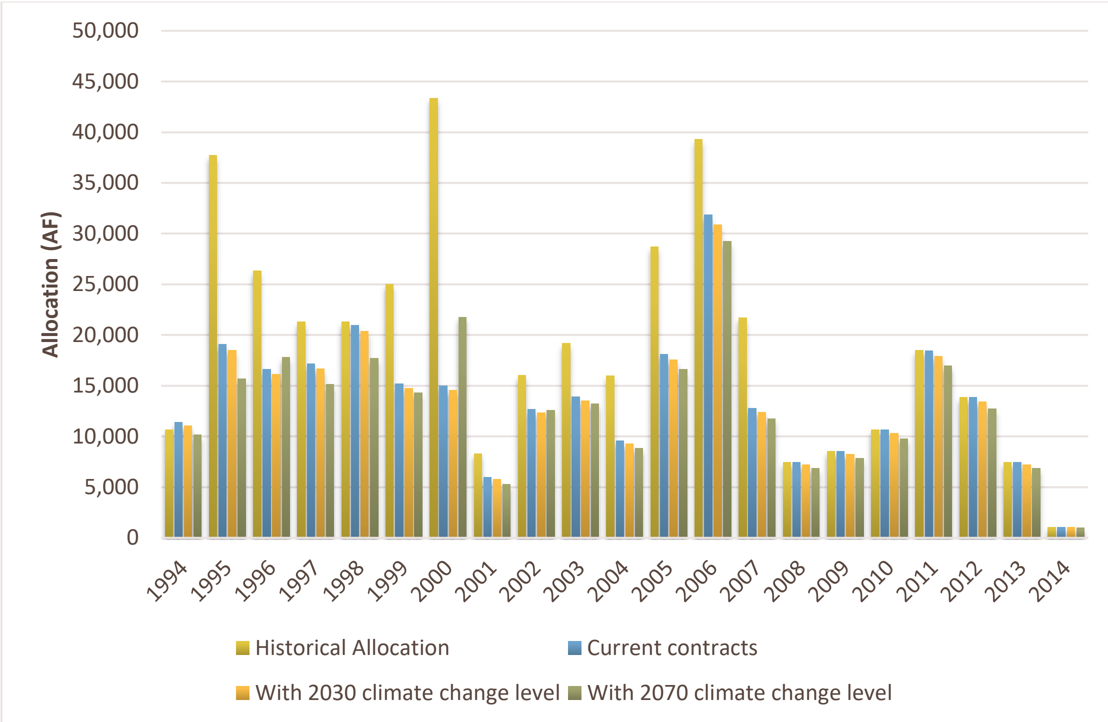

Figure 6-14. Impact of Climate Change on Total SWP Allocations to BVWSD

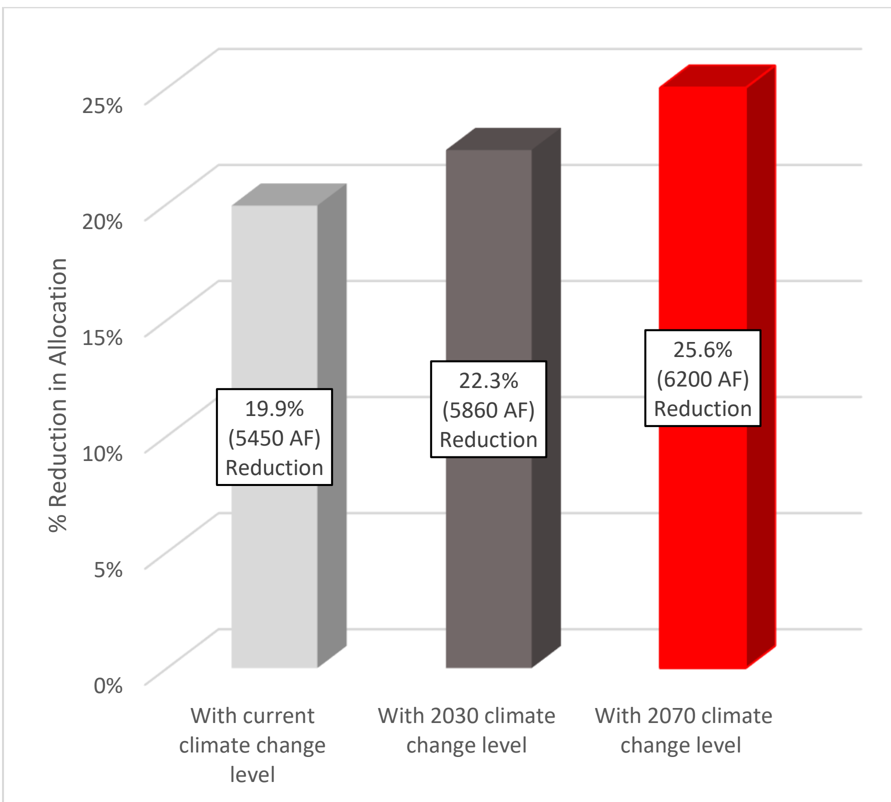

Figure 6-15. Percent Reduction in Total SWP Allocations with Climate Change Levels

Figure 6-15 indicates the degree to which historical deliveries from 1994 to 2014 are likely to be reduced in the future. The estimates from this analysis estimate that total SWP Table A and Article 21 allocations will be reduced by 22.3% and 25.6% under 2030 and 2070 climate change levels, respectively. Here again, the projects and actions presented in Section 7 – Projects, Management Actions and Adaptive Management Actions, are designed to anticipate reductions in water supply available from the SWP.

6.9.2.3 Precipitation and Evapotranspiration

California's Fourth Climate Change Assessment provides information on climate impacts, including temperature, wildfire, water, sea level rise, and governance (www.climateassessment.org). This report suggests that an increasing proportion of precipitation in the southern Sierra Nevada will fall as rain instead of snow accelerating and compressing the period of runoff from mountain watersheds. This shift in timing is likely to create a mismatch between peak flows in the Kern River and the peak diversion period to meet irrigation water demand.

For precipitation and evapotranspiration within BVGSA, analyses performed to support use of the C2VSim model to project the impacts of climate change on the Kern County Subbasin provided change factors for both precipitation and ET. These change factors were then applied to historical averages for the BVGSA to project future levels of precipitation and evapotranspiration. For precipitation, historical data was taken from CIMIS Station #146 (Belridge) (Table 6-5). The evapotranspiration change factor data was applied to ETa data developed using ITRC METRIC, described in Section 6.2.1. Tables 6-12 and 6-13 and figures 6-16 and 6-17 summarize annual precipitation and annual evapotranspiration after adjustment using the "change factors".

Table 6-12. Effects of Climate Change Scenarios on Annual Precipitation

Annual average precipitation: Baseline condition	**6.85**	**inches**
Annual average precipitation volume: Baseline condition	**25.0**	**TAF**
Annual average precipitation volume: 2030 climate scenario	**20.6**	**TAF**
Change from baseline condition: volume	**-4.4**	**TAF**
Change from baseline condition: percentage	**-18**	**%**
Annual average precipitation volume: 2070 climate scenario	**21.1**	**TAF**
Change from baseline condition: volume	**-3.9**	**TAF**
Change from baseline condition: percentage	**-16**	**%**

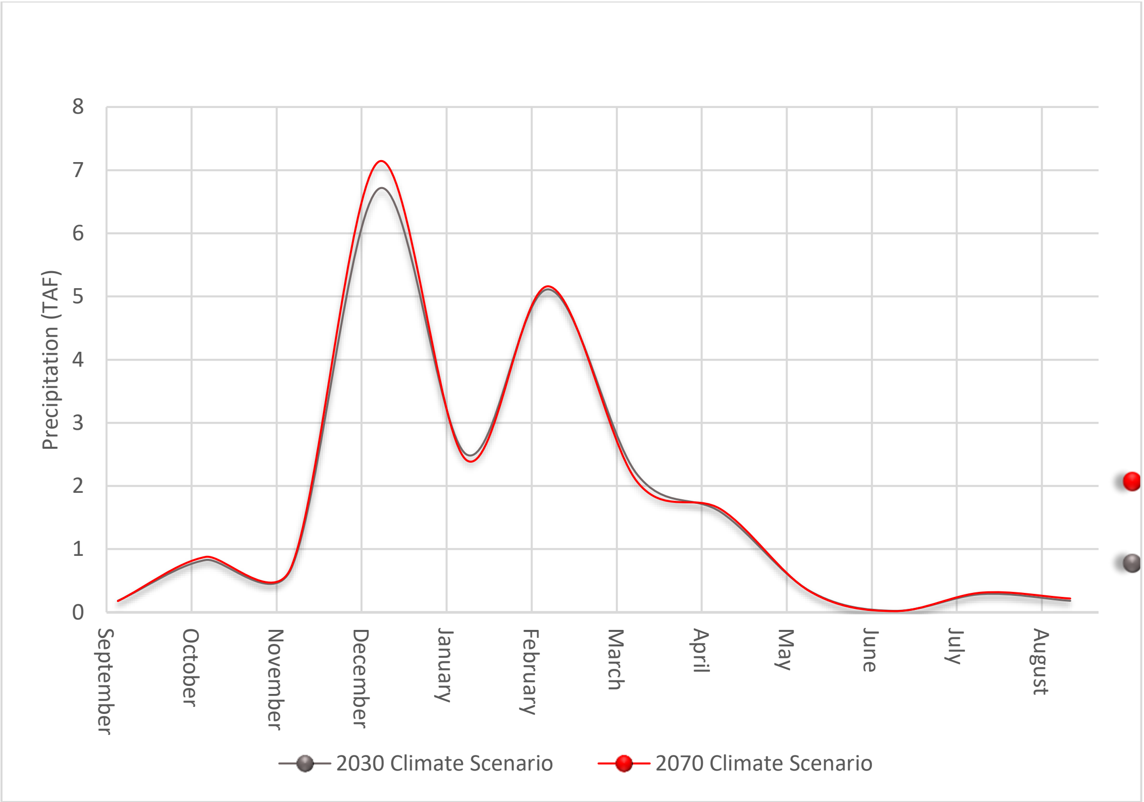

Figure 6-16. Average Monthly Variation of Precipitation (TAF)

Table 6-13. Effects of Climate Change Scenarios on Annual Evapotranspiration

Annual average ET: baseline condition	**110.8**	**TAF**
Annual average ET volume: 2030 climate scenario	**114.1**	**TAF**
Change from baseline condition: volume	**3.32**	**TAF**
Change from baseline condition: percentage	**3.0%**	**%**
Annual average ET volume: 2070 climate scenario	**119.2**	**TAF**
Change from baseline condition: volume	**8.4**	**TAF**
Change from baseline condition: percentage	**7.6%**	**%**

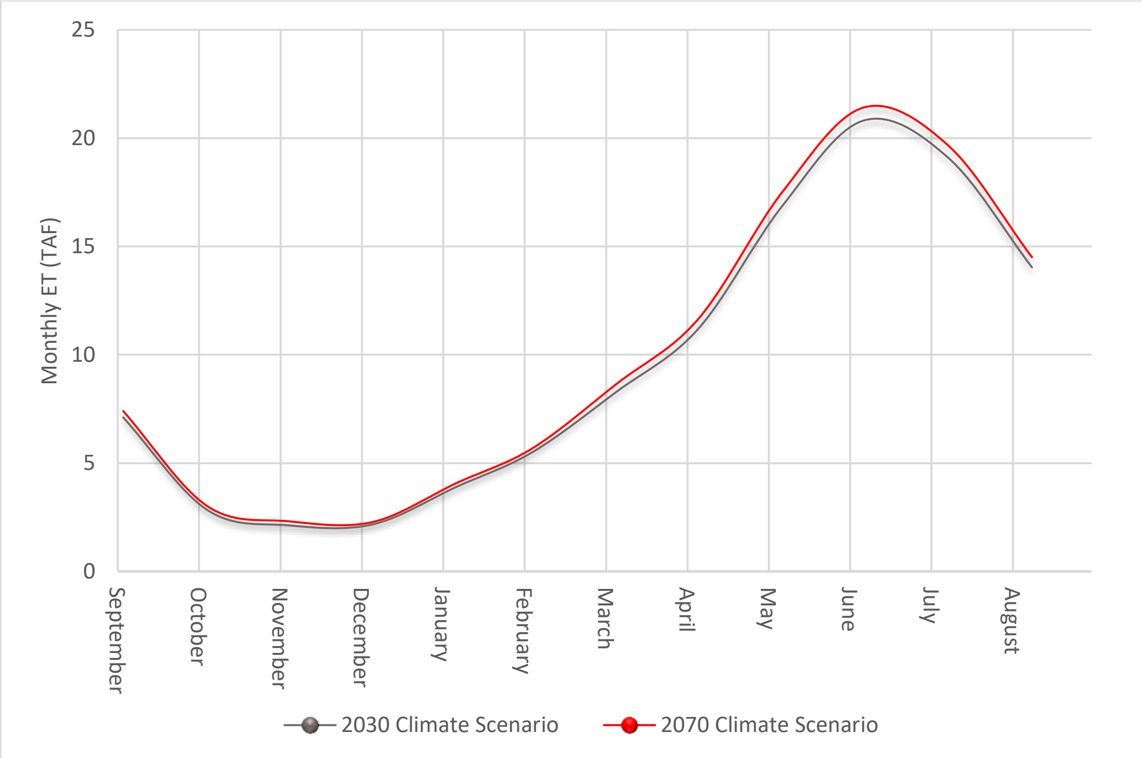

Figure 6-17. Average Monthly Variation of Evapotranspiration (TAF)

Tables 6-12 and 6-13 and figures 6-16 and 6-17 illustrate the projected effects on precipitation and evapotranspiration of climate change. The decreases in precipitation and increases in evapotranspiration, discussed here, together with the effects of increased planting density and changes in cropping, discussed in Section 7 – Projects, Management Actions and Adaptive Management Actions, are expected to increase consumptive use in the BMA during a period of declining supplies of surface water from both the Kern River and the SWP. The projects and programs presented in Section 7 are aimed at enabling the BVGSA to continue to serve its water users by preparing for these increases in demand and reductions in supply by improving facilities and management of the available supply.

6.10 Maples Management Area Water Budget

The second, smaller management area of the BVGSA is the Maples Management Area (MMA). This area covers 4,360 acres and is located about 15 miles south of the Buttonwillow Management Area (BMA). The MMA lies within the KRGSA, so all subsurface fluxes across MMA boundaries are between the MMA and the KRGSA and changes in groundwater levels and storage within the MMA are heavily influenced by conditions in the KRGSA. Because groundwater interactions between the MMA and the surrounding area are internal to the KRGSA and because Sustainable Management Criteria applied in the MMA will be determined by the KRGSA, subsurface fluxes are not tracked in this water budget.

Like the budget for the BMA, this water budget is based on historical water supplies and uses over a period extending from 1993 to 2015. In the case of the MMA, the objective of the water budget is to account for inflows of surface water and precipitation and outflow of crop consumptive use, the one water use of any significance. This analysis is intended to reveal whether the MMA is in surplus or deficit, identify data gaps that compromise the accuracy of the budget and indicate trends in water management that may lead to long-term benefits or liabilities.

The same levels of uncertainty assigned to flow paths in the BMA water budget are associated with the flow paths used in the MMA budget. Inflows are based on measured flow in the Maples Canal and rainfall data from a nearby CIMIS station. ETa data from the ITRC METRIC analysis performed for the Kern County Subbasin was used to estimate crop consumptive use.

6.10.1 Water Budget Flow Paths

Land use in the Maples Management Area almost entirely irrigated agriculture and fallowed land. A schematic water budget for MMA is shown in Figure 6-18.

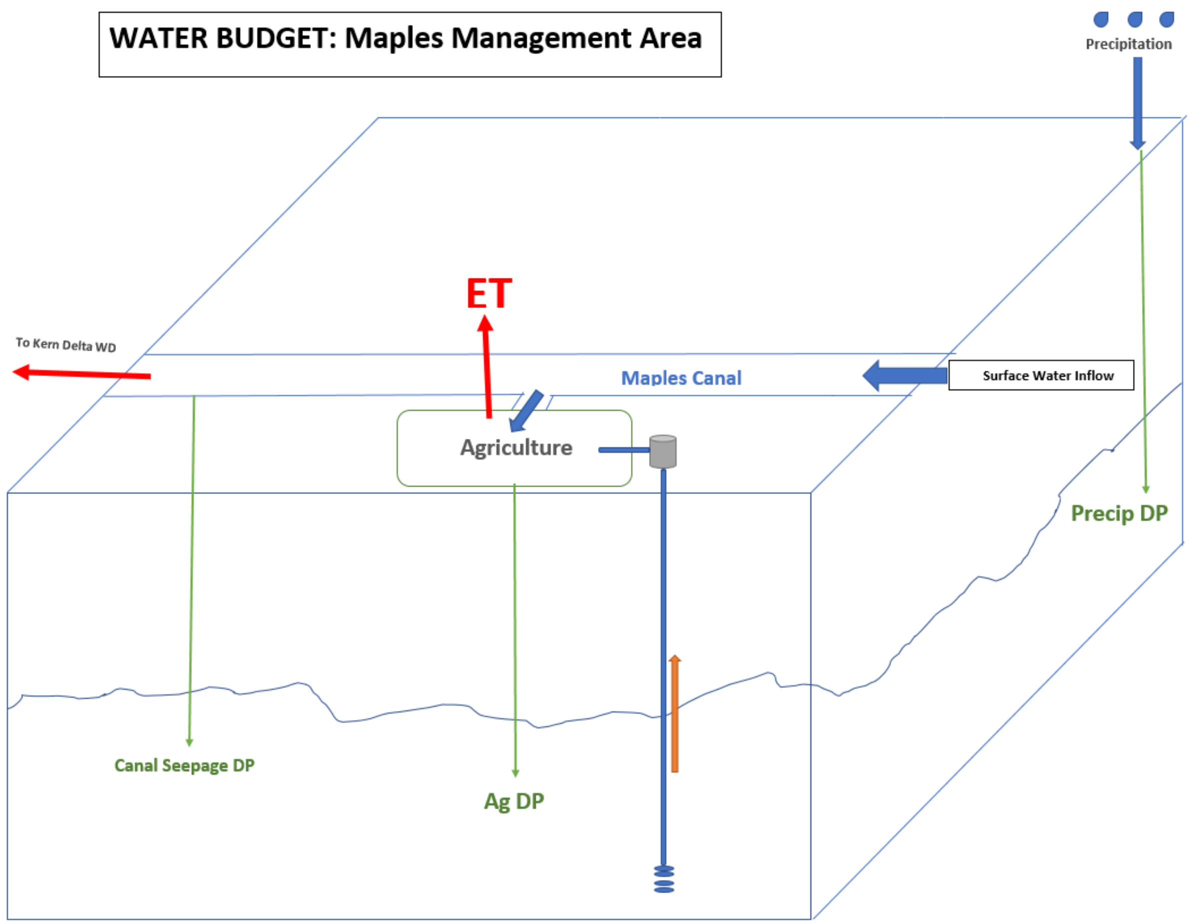

Figure 6-18. Simplified Water Budget Diagram for MMA

Inflows

Inflows to the MMA are based on the BVWSD's rights to Kern River water. Inflows to the MMA include:

- Kern River - delivered through the Maples Canal which begins at Lake Webb, and
- Precipitation.

As no rivers or streams cross the boundaries of the MMA, surface water inflows are restricted to water delivered via the Maples Canal. Table 6-14 below shows surface water inflows from 2006 - 2015. Figure 6-19 shows longer-term trends in surface water deliveries (1993 through 2015).

Table 6-14. Surface Water Deliveries to MMA [2006-2015]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Maples Canal (AF)	12,977	6,654	4,991	3,045	1,232	571	2,933	2,174	-	-

Table 6-15 presents estimates of the volume of annual precipitation falling on the MMA from 1993 through 2015.

Table 6-15. Precipitation in MMA [1993 - 2015]

Year	MMA Precipitation (AF)	Station
1993	2,496	Shafter
1994	2,601	Shafter
1995	3,612	Shafter
1996	2,889	Shafter
1997	2,089	Shafter
1998	4,974	Shafter
1999	2,231	Belridge
2000	1,519	Belridge
2001	2,529	Belridge
2002	1,733	Belridge
2003	2,903	Belridge
2004	2,351	Belridge
2005	2,707	Belridge
2006	2,620	Belridge
2007	1,192	Belridge
2008	2,096	Belridge
2009	1,944	Belridge
2010	3,880	Belridge
2011	3,909	Belridge
2012	1,777	Belridge
2013	956	Belridge
2014	981	Belridge
2015	2,009	Belridge
Average (AF)	2,435	
Average (ft/ac)	0.56	

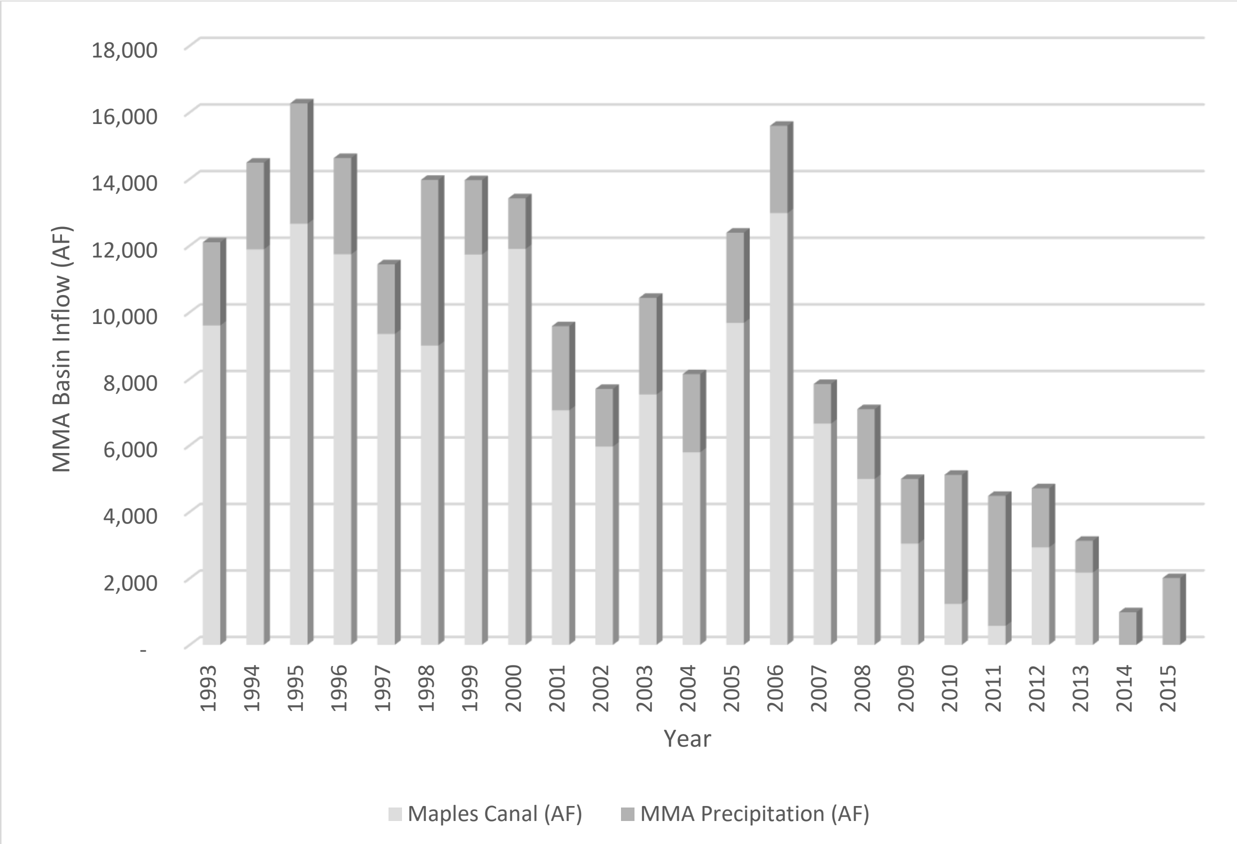

Figure 6-19. Inflows to MMA by Source [1993 - 2015]

Outflows

Outflows from the MMA include water that leaves the boundaries of the management area via surface water flow paths that include canals, drains, and evapotranspiration.

- Deliveries to the Kern Delta Water District through the Maples Canal, and
- Agricultural consumptive use.

Figure 6-20 summarizes surface water outflows from the MMA and Figure 6-21 summarizes evapotranspiration leaving the MMA.

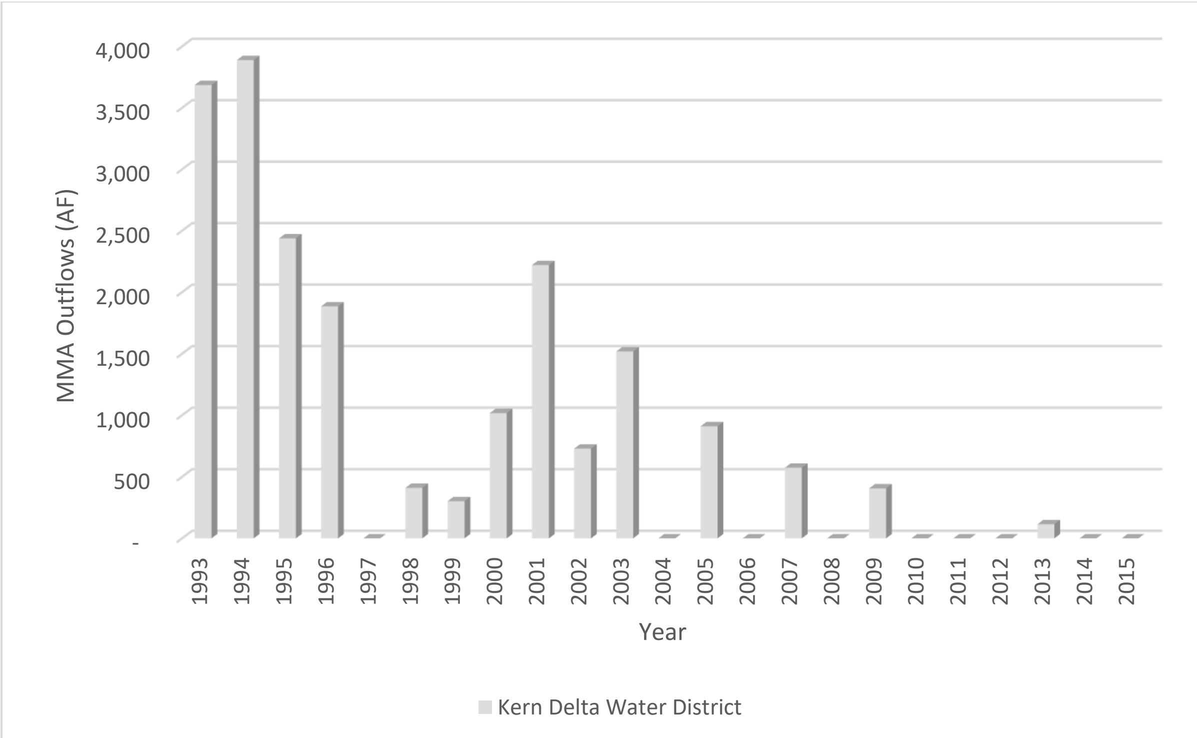

Figure 6-20. Outflows from MMA by Destination [1993 - 2015]

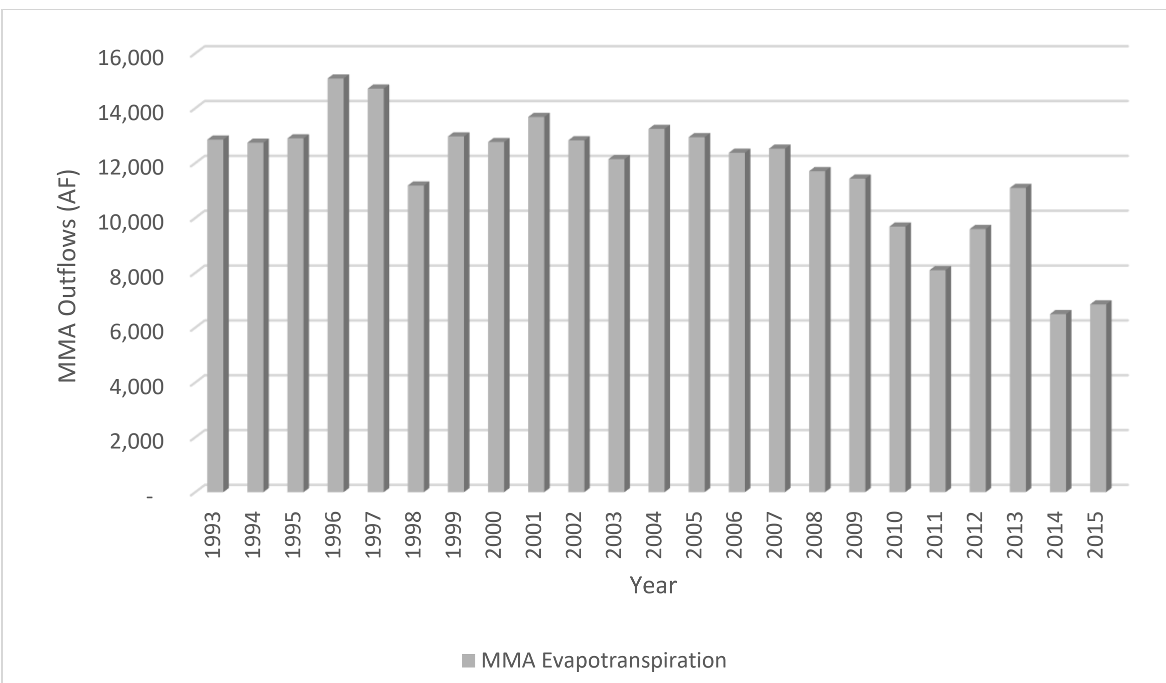

Figure 6-21. Evapotranspiration in MMA [1993 - 2015]

It should be noted that the ITRC-METRIC evapotranspiration data for the MMA displays the same decline in values after 2009 described earlier for the BMA.

Table 6-16 presents the results of the analysis of deep percolation of precipitation described earlier for the BMA. This analysis yields an average annual value for deep percolation of precipitation of 0.07 feet (0.79 inches). Figure 6-22 illustrates how percolation of precipitation has ranged over the period of study.

Table 6-16. Percolation of Precipitation

Year	Estimated Percolation (AF)
1991	107.79
1992	83.14
1993	-
1994	16.24
1995	995.13
1996	294.41
1997	-
1998	2315.58
1999	-
2000	-
2001	-
2002	-
2003	308.50
2004	-
2005	118.35
2006	33.84
2007	-
2008	-
2009	-
2010	1,255.70
2011	1,283.87
2012	-
2013	-
2014	-
2015	-
2016	692.31
Average (AF)	288.53
Average (ft/ac)	0.07

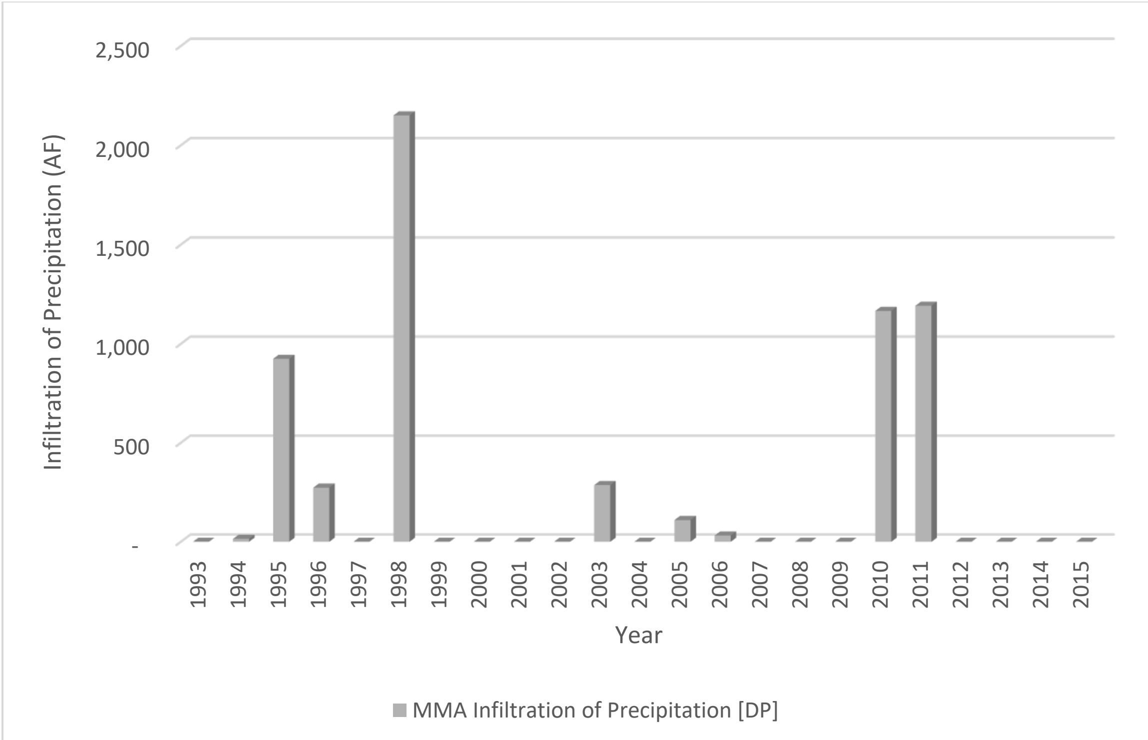

Figure 6-22. Infiltration of Precipitation in MMA

As noted above, in addition to the contribution of precipitation to the groundwater system, there are other flow paths that convey surface water entering the MMA to groundwater. These flow paths are essential for the BVWSD's program of conjunctive management and include seepage from unlined canals and deep percolation of irrigation water applied to fields and are the same in the MMA as in the BMA.

Canal seepage

Canal seepage totals are based on data from Water Distribution Summaries provided by the BVWSD from 1993 through 2015. Figure 6-23 summarizes the amount of canal seepage within the MMA. As shown in Figure 6-23, seepage from unlined canals varies from 3,168 AF in 2000 to zero in 2014 and 2015, two years when BVWSD received no surface water and relied exclusively on stored groundwater to satisfy irrigation demands. The average annual rate of canal seepage was 1,644 AF.

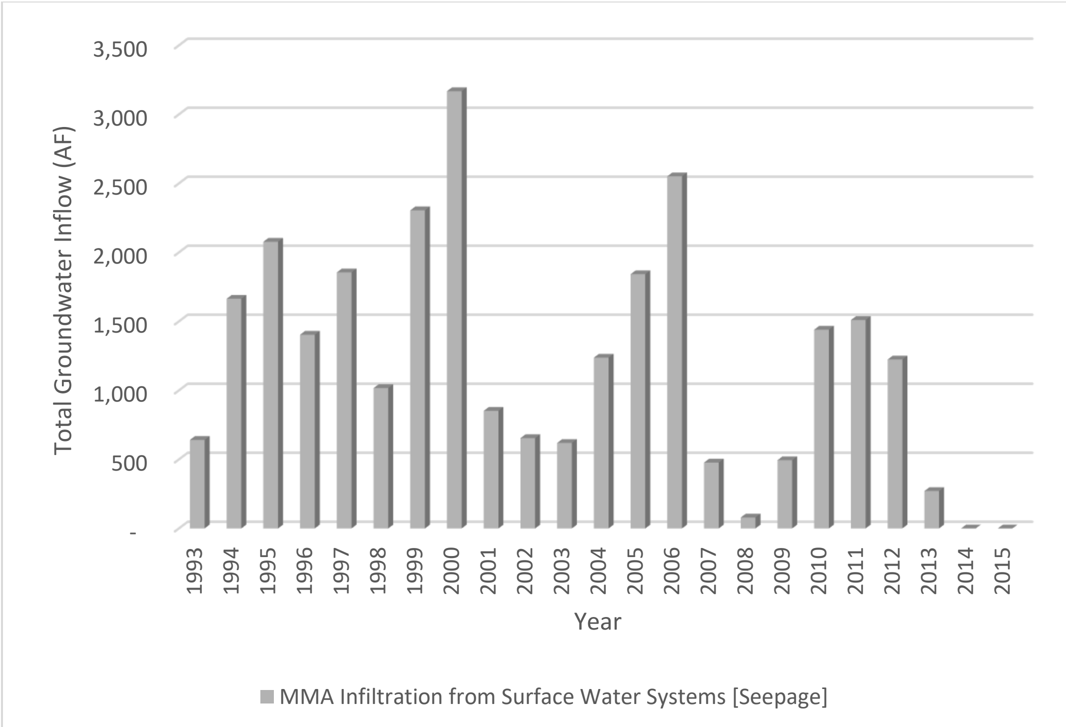

Figure 6-23. Canal Seepage in MMA

Deep Percolation

Agricultural deep percolation has been estimated within the BVWSD for 2013 through 2015 in the BVWSD AWMP, 2015. As is the case with the BMA, deep percolation in the MMA has been estimated to be roughly 5 percent of total crop irrigation demand. This value was reached by adjusting the ITRC-METRIC annual actual evapotranspiration (ETa) values to account for a typical irrigation efficiency and taking 5 percent of this total. Using this methodology, the annual average agricultural deep percolation for the period from 1993 through 2015 is estimated to be 587 AF.

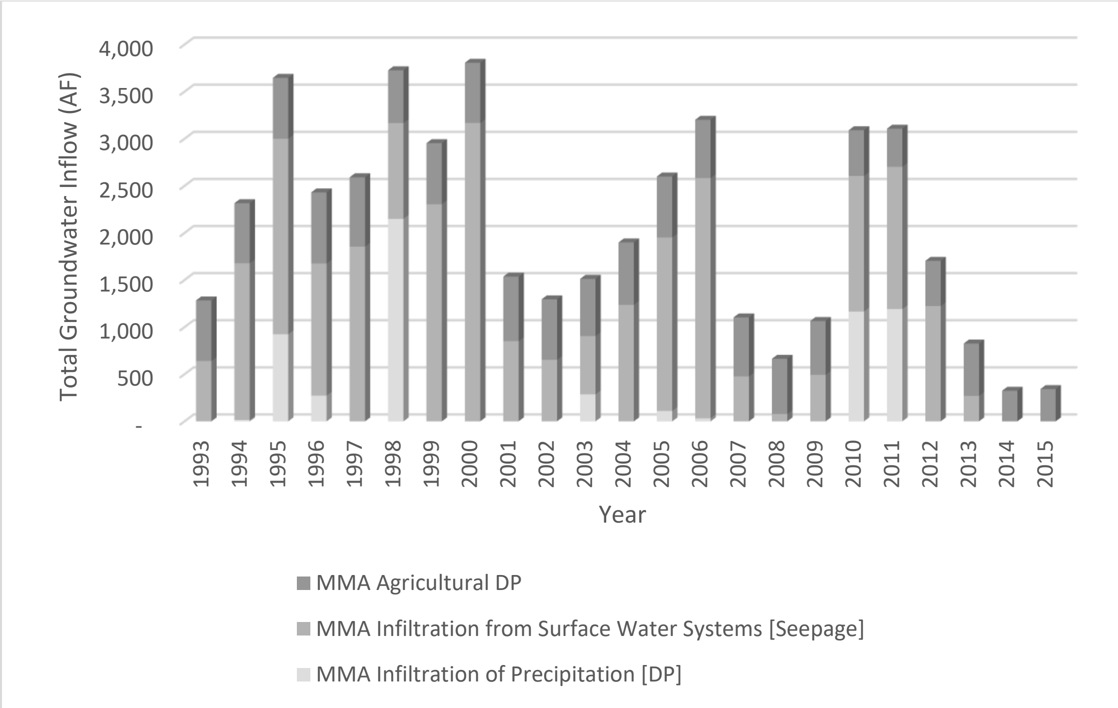

Figure 6-24. MMA Groundwater Inflows by Source [1993 - 2015]

6.10.2 MMA Water Budget Summary

Table 6-17 summarizes the water budget for the MMA from 1993 through 2015 by water year. Unknowns in the water budget include subsurface cross-boundary flux with the KRGSA and extractions by private pumpers that were not metered over the period used to construction this water budget but are now metered under the BVGSA metering program.

Table 6-17. Water Budget Summary

INFLOWS	Wet	Above Normal	Below Normal	Dry	Critically Dry
Surface Water Inflow					
Maples Canal	9,448	8,290	5,287	5,436	4,285
Precipitation	3,447	2,772	2,642	2,286	1,787
Total MA Inflow	**12,894**	**11,062**	**7,929**	**7,722**	**6,072**
Infiltration to Groundwater					
Infiltration of Precipitation	585	389	143	-	3
Canal Seepage	2,626	2,304	701	913	807
Infiltration of Applied Water	587	587	587	587	587
Total Groundwater Inflow	**3,798**	**3,280**	**1,431**	**1,500**	**1,397**
OUTFLOWS	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critically Dry**
Surface Water Outflow					
Kern Delta Water District	1,166	440	963	738	763
Evapotranspiration	8,424	7,945	7,932	8,301	6,886
Total MMA Outflow	**9,590**	**8,385**	**8,894**	**9,039**	**7,649**
Groundwater Extraction (BVWSD and Measured Grower Wells)	2,892	4,851	4,878	5,129	3,155
Groundwater Extraction (BVWSD and Grower Reclamation)	-	307	-	-	-
Total Measured Groundwater Outflow	**2,892**	**5,158**	**4,878**	**5,129**	**3,155**

6.11 BVGSA Resources Accounting Budget

An important consideration for the BGVSA with respect to overall management of the Kern County Subbasin is the degree to which the GSA's supplies are in balance with its demands, a question that can be approached by constructing a simple water budget that combines measured values with parameters that have been agreed upon by the Kern County Subbasin Coordinating Committee. Estimates of parameters such as groundwater extraction and subsurface cross-boundary fluxes are not included as the sole purpose of this budget is to combine water the BVGSA is entitled to receive from the Kern River and the SWP with water available from native yield and precipitation. These sources of supply are then compared with water exiting the GSA through the largest and best defined flow path, evapotranspiration.

Unlike the GSP water budget which tracks pathways for movement of water into and out of the BVGSA, this budget is based on native yield and precipitation, the BVWSD's current and projected surface water supplies, and current and projected demands and outflows. Therefore, while the flow paths presented in the GSP budget are affected by exchanges, transfers and banking agreements that alter the location and timing of flows entering and leaving the BVGSA, this budget rests on the underlying access to water and the demands expected to be placed on those resources.

6.11.1 Budget Inputs

The following section describes the basic inputs into the water budget. Because the purpose of the budget is to assess the difference between inflows and outflows, there is no need for a closure term to bring the budget into balance.

6.11.1.1 Native Yield and Precipitation

The two basin-wide parameters used as a foundation for this analysis are native yield and precipitation. For the Subbasin, 0.15 AF/ac is a generally accepted value for native yield. Values for precipitation discussed by the Coordinating Committee range from 0.15 to 0.5 AF/ac with the BVGSA adopting 0.2 AF/ac, a number in the lower 15% of this range. Applied over the entirety of the BVGSA's two management areas, the Buttonwillow Management Area (BMA - 46,480 acres) and the Maples Management Area (MMA - 4,360 acres), use of these values for the 2020 estimate results in an average annual contribution of 7,626 AF of native yield and 10,168 AF of precipitation for a total contribution of 17,794 AF. The native yield has been held constant for the 2030 value, while precipitation, after adjustment for climate change, has been reduced by 18%. For 2070, the native yield has remained constant, while the value for precipitation is 16% below the 2020 baseline.

6.11.1.2 Kern River Water Right

The BVWSD's diversions from the Kern River are based on an average entitlement of 156,000 AF/yr delivered by First Point interests to the Second Point of measurement, undiminished by delivery losses. Buena Vista's entitlement is 96.044% of this flow or 149,828 AF/yr. This entitlement is expected to remain essentially intact during the period of SGMA implementation with the BVGSA applying a future average annual entitlement of 147,000 AF/yr for the 2030 and 2070 budgets. This reduction lies between the 1.5% reduction due to climate change projected for 2040 and the 2.8% reduction projected for 2070.

6.11.1.3 SWP Deliveries

Deliveries of SWP water of 12,960 estimated for 2020 are based on the BVWSD's Table A allocation of 21,600 AF/yr after adjustment by DWR's 62% projected system reliability (State Water Project Final Delivery Capability Report, DWR, 2015). Under the 2030 climate change scenario, the 2020 Table A supply is reduced by 22.3% to 10,070 AF/yr. Under the 2070 scenario, the Table A supply is reduced by 25.6% to 9,642 AF/yr.

The BVWSD has historically taken an average of 1,800 AF/yr of Article 21 water. Because of the development of the Palms and the Corn Camp water banking projects described below, the amount of Article 21 water to be received by the GSA in 2040 and 2070 is expected to increase to 3,900 AF/yr.

6.11.1.4 Demand and Surface Water Outflow

As presented throughout the GSP, consumptive demand has fluctuated considerably during the period between 1993 and 2015. Some of this fluctuation is a response to variations in the weather. However, the factors having the greatest impact on demand have been changes in cropping, particularly conversion from seasonal field crops to permanent plantings and varietal improvements. As extensive plantings of orchards are now maturing in the BVGSA and further conversions of field crops to orchards and high production vineyards are anticipated, the increase in consumptive use due to climate change is likely to be exceeded by the factors described below.

- Irrigation demand measured by the BVWSD in 2019 is approximately 100,000 AF, an average of 2.14 AF/acre over the 43,643 acres eligible to receive water service. This value is comparable to the average total ETa observed over the BVGSA from 2006 through 2015. Demand in 2020 is expected to be comparable to 2019.
- Irrigation demand in 2030 is anticipated to reach 150,000 AF/yr (3.22 AF/acre served). This increase is due to the combined impacts of climate change, maturing orchards and vineyards, and continued conversions to permanent crops;
- Irrigation demand in 2070 is anticipated to reach 175,000 AF/yr (3.75 AF/acre served). This continued increase is also driven by climate change, continued cropland conversion and introduction of higher yield crop varieties having lower consumptive demands relative to yield but higher water demands per acre. The average per acre served values can be compared with a current consumptive demand for high-yielding almonds grown in the San Joaquin Valley of 4.33 AF/acre.

Most surface water outflows from the BVGSA serve transfer agreements or exchanges that are captured in the values given above for entitlements to Kern River and SWP water. An example of this is a 2017 agreement with Semitropic Water Storage District under which SWSD banked 11,238 AF in Buena Vista with the understanding that this water would be recovered by Semitropic, within their own borders. Although this water was formally transferred to Buena Vista under a Transfer Request Form with the KCWA, Buena Vista did not enter the activity in its Groundwater Account or water budget as the banked water belonged to SWSD and will be withdrawn by SWSD after adjustment for the agreed to 10 percent leave behind. Therefore, this water should be entered in SWSD’s Groundwater Account

A second example are lands managed by California Waterfowl. In addition to the lands they own and operate as a duck club and dog club, there are other lands within the District encumbered by Conservation Easements. Historically, these lands have been given the same allocation of surface water as other lands within the District. Also, lands within the District have pumped groundwater as required for their operations. To date, there have been no changes for these lands.

An on-going exception is the Castaic Water Sale, a joint project between the BVWSD and the Rosedale-Rio Bravo WSD (RRBSWD). Under this agreement, Buena Vista banks high flow Kern River water in RRBWSD, which then returns 9,250 AF/year of this water to the Castaic Lake Water Agency. Over the 17-year period between 2020 and 2036, the BVWSD is obligated to bank an additional 29,900 AF (1,759 AF/year) of Kern River water. In addition, Buena Vista contributes 2,750 AF of its SWP entitlement as a part of the sale yielding an annual combined demand of 4,509 AF/year through 2036. Because it is an obligation on the water resources available to the BVGSA, the Castaic Water Sale is accounted for in the Water Resources and Demands Budget.

Another historical exception are flows leaving the GSA via the Main Drain Canal. These flows have greatly diminished over the past 10 years as growers in Buena Vista have converted from gravity irrigation systems which produce substantial volumes of tailwater and tilewater to drip and micro-sprinkler systems which have essentially eliminated these sources of drainage. This reduction is illustrated by flow records showing that prior to 2013 the average annual outflow in the Main Drain Canal was 10,000 AF/yr, but that since June of 2013 there has been zero outflow, even with 2017 flows on the Kern River being 270% of normal. As a result, Main Drain Canal outflows are not an element of the 2020 budget and are not included in the 2030 and 2070 budgets as future outflows are unlikely.

6.11.1.5 Projects

Palms Water Banking Project

Completion of the Palms Groundwater Banking Project, described in Section 7 – Projects, Management Actions and Adaptive Management Action, will remove approximately 1,160 acres from agricultural production. Therefore, although water will evaporate from the project area during periods when the water bank is recharging, the retirement from irrigated land use is expected to lower evapotranspiration by 3.0 AF/ac. Secondly, the Palms will enable the BVWSD to double the volume of Article 21 water the District is now able to accept from the California Aqueduct from 1,800 AF/yr to approximately 3,600 AF/yr. These two adaptations will increase net inflow to the GSA by approximately 5,280 AF/yr.

Corn Camp Water Banking Project

The BVWSD is currently developing a second in-District banking facility on land owned by Chevron at the intersection of Corn Camp Road and Highway 58. This 85-acre project is expected to increase banking of Article 21 water by an estimated 300 AF/yr. In the case of the Corn Camp Project, there will be no reduction in demand, as Chevron will continue to have access to the “Ag Water” associated with this property.

6.11.1.6 Water Resource and Demand Distribution

Table 6-18 presents the parameters and values described above with the 2020, 2030 and 2070 conditions each presented in a single column.

Table 6-18. 2020, 2030 and 2070 Resources and Demands

BVGSA Resource vs Demand	2020	2030	2070
Water Resource		**Volume (AF/yr)**	
Native yield	7,626	7,626	7,626
Precipitation	10,168	8,338	8,541
Subtotal	17,794	15,954	16,167
Kern River	149,000	147,000	147,000
SWP Table A[1]	13,392	10,406	9,964
SWP - Article 21[2]	1,800	3,900	3,900
Subtotal	164,192	161,306	160,864
Available Resource	181,986	177,260	177,031
Water Demand		**Volume (AF/yr)**	
Evapotranspiration[3]	100,000	150,000	175,000
Castaic Water Sale	4,509	4,509	
Main Drain Canal[4]	-	-	-
Total Demand	104,509	154,509	175,000
Balance	77,477	22,751	2,031

[1] Table A reduced by 22% in 2030 and by 26% in 2070

[2] Article 21 increased by 2,100 AF/yr due to completion of Palms and Corn Camp water banking projects

[3] 2020 estimate based 2019 water demands measured by BVWSD

[4] Based on average Main Drain Canal outflow since June 2013. This value is used because it represents current and expected future outflows.

The 2020 budget is based on the native yield and precipitation values agreed to by the coordinating committee. Kern River and SWP values are based on the BVWSD's entitlement to the Kern River and its Table A contract amount adjusted to conform to DWR projections of water supply reliability. Values for Article 21 water and for irrigation demand are based on 2019 measurements and the value for Main Drain Canal outflow is the average of measurements taken between 2006 and 2015, as well as BVWSD records that extend for nearly 100 years.

As described above, the 2030 projection holds native yield constant while precipitation has been reduced by 18% to 8,338 AF/yr. Diversions from the Kern River have been reduced by 1.8% to 147,000 AF, Table A diversions have been reduced by 22% and Article 21 inflows have been increased by 2,100 AF/yr to account for the capacity of the Palms and the Corn Camp water banking projects to accept Article 21 water. Crop consumption has been increased by 50% which includes a 3.0% increase in response to climate change with the additional increase due to other factors described above. Outflows via the Main Drain Canal credited to the inflows described above are expected to be negligible with any measurable outflows resulting from runoff of precipitation in excess of the precipitation value credited to the GSA.

The 2070 projection continues to hold native yield constant while precipitation has been reduced by 16% from the 2020 baseline to 8,451 AF/yr. The Kern River entitlement is projected to remain the same as that presented for 2030, 147,000 AF/yr. Article 21 inflows used in the 2070 budget are the same as those shown for 2030 while Table A deliveries have been further restricted due to climate change. The Buena Vista Water Storage District expects to participate in the Delta Conveyance Project, and, as a result, should not suffer Article 21 reductions. Irrigation demand is projected to increase to 175,000 AF/yr, 17% greater than the demand estimated for 2030 with 4.6% of this increase attributed to climate change. This is a conservative estimate anticipating continued conversion to higher value permanent crops and their associated higher demand.

6.11.1.7 Summary

The 2030 and 2070 projections indicate that the impacts of climate change are expected to do little to reduce BVWSD's entitlement to the Kern River. Therefore, as demands within the BVGSA increase, the current gap between the BVWSD's entitlement to the river and its diversions to serve internal demands is likely to shrink as the District reduces transfers to other users to meet its own growing demands in the face of diminishing SWP supplies.

The water budget table for 2020, 2030 and 2070 demonstrates that when applying agreed values for native yield, precipitation and climate change projections, the BVGSA is in surplus and will remain in surplus through 2070 albeit with the surplus diminishing due primarily to anticipated increases in irrigation demand with climate change being an important but secondary factor. Nevertheless, due largely to the BVWSD's entitlement to the Kern River and the District's history of conjunctive management, the BVGSA has the resources and the mechanisms to remain in balance internally and to contribute to achieving sustainability throughout the Kern County Subbasin.

The BVWSD has other projects, such as the McAllister Ranch Water Banking Project and future internal pipeline projects, which will provide the GSA opportunities to stay in balance should projected increases in demand be underestimated, or should the changes occur more rapidly than now anticipated. To a large degree, the water needed to address these contingencies is already available to the District, and the projects needed to manage this water are under development.

7. Projects, Management Actions, and Adaptive Management Actions

7.1 Management Program

As documented in preceding sections, due to the BVWSD's geologic setting and its conjunctive management of surface water and groundwater, the BVGSA has maintained stable groundwater elevations while supporting irrigated agriculture with most of the GSA showing little fluctuation in depths to groundwater between wet periods and droughts. Although the GSA does not need to construct projects and introduce management actions to correct a history of unsustainable groundwater use, it has developed an integrated program of measures that will enable the GSA to continue to manage groundwater effectively to achieve the goal of supporting water users in the Kern County Subbasin in the face of changing conditions. Foreseeable changes include both increasing demands within the BVGSA and external forces likely to change the timing and volumes of surface water available from the Kern River and the State Water Project.

Two principles that have guided the BVWSD in the past and will continue to guide the District and the BVGSA during implementation of SGMA are:

- Conjunctive management of surface water and groundwater, and
- Adaptive management.

The application of these principles is illustrated by the program of pipeline and groundwater recharge projects now underway that are adapting the District's facilities and operations from a period characterized by reliable surface water deliveries and farming of seasonal crops to an era of highly variable surface water supplies and expanded plantings of permanent crops. In this light, the on-going efforts to introduce projects and management actions needed to provide a secure water supply for the future are consistent with actions needed to protect the groundwater resource.

Internal Changes

The BVGSA anticipates that land use within the BMA will remain predominately irrigated agriculture and that the irrigated acreage will remain stable. This stability in land use and acreage notwithstanding, the GSA anticipates crop water demands to increase and harden during the period of SGMA implementation as the percentage of land devoted to permanent crops increases and because of the likelihood that new plantings of vineyards and tree crops will be at higher densities to increase productivity. The effects of climate change are projected to increase evapotranspiration by 3 percent between the baseline period and 2040 with a further 5 percent increase between 2040 and 2070 thereafter (DWR, 2019). However, the relation between predicted increases in temperature and consumptive use are not well understood because increased rates of consumptive use may lead to shorter growing seasons and other changes in plant phenology. Increases in crop consumption caused by climate change are expected to be accompanied by increases in demands resulting from changes in cropping patterns and improvements in farming practices. Total increases in consumptive use for mature plantings may reach 8 percent above the baseline period by 2040 and 15 percent above the baseline by 2070. As described later in this section, the Palms Groundwater Banking and Recharge Project will replace 1,160 irrigated acres, approximately 3 percent of the irrigated acreage in the BMA, with spreading grounds.

Responses to Internal Changes

The goal of the BVGSA's program of projects and management actions is to continue to prepare for a future characterized by higher water demands. Because the cropping pattern anticipated in the GSA is likely to have a higher concentration of permanent crops than under the baseline condition, this continuing shift will leave fewer opportunities to reduce demand during prolonged droughts by land fallowing. However, because of the resilience of some permanent crops to deficit irrigation, incentives to reduce irrigation applications will remain a management action that can be instituted as a direct response to drought.

External Changes

The primary forces driving external changes are the potential consequences of climate change on the volume of water delivered by the SWP and Kern River and on the timing of Kern River flows. Although the magnitude of these potential shifts in the volumes and timing of surface water supplies remains uncertain, the BVGSA and landowners within the GSA are cognizant of the impacts changes in water supply may have on their operations.

Responses to External Changes

For conjunctively managed areas such as the BVGSA, the ability to sustainably manage groundwater depends on sound management of surface water supplies, coordinated use of surface water and groundwater facilities and continual refinement of facilities and operational practices to conform with the availability of surface water and with changes in cropping patterns and farming practices. The five major elements of the BVGSA's program for sustainable groundwater management are:

- Capture and recharge of water received from the Kern River and the SWP in facilities constructed within the boundaries of the BMA and in partnerships with neighboring GSAs.
- Improve distribution facilities to expand the ability to deliver surface water throughout the GSA as a means of reducing reliance on groundwater.
- Measurement of:
    - Surface water deliveries;
    - Water pumped from district-owned and landowner wells; and

- Water distributed to farm fields and recharge facilities.

- Monitoring of groundwater elevations and water quality.
- Water conservation and treatment.

Projects and management actions described in this section were developed by the BVWSD and by stakeholders. While each of these actions addresses sustainability indicators introduced by the SGMA legislations, none were formulated specifically as responses to SGMA. For example, the BVWSD's program to install meters on all production wells was completed before the formation of the BVGSA. In short, sustainable groundwater management is not a concept that has been introduced by SGMA, but rather, is an expression of the BVWSD's mission to serve its water users. Important contributions of the SGMA legislation have been to require that the BVGSA quantify the performance of its conjunctive management program through establishment and monitoring of minimum thresholds and measurable objectives and that the GSA coordinate management of its water resources with other GSAs to promote sustainable management of groundwater in the Kern County Subbasin.

Given the BVWSD's history of successful conjunctive management under a wide range of water supply conditions, the GSA intends to continue to implement projects to prepare for changing conditions. One of the objectives of the GSA's emphasis on anticipation and preparation is to minimize reliance on emergency demand management actions taken in response to breaches of trigger conditions such as minimum thresholds. The emphasis on long-term planning is possible because of the following factors:

- As presented in Section 5 – Minimum Thresholds, Measurable Objectives and Interim Milestones, the BVGSA is estimated to have a drought reserve of 362,000 AF with substantially greater volumes of groundwater that can be accessed in a drought emergency;
- BVWSD has a well-established history of conjunctive management that has enabled it to withstand prolonged droughts with little change in groundwater storage, and
- The extensive commitment by landowners to planting of permanent crops favors a program of projects and management actions that emphasizes preparation for future conditions and predictability of water supply.

In the unlikely event that long-term planning is insufficient to prevent breaches of minimum threshold, the BVGSA has established a sequence of adaptive management actions to reverse adverse conditions. These adaptive management actions, detailed in Section 7.4, are based on actions including curtailment of transfer and exchanges of BVWSD, fallowing of lands in annual crops, securing supplemental water through transfer and exchange, and curtailment of pumping for wells within a specified radius of the locations where breaches of minimum thresholds have been observed.

Activities already under development are included in 2040 and 2070 water budget projections. Also included in these projections are management actions anticipated to capture Kern River flood flows anticipated under 2040 and 2070 climate change scenarios.

7.1.1 Sustainability Goal

The six sustainability indicators defined by SGMA are guideposts that warn of groundwater conditions occurring throughout a subbasin which, when significant and unreasonable, lead to undesirable results. As described in the California Water Code Section 10721 (x), the six sustainability indicators are:

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

In the BVGSA, undesirable results are likely to be associated with four of these sustainability indicators. Significant and unreasonable seawater intrusion is not relevant given the GSA's inland location in Kern County, and, as discussed in Section 2 - Basin Setting, the potential for depletions of interconnected surface waters is small given the following factors:

- The absence of streams flowing into or through the BVGSA;
- The depth of the principal aquifer system which makes it unlikely that groundwater pumping has the potential to deplete surface water, and
- The absence of groundwater dependent ecosystems (GDEs) mapped within the boundaries of the BVGSA.

7.1.2 Development Process

7.1.2.1 Project Identification

The BVGSA's approach to sustainable groundwater management is to emphasize continued development of projects that will recharge available surface water and provide efficient, metered extraction and distribution of stored groundwater and effective application of water to irrigated lands to minimize losses resulting from evaporation and runoff.

7.1.2.2 Management Action Identification

The BVGSA will exercise management actions when needed to prevent dewatering of wells should water tables drop below well screens or breach minimum thresholds. These actions will focus on protection of owners of shallow domestic wells, the groundwater users most vulnerable to declines in well production.

7.1.2.3 Adaptive Management Identification

As uncertainties and data gaps are reduced with information and insights obtained from the GSA's monitoring networks and from assessment of the performance of newly implemented projects, management actions will be amended accordingly. Furthermore, if in the future DWR mandates certain corrective actions, the GSP will be adjusted to accommodate those new requirements in the Sustainable Groundwater Management Program, GSP Emergency Regulations Guide, p. 4 (DWR, 2016). In this way, projects and management actions can be pursued which reflect the evolving condition of groundwater management within the GSA and the Subbasin, and the current status of SGMA regulations.

7.1.2.4 Evaluation of Projects and Actions

Projects presented in this section have been developed and evaluated largely through the Integrated Regional Water Management (IRWM) process. Projects developed through this process do not focus exclusively on meeting SGMA goals. However, they do evolve through a regional water management framework centered on sustainable management of surface and groundwater resources applying a process that considers factors including land use and the impacts of climate change. Therefore, while IRWM planning does not specifically reference the regulatory aspects of SGMA, projects evaluated and prioritized through the IRWM process are based on a regional perspective and are well suited to the goal of sustainable groundwater management.

The adaptive management actions presented in this GSP resemble those presented in earlier groundwater management plans, in being phased actions triggered by chronic lowering of groundwater levels and the consequent depletion of groundwater storage.

7.2 Projects

Projects that will enable the BVGSA to sustainably manage groundwater fall into five categories:

- Water measurement projects;
- Sustainability monitoring projects;
- Water distribution system improvement projects;
- Groundwater recharge and recovery projects, and
- Water conservation and treatment projects.

Projects falling under each of these categories are discussed below.

7.2.1 Water Measurement Projects

7.2.1.1 Summary of Projects

The BVWSD has installed magnetic flow meters on all production wells in the BVGSA. As described below under Water Distribution System Improvements, the District is also in the process of converting portions of its canal system to pipelines with magnetic flow meters installed at each turnout and is improving measurement of water delivered from canals by upgrading gates as detailed in the BVWSD AWMP, 2015. Each of these activities improves the performance of the conjunctive management program and reduces the uncertainty of inputs to the GSA's groundwater budget. The meters now installed on all production wells will enable the GSA to give an exact accounting of groundwater extractions for annual reports required by SGMA and as inputs to the GSA's water budget. The improvements in water measurement instituted by the District have been accompanied by the implementation of volumetric pricing which provides a mechanism for introducing pricing tiers to incentivize water conservation.

All improvements to water measurement facilities within the BVGSA are being funded through the activities of the BVWSD and place no payment obligations on the BVGSA.

7.2.1.2 Public Notice and Outreach Process

Installation of meters on pipeline turnouts was a component of construction projects approved by the Board of the BVWSD and noticed for public comment as part of the environmental review process. Installation of meters on district-owned and landowner production wells was carried out after the approval of all affected parties. Installation of improved gates on canal turnouts is being carried out during routine system maintenance by the BVWSD as part of the measurement improvement program described in the BVWSD, AWMP, 2015.

7.2.1.3 Permitting and Regulatory Process

All necessary permits have been obtained for improvements to measurement facilities. Meters installed on pipeline turnouts were all permitted under the pipeline construction projects. Installation of magnetic flowmeters on wells required no permitting as no site disturbance or construction was needed. Installation of improved gates on canal turnouts also required no permitting as this work was a routine maintenance activity.

7.2.1.4 Benefits and Affected Sustainability Indicators

The benefits of improved water measurement tie directly to improvements in conjunctive management and detection of changed conditions that drive formulation of projects to adapt facilities and operating practices to changing conditions. As noted throughout this section, the BVGSA's goal is to identify fundamental changes in factors ranging from hydrology to farming practices and use tools such as the BVGSA's water budget to plan responses that preserve the District's ability to manage its resources sustainably so that it may continue to serve water users.

7.2.1.5 Source and reliability of Water

Given projected supplies available to the BVWSD from the Kern River and the State Water Project, the BVGSA is confident adequate supplies of surface water will be delivered under predicted conditions to meet future demands. However, changes in demands and in the timing and volume of supplies will require that the BVWSD develop new facilities and modify operational practices to accommodate the anticipated changes in ways that will minimize their impacts both within the GSA and within the Kern County Subbasin. Improved measurement of deliveries to the GSA and of distribution of surface water and groundwater within the GSA will be important for identifying changing conditions and for operating facilities in ways that will respond to those changes.

7.2.1.6 Legal Authority Required

The BVWSD has the responsibility and the authority to measure water resources within its boundaries.

7.2.1.7 Costs and Funding

As described above, extensive improvements to water measurement facilities have recently been completed within the BVGSA, notably installation of magnetic flow meters and totalizers on district-owned and landowner production wells and on turnouts from planned and newly completed pipelines. Costs for the water measurement projects are covered by the BVWSD.

7.2.1.8 Schedule

Magnetic flowmeters have been installed on all district-owned and landowner production wells within the BVGSA with installation having been completed in 2016. Magnetic flowmeters have also been installed on turnouts from all completed pipeline projects and will continue to be installed as pipeline projects are approved and constructed.

7.2.1.9 CEQA/NEPA Considerations

Measurement facilities on pipeline projects are installed as a component of pipeline construction projects that commence after completion of CEQA documentation and, in the case of projects receiving federal funding, after NEPA documentation has also been completed. Improvements to gates at canal turnouts are implemented as routine canal maintenance activities that are generally exempt from CEQA. Similarly, installation of meters on district-owned and landowner production wells is typically regarded as a routine improvement and is exempt from CEQA.

Future expansion of or improvement to measurement facilities will be performed after completion of the appropriate level of CEQA documentation. Any projects having a Federal nexus, for example due to award of Reclamation grant funding, will have NEPA documentation completed as a requirement of the Reclamation funding.

7.2.1.10 Uncertainty Assessment

Measurement of water is central to reducing the uncertainty of the BVGSA's water budget and of the water distribution and use within the GSA. The BVWSD's investment in metering groundwater extracted from all production wells within the GSA's boundaries expresses the commitment of local water users to minimizing the uncertainty associated with water use. The BVGSA foresees no impediments to carrying out its planned program of improved water measurement.

7.2.2 Sustainability Monitoring Projects

7.2.2.1 Summary of Projects

Section 4 – Monitoring Networks, describes existing monitoring networks within the BVGSA. The role of the BVGSA will be to meet SGMA reporting requirements by collecting data gathered through monitoring programs operated by the BVWSD and the Buena Vista Coalition. Should data gaps become apparent in monitoring of groundwater levels or groundwater quality for the purposes of SGMA, the GSA will develop a plan for filling these gaps by collecting data at additional locations or through installation of new monitoring wells. Additional monitoring wells are included in the plans for new and expanded recharge facilities being developed by the BVWSD and are described below under Groundwater Recharge and Recovery Projects.

7.2.2.2 Public Notice and Outreach Process

The existing facilities of the BVGSA monitoring networks rely on district monitoring wells that are part of the CASGEM system, monitoring wells and piezometers that are elements of the monitoring network developed for the GQTMWP, 2018, piezometers now monitored by the BVWSD in the northwest of the BMA and a landowner well in the southeast. All production wells in the BVGSA's network are metered and all monitoring wells are part of established monitoring programs. For this reason, no further public notice and outreach is required beyond the public outreach program described in Section 9 – Public Outreach and Engagement.

7.2.2.3 Permitting and Regulatory Process

No new facilities are needed to implement the BVGSA's initial monitoring program. Should the need for construction of supplemental monitoring sites be established to fill data gaps within the GSA, the necessary permitting and regulatory processes will be followed prior to construction of these facilities.

7.2.2.4 Benefits and Affected Sustainability Indicators

Operation of the facilities in the existing monitoring networks and expansion of these networks to fill data gaps identified during the period of SGMA implementation provides the foundation for monitoring attainment of measurable objectives and avoidance of minimum thresholds. Thus, there is a direct connection between this project and the sustainability indicators to be observed by the monitoring networks.

7.2.2.5 Source and Reliability of Water

Given projected supplies available to the BVWSD from the Kern River and the State Water Project, the BVGSA is confident adequate surface water will be available under predicted conditions to meet future demands. However, changes in demands and in the timing and volume of supplies will require that the BVWSD develop new facilities and modify operational practices to accommodate the anticipated changes and their impacts both within the GSA and within the Kern County Subbasin. By improving observation of sustainability indicators, data generated by this project will contribute to guiding water management practices in the BVGSA in ways that will support sustainable groundwater management in the GSA and in the Kern County Subbasin. The BVWSD will also consider participation in the Delta Conveyance Project (DCP) to improve volume and reliability of deliveries from the SWP.

7.2.2.6 Legal Authority Required

Facilities included in the BVGSA's monitoring networks are all either wells owned and maintained by the BVWSD, subsidence monitoring locations maintained by state or federal agencies or private wells whose owners have agreed to allow their wells to be included in the monitoring networks.

7.2.2.7 Costs and funding

The facilities included in the existing monitoring program have been constructed and most are operated by the BVWSD and the Buena Vista Coalition. The BVGSA will bear the cost for consolidating information from these sources into the reporting format specified by SGMA and followed within the Kern County Subbasin. The GSA will also be responsible for gathering data from wells not now monitored by other agencies. Funding for new monitoring facilities, should they be required, will be obtained from internal resources and from grant programs administered by DWR and by Reclamation.

7.2.2.8 Schedule

There is no schedule now defined for expansion or improvement of the monitoring network. The need for these activities will be based on performance of the existing network and identification of data gaps.

7.2.2.9 CEQA/NEPA Considerations

Future requirements for CEQA and NEPA compliance will be determined based on the need for inclusion of new facilities to expand the GSA monitoring networks, the types of facilities and the sources of funding. All new projects will be constructed after completion of the required level of CEQA documentation. Projects having a Federal nexus due to award of Reclamation grant funding will have NEPA documentation completed as a requirement of the Reclamation funding.

7.2.2.10 Uncertainty Assessment

Establishment and operation of effective monitoring networks is central to SGMA compliance and to effective conjunctive management of surface water and groundwater. For these reasons, while the specifics of future modifications to the monitoring networks are not known, the BVGSA is committed to maintaining networks able to perform the needed functions and anticipates no obstacles that would jeopardize the GSA's capacity to make improvements needed to fill data gaps that may be identified during the course of SGMA implementation.

7.2.3 Water Distribution System Improvement Projects

7.2.3.1 Summary of Projects

This group of projects is being implemented to improve and expand distribution of surface water from the SWP and the Kern River to areas in the north of the BMA using pipeline systems that replace existing unlined canals and ditches. The BVWSD has been actively engaged in this suite of projects for the past eight years. Elements of the water distribution improvement project include the:

- Northern Area Pipeline (completed);
- Northern Area Pipeline - Southern Extension (completed);
- Northern Area Pipeline - Eastern Extension (completed);
- 7th Standard Road Project (under construction);
- The Palms Recovery Wells and Pipelines (CEQA documentation under preparation);
- Wasco Way Pipeline (planned);
- Elk Grove Pipeline (planned);
- Belridge Pipeline (planned), and
- Brite Road Pipeline and Pump Station (planned).

The purposes of the pipelines are to:

- Expand the area in the northern portion of the BMA able to receive surface water;
- Extend the season during which surface water can be distributed to these areas;
- Reduce the need for groundwater pumping to supplement surface water supplies;
- Provide water users with conveyance and distribution facilities having the responsiveness and flexibility to supply the drip and micro-spray systems now prevalent on farms in the BVGSA, and
- Separate groundwater recharge from irrigation delivery.

In addition to their stated purposes, coupled with the expansion of the drip and micro-spray on-farm irrigation systems, the pipeline projects have altered the BVGSA's water budget by reducing the volume of drainage water collected in the Main Drain Canal that flows north out of the District.

As shown in the Section 6 – Water Accounting, the BVGSA's water budget includes an average annual volume of 31,141 AF of canal seepage [1993 – 2015] that percolates to groundwater. To mitigate the loss of this recharge capacity resulting from conveyance of water through pipelines rather than canals, selected canals removed from service as distribution facilities are being retained as linear recharge features that receive surface water during years of adequate supply. The goal is to maintain the quantity of water now recharged through canals, but to shift the timing of recharge by not having recharge tied to the delivery of irrigation water.

7.2.3.2 Public Notice and Outreach Process

The elements of the Distribution Improvement Project have been developed though and supported by regional planning efforts and meet the criteria set forth by local and state plans, including the Kern County Integrated Regional Water Management Plan, BVWSD AWMP, 2015, Governor's Water Action Plan, BVWSD Groundwater Management Plan, and California Water Plan. No opposition has been expressed to completed or on-going phases and none is anticipated for future phases.

7.2.3.3 Permitting and Regulatory Process

The BVWSD adhered to the permitting and regulatory process required by the County of Kern for the Northern Area Pipeline and for other pipeline conversion efforts that have been completed or are now under construction. The District will continue to adhere to these requirements for future phases of the project.

7.2.3.4 Benefits and Affected Sustainability Indicators

Using pipelines instead of unlined canals extends the area that can be served with surface water and prolongs the season of delivery. In addition, as described under the water measurement project, converting distribution facilities from canals to pipelines enables more accurate measurement of deliveries at turnouts by replacing gates with magnetic flow meters, an improvement which also supports volumetric billing. Benefits of the Distribution System Improvement Projects include:

- reduced canal seepage;
- extended land area served with surface water and extended delivery season reducing reliance on groundwater;
- potential to distribute high-quality water from the SWP and the Kern River throughout the BMA, and
- conversion of retired canals to dedicated linear recharge facilities.

The water system distribution improvement projects affect several sustainability indicators including:

- Chronic reduction in groundwater levels: As mentioned above, improved distribution and application of surface water supports groundwater elevations by reducing the need to extract groundwater for irrigation;
- Reduced Groundwater Storage: This project protects stored groundwater by reducing the need to pump groundwater to meet irrigation demands;
- Diminished Groundwater Quality: This project is expected to help control the possible migration of saline groundwater into the northern portion of the GSA as reduced reliance on groundwater may prevent a worsening of the gradient drawing saline water from the west.
- Subsidence: Although only limited subsidence has been observed in the BVGSA, pipelining of canals is expected to limit the likelihood of future subsidence by reducing reliance on groundwater extraction to satisfy agricultural water demands.

7.2.3.5 Source and Reliability of Water

Given projected supplies available to the BVWSD from the Kern River and the State Water Project, the BVGSA is confident adequate surface water will be available under predicted conditions to meet future demands. However, changes in demands and in the timing and volume of supplies will require the BVWSD to develop new facilities and modify operational practices to accommodate the anticipated changes and their impacts within both the GSA and the Kern County Subbasin. The Water Distribution System Improvement Project is being implemented in anticipation of predicted changes in the reliability of surface water to improve the efficiency and effectiveness of these water supplies.

7.2.3.6 Legal Authority Required

This group of projects is proceeding based on authorization by the BVWSD Board of Directors. All water distributed through the improved distribution system is available to the District under its contracted allocation of SWP water through the Kern County Water Agency or water diverted from the Kern River under the District's established water right.

7.2.3.7 Costs and Funding

The total cost of completed water system distribution projects (Northern Area Pipeline (NAP), NAP Eastern Extension, and NAP Southern Extension) have been paid in full. The 7th Standard Pipeline, now under construction, has all material purchased and will have BVWSD crews install the pipeline. Funding for each of these phases has been provided through the BVWSD and from grant funding received from DWR and from Reclamation. The cost of developing the McAllister Ranch (a future water bank), and the Palms (an in-district water bank) and been paid. The District has established a banking relationship for short- and medium-term funding of projects. Therefore, it is not anticipated that bond offerings will be needed for development of future projects.

7.2.3.8 Schedule

The schedule for projects in the Distribution System Improvement Category will be based on the need for and benefits of pipeline construction projects that are identified during the period of SGMA implementation. As noted above, planned pipeline conveyance facilities include the Belridge, Brite Road, Wasco Way, and Elk Grove pipelines, the Palms Recovery Wells and Pipelines and pipelines associated with the McAllister Ranch Water Bank.

7.2.3.9 CEQA/NEPA Considerations

All projects in the Distribution System Improvement Projects category that have been completed to date or are now under construction have been performed in compliance with CEQA through completion of Mitigated Negative Declarations. Projects that have had a Federal nexus due to award of Reclamation grant funding also complied with CEQA and had Environment Assessments completed to comply with NEPA before the commencement of construction. The same level of CEQA and NEPA compliance is anticipated for future phases of this project.

7.2.3.10 Uncertainty Assessment

Based on the success of the BVWSD in funding, environmental compliance, permitting and construction of projects in the Distribution System Improvement category, the District does not anticipate any unforeseen risks to development and completion of future projects in this category.

7.2.4 Groundwater Recharge and Recovery Projects

7.2.4.1 Summary of Projects

Farmland in the BVGSA is characterized by tight (non-permeable) topsoils overlying permeable subsoils as described in Section 2 – Basin Setting. Therefore, deep percolation of applied irrigation water contributes little groundwater recharge, and conversion from gravity irrigation systems to low-volume pressurized on-farm systems has less impact on groundwater recharge than have such conversions in areas having more permeable soils.

While topsoils limit infiltration from the soil surface in the southern portion of the BMA, apart from this surface layer there are no confining layers that obstruct water from percolating to the principal aquifer system. For this reason, facilities constructed in the BMA that place water in contact with soils below the surface layer are effective mechanisms for aquifer recharge.

In addition to continuing to rely on canals as recharge facilities, both in combination with conveyance functions or as dedicated linear recharge features, the BVWSD is now developing a groundwater banking facility, the Palms Project, within its boundaries and is the lead agency in development of the Corn Camp Water Bank, which will also lie within the GSA boundaries. The

BVWSD is also involved in the development of the McAllister Ranch banking facilities that lie outside of the GSA.

The most important on-going project in the Groundwater Recharge and Recovery Category is the Palms Project. This project will function as a water bank with groundwater levels increasing during periods when water is recharged and decreasing when groundwater is pumped. However, the project will be managed so that groundwater elevations will increase, over the long-term, from historic levels. The annual water recovery will be limited to no more than 25,000 acre-feet.

An alternative method of groundwater recovery will be to provide flexibility to landowners by allowing private pumping in lieu of surface water deliveries. Landowners would have the option to utilize on-farm wells to either pump water for irrigation needs or continue to receive surface water deliveries through the District canals and pipelines. No additional facilities would need to be constructed for this delivery option and all eligible wells are metered, so volumes of pumping under the program would be accurately reported. Interested landowners would be required to sign up for the program, and participation would be limited by the amount of water available for recovery, no more than 25,000 acre-feet per year.

The Palms Project has the following primary objectives:

- Increase conjunctive management on the west side of Kern County by expanding the area's ability to accept surface water for groundwater recharge during periods when surface water is available. Groundwater stored by the Project will be available to meet demands during periods when surface water is limited.
- Reduce agricultural demand by replacing 1,160 acres of irrigated farmland with spreading grounds.
- Sustain groundwater elevations in the extreme south of the BMA, an area where groundwater elevations are influenced by banking operations lying immediately outside the BVGSA.

7.2.4.2 Public Notice and Outreach Process

In January 2016, the District approved construction of the Palms Project. The public has been engaged in development of the Palms Project through scoping meetings and other outreach efforts conducted through the environmental compliance process.

On October 26, 1995, the Kern Water Bank Authority and its Member Entities, as the "Project Participants," and Buena Vista Water Storage District, Rosedale-Rio Bravo Water Storage District, Kern Delta Water District, Henry Miller Water District and West Kern Water District, as the "Adjoining Entities," entered into an agreement based on a Memorandum of Understanding (MOU). In this MOU, Paragraph 8 states that "any future project within the Kern Fan Area, the Parties hereto shall use good faith efforts to negotiate an agreement substantially similar in substance to this MOU." In accordance with Paragraph 8, the District will develop an MOU, to be negotiated with adjoining entities, which will address the operation and monitoring of the Palms Groundwater Recovery Project. This project-specific MOU will be substantially similar in substance to the 1995 MOU.

7.2.4.3 Permitting and Regulatory Process

As with other construction projects undertaken by the BVWSD, the District obtained all necessary construction and environmental permits prior to construction of phases 1 and 2 of the Palms Project and will follow similar procedures in obtaining permits and complying with regulations for future project phases and for other groundwater recharge and recovery projects.

7.2.4.4 Benefits and Affected Sustainability Indicators

The District has recharged approximately 30,190 acre-feet diverted under its Kern River water right in the project over the last two years (16,000 acre-feet recharged from canals in the Palms project area and 14,190 acre-feet in the constructed recharge basins). High quality Kern River water recharged by the Palms Project flows to aquifers that are sources for domestic and municipal wells providing water to residents of Taft and Tupman, to the disadvantaged community of Buttonwillow, and to replenish groundwater under the Tule Elk Reserve.

Water recovered from the Palms Project will be distributed to district water users, exchanged with other districts, or made available to industrial or municipal users. The project may also discharge to the California Aqueduct to satisfy existing and future water contracts between the District and other public water agencies.

Project benefits fall into three primary categories: 1) benefits to groundwater users and prospective banking partners, 2) habitat benefits as a result of greater availability of water for transfer to the Tule Elk Reserve, and 3) water quality improvements due to retirement of project land from agricultural production resulting in reduced leaching of contaminants to groundwater. These benefits are described in greater detail below.

1. Water supply and energy savings will result from a general increase in groundwater elevations in the Project area. Although the Palms Project will function as a banking project with groundwater levels increasing during periods when water is recharged and declining when groundwater is pumped to meet local demands or for delivery to agricultural users and banking partners, the Project will contribute to SGMA compliance within the Kern County Subbasin by supporting groundwater elevations in and around the project area and will enable groundwater pumpers including local domestic and municipal users to reduce pumping lifts.

2. Banking of groundwater in an area immediately adjacent to the Tule Elk Reserve will strengthen the BVGSA’s ability to provide water to the reserve.

3. Groundwater recharge facilities within the BVGSA are typically constructed on lands that were previously irrigated farmland. By removing acreage from agricultural production, the project both lessens water demand and reduces the leaching of contaminants introduced through farming practices.

7.2.4.5 Source and Reliability of Water

Given projected supplies available to the BVWSD from the Kern River and the State Water Project, the BVGSA is confident adequate surface water will be available to meet future demands. However, changes in demands and in the timing and volume of supplies will require that the BVWSD develop new facilities and modify operational practices to accommodate the anticipated changes and their impacts both within the GSA and within the Kern County Subbasin. The suite of groundwater recharge and recovery projects described above will improve the BVGSA's capability to store groundwater when water is available to be placed in storage, to recover stored groundwater when needed and to monitor inflows and outflows to facilitate effective operation of these storage and recovery projects.

7.2.4.6 Legal Authority Required

Groundwater recharge and recovery project are proceeding based on authorization by the BVWSD Board of Directors. All water banked in these facilities will be available to the District under its contracted allocation of SWP water through the Kern County Water Agency, water diverted from the Kern River under the District's established water right, or water made available for storage under agreements with banking partners.

7.2.4.7 Costs and Funding

Construction of new water banks and expansion of the existing Palms Project will be funded primarily through the resources of the BVWSD. State and federal grant programs are likely to provide supplemental funding; however, the timing for implementation of these projects is not contingent on the timing of grant programs. The BVWSD has established a banking relationship that allows the District access to short-term loans for project construction. In the past six years, the District has invested $95,000,000 in land acquisition and project development and has issued $3,500,000 in debt.

7.2.4.8 Schedule

The Palms and the Corn Camp groundwater banking project are both scheduled for completion within five years with the exact date of completion contingent on environmental review. Other groundwater banking projects will continue to be developed and placed into operation throughout the period of SGMA implementation.

7.2.4.9 CEQA/NEPA Considerations

An Initial Study/Mitigated Negative Declaration (SCH # 2015121030) was prepared in 2015, and the Notice of Determination was filed in January 2016 addressing construction and operation of Stages 1 and 2 of the Palms Project. Additional CEQA documentation is now being prepared for future stages of the project. Discussions are underway regarding CEQA compliance for the McAllister Ranch Groundwater Banking Project (outside boundaries of the BVGSA) and the Corn Camp Water Banking Project, which is to be constructed within the BVGSA.

7.2.4.10 Uncertainty Assessment

Stages 1 and 2 of the Palms Project were completed in 2017 and have been in operation since that time. Additional environmental documentation and coordination is being performed on the remaining stages. Given the successful performance of the completed stages and the value these elements have demonstrated by capturing and recharging available flows from the Kern River, the BVGSA sees no major impediments to completion of future project stages. The BVGSA is continuing to advance planning for the McAllister Ranch and Corn Camp projects

7.2.5 Conservation and Water Treatment Projects

7.2.5.1 Summary of Projects

The Brackish Groundwater Remediation Project (BGRP) is being implemented to improve the quality of shallow, perched groundwater in the northern area of the BMA by recovering brackish groundwater for blending with low salinity water prior to application to crops. This project is expected to contribute up to 12,000 AF of additional water resources to the GSA per year. The project includes approximately 60 wells, placed about 200 feet apart following an alignment parallel to the right-of-way of the recently completed Northern Area Pipeline.

7.2.5.2 Public Notice and Outreach Process

The outreach process for the project followed the BVGSA's normal public notice and outreach process as well as the public notification requirements of CEQA.

7.2.5.3 Permitting and Regulatory Process

No major permits or third-party approvals where required from local, State, or federal agencies other than county well drilling permits and road easements, and formal easements from landowners.

7.2.5.4 Benefits and Affected Sustainability Indicators

This project is designed to increase water supply by augmenting supplies of surface water through blending with groundwater that otherwise would not be used because of its marginal quality. As a result of the intended increase in water resources made available to the GSA from this project, and the subsequent reduced groundwater pumping, the primary affected sustainability indicator will be chronic lowering of groundwater levels and its corollary, reduction of groundwater storage.

7.2.5.5 Source and Reliability of Water

Operation of the Brackish Groundwater Recovery Project relies on shallow, groundwater underlying the project area and surface water imported via the State Water Project and diverted from the Kern River. One of the project objectives is to blend the fresh surface water with brackish groundwater to augment the reliability of the overall supply.

7.2.5.6 Legal Authority Required

The project was approved by the BVWSD Board of Directors and was constructed following completion of CEQA compliance requirements.

7.2.5.7 Costs and Funding

The total budget for the project was $3,088,690. Of this, the State Share of $2,100,000 was dedicated to construction costs. The remaining $988,690, provided by BVWSD, supported the remaining construction costs and other items including staff and consultants, environmental documentation, easements. Northern Area Pipeline – Southeast Extension, p. 15.

7.2.5.8 Schedule

Construction of this project was completed in 2018.

7.2.5.9 NEPA Considerations

The Brackish Groundwater Recovery Project was implemented after completion of CEQA and NEPA compliance requirements. A mitigated negative declaration was prepared for CEQA and an Environmental Assessment was completed for NEPA.

7.2.5.10 Uncertainty Assessment

The Brackish Groundwater Recovery Project is now operational, and a high degree of certainty can be assigned to its continued operation.

7.3 Management Actions Planned as Part of GSP to be Implemented Regardless of Conditions

As described in the previous sections, the BVGSA has projects that have recently been completed, are now under construction or are in the various stages of planning. Together these projects constitute a comprehensive program to provide a reliable, actively managed water supply that supports sustainable groundwater management in the GSA and prepares the GSA to maintain measurable objectives and avoid breaches of minimum thresholds.

By expanding recharge facilities, modernizing distribution features and enhancing monitoring and measurement of surface water and groundwater, these projects will improve the flexibility and responsiveness of the BVWSD's conjunctive management practices. These improvements are intended to provide water users within the GSA a stable, predictable water management landscape for agricultural, municipal, industrial and domestic land and water users that provides a foundation for prudent management decisions on the water users.

7.3.1.1 Summary of Actions

The Landowner Well Use Program is an existing management action which reimburses participating landowners for utilization of their unused well capacity during dry years. The ability to mobilize privately-owned wells enables the BVWSD to avoid the need to construct district-owned wells that would create capacity needed only during droughts. This Program is operated within the framework of the District's conjunctive management policy which encourages use of groundwater recharged through District facilities during wet years to augment the diminished supplies available during dry years.

7.3.1.2 Public Notice and Outreach Process

The outreach process for the Program followed the BVGSA's normal public notice and outreach process. Additional outreach will take when the BVWSD is interested in identifying interested landowners.

7.3.1.3 Permitting and Regulatory Process

No major permits or third-party approvals where required from local, State, or federal agencies.

7.3.1.4 Benefits and Affected Sustainability Indicators

This Program is an element of the BVWSD's conjunctive management strategy that provides a low-cost means to bridge short-term gaps in water supply available to growers. The affected sustainability indicator will be chronic lowering of groundwater levels and its corollary, reduction of groundwater storage. During periods when the Program is operational, the effects of Program activity will be tracked by the GSA's monitoring network.

7.3.1.5 Source and Reliability of Water

Operation of the Landowner Well Use Program relies on water pumped from the principal aquifer system. Groundwater is extracted from wells owned by program participants to augment the supply available for distribution throughout the BMA.

7.3.1.6 Legal Authority Required

The Landowner Well Use Program was approved by the BVWSD Board of Directors and was initiated following completion of CEQA compliance requirements.

7.3.1.7 Costs and Funding

This Program is funded by the BVWSD and is implemented at the District's discretion. The extent of program participation varies with hydrologic conditions and with the degree of landowner interest and participation. During years when the Program is not active, the District bears no costs. The 2020 fallowing program allocates up to $500/ acre for lands enrolled in the program (see Appendix J).

7.3.1.8 Schedule

The current fallowing program was approved by the District Board on December 6, 2019.

7.3.1.9 NEPA Considerations

The Landowner Well Use Program is being implemented in compliance with CEQA.

7.3.1.10 Uncertainty Assessment

The Landowner Well Use Program is now operational, and a high degree of certainty can be assigned to its continued operation.

7.4 Adaptive Management Actions Planned as Part of GSP

Each GSP is required to include contingency projects or management actions to be implemented in the event groundwater conditions do not adequately respond to the projects and management actions planned for implementation. The actions described in this section are intended to be implemented if measurable objectives have not been met and to correct breaches of minimum thresholds before they lead to the occurrence of undesirable results, DWR, 2016.

7.4.1 Adaptive Management Action Description

7.4.1.1 Summary of Adaptive Management Actions

In the event implementation of the projects described above is insufficient to prevent breaches of minimum thresholds, the BVGSA has developed a suite of adaptive management actions that can be implemented to quickly reverse adverse conditions. The adaptive management program entails the following four types of actions:

- Curtailment of on-going transfers and exchanges of Kern River water to other entities;
- Fallowing of land planted in annual crops;
- Transfers or exchanges to bolster surface water supplies;
- Limiting extractions from agricultural and industrial wells within a specified radius of the monitoring sites where minimum thresholds have been breached, and
- Proposition 118 process would allow doubling of current assessments and tripling of current water rates.

A fourth adaptive management action is a program the GSA will establish to deepen or otherwise rehabilitate or replace wells where the ability to extract groundwater has been compromised by groundwater elevations that have dropped below minimum thresholds. This action is designed to rapidly restore the capacity of affected wells.

Curtailment of Transfers and Exchanges

Because of the BVWSD's water rights on the Kern River, the District has access to large quantities of Kern River water in wet years. Under the Water Exchange Project (WEP), the District delivers a portion of its surplus wet-year supplies to other entities with those entities later returning a predetermined or negotiated quantity of their regulated water to the District, with or without an additional financial consideration. Current and potential participants in the WEP include Poso Creek Water Company, Cawelo WD, Kern Delta WD, West Kern Water District

(WKWD), North Kern WSD, Rosedale-Rio Bravo WSD, Semitropic WSD, Castaic Lake Water Agency (CLWA), and Improvement District No. 4 of the Kern County Water Agency.

In addition to transfers with other entities, the BVWSD facilitates certain types of transfers within the District provided that these transfers do not injure other landowners or impair District operations. Categories of intra-district transfers include the following:

- Transfer within a farming unit;
- Transfer of water generated by intentional fallowing;
- Transfer of reclaimed water, and
- Minor transfers

In addition to these general categories, for the duration of an emergency, the District will make every reasonable and prudent effort to provide needed additional water service to any water user to prevent crop loss or other damages.

The BVWSD's policies on transfers and exchanges provide a foundation for the initial adaptive management action the BVGSA would implement to correct unsustainable groundwater management conditions. These actions could include both curtailment of transfers to partner agencies and use of intra-district transfers to relieve breaches of minimum thresholds at representative monitoring sites.

Land Fallowing

This adaptive management action will fallow land planted in annual crops to reduce demand for irrigation water. The program targets a reduction of 15,000 AF/year of ET, (12 percent of the average annual ETa of 121,000 AF estimated over the period from 1993 through 2011) but is scalable based on the need to reduce demand and the ability to enroll willing participants.

Growers will be invited to enroll land in an acreage pool to become eligible for participation. If conditions necessitate activation of the program, a reverse auction will be held where owners of lands enrolled in the program may bid to accept payments of a specified dollar amount per acre of land fallowed. The BVGSA will review bids and accept those up to the threshold needed to reach the demand reduction target. To fallow the targeted acreage at the lowest cost, bid acceptance will begin with the low bid and include increasingly higher bids until the target acreage has been reached. The term of the agreement will typically be for one year subject to extension if the GSA determines groundwater conditions warrant and participating growers agree to continue to forego planting. Enrollment of eligible fields will be refreshed each year with growers having the opportunity to enroll fields or to discontinue enrollment during an annual sign-up period.

The objective of this adaptive management action is to reduce the volume of groundwater and surface water applied to farmlands. The reverse auction approach is intended to maximize the reduction in demand that can be achieved through available funding. In addition, by giving priority to the lowest bids, the reverse auction is likely to minimize impacts on agricultural production within the GSA by targeting the least productive fields.

The program will be monitored using the standard crop reporting procedures now employed by the BVWSD, and rules for management of lands fallowed under the program will be based on those developed by the Palo Verde Irrigation District (PVID) as part of the land fallowing program that is carried out in partnership with the Metropolitan Water District of Southern California (MWD). Details of Buena Vista's land fallowing program are contained in Appendix J.

The effectiveness of the fallowing program in reducing consumptive use will be monitored using satellite imagery-generated estimates of actual evapotranspiration (ETa) based on remote sensing algorithms such as Mapping Evapotranspiration at High Resolution using Internal Calibration (METRIC) or SEBS (Zu, 2002). The selected algorithm will be used to establish a 5-year baseline ETa for program-eligible fields, and this baseline will be used as a basis for comparison with ETa from fallowed fields.

Water Transfers and Exchanges

A second adaptive management option is water transfers and exchanges. These actions give the GSA the ability to increase water users' access to surface water thereby reducing their reliance on groundwater.

Water transfers and exchanges are a well-established element of BVWSD operations and are among the tools the District uses to support its conjunctive management program. The BVGSA will expand its portfolio of water transfer and exchange options by developing banking agreements with its partners in the groundwater recharge projects such as the Palms that will be managed by the BVWSD and are described above. Both in instances where the banking facilities are located within the BVGSA and in instances where the facilities lie outside the GSA, agreements with banking partners lying outside the Kern County Subbasin will include provisions allowing the GSA to access banked water in exchange for long-term repayment with terms expressed as replenishment of banked water or monetary compensation.

This approach will provide short-term support for groundwater levels in the BVGSA and in the Subbasin as a whole because the relevant banking partners will be located outside the Subbasin so water extracted under these conditions will not be water banked by neighboring GSAs.

Pumping Curtailment

Curtailment of pumping is the third adaptive management action included in the GSA's program. Of the suite of actions, this is the action best suited to quickly correcting adverse conditions observed at representative monitoring sites.

Minimum thresholds have been set at all wells in the GSA's groundwater level monitoring network that are used to monitor two important sustainability indicators:

- Chronic lowering of groundwater levels, and
- Reduction of groundwater storage.

Should groundwater levels drop below the minimum threshold at any well in this network, and it can be determined that the decline can be attributed to extraction occurring within the BVGSA, the GSA will curtail pumping through the following series of steps to be taken after notification that groundwater levels have breached a minimum threshold.

1. Verification measurements will be made within 72-hours, after ensuring that no nearby wells are actively pumping.
2. If the verification measurement is still below the established minimum threshold, groundwater levels at nearby monitoring wells in the BVGSA and neighboring GSAs will be checked to confirm that the breach is the result of localized extraction and is not due to extraction from neighboring areas.
3. If determined that the breach is primarily due to localized pumping, a curtailment notice will be sent to all agricultural and industrial well operators within a 1-mile radius of the relevant monitoring site. Wells subject to curtailment will be identified through GIS software and known locations of production wells.
4. Weekly groundwater level measurements will be taken at the affected monitoring site to observe the impact of the curtailment.
5. Pumping will be allowed to resume if the water level rises above the established minimum threshold and is sustained for 2 consecutive weeks. The volume of pumping may be limited by the BVGSA based on trends in groundwater levels observed prior to and after implementation of the curtailment.
6. If groundwater levels continue to decline or are unchanged after imposition of a 1-mile radius pumping restriction, the radius of the restriction will be increased to a distance the BVGSA determines adequate based on assessment of regional groundwater elevations and modeling of the likely impacts of extending or prolonging the restriction.
7. Pumping restrictions are enforceable through monitoring of the magnetic flow meters now installed on all production wells in the BVGSA.

Depending upon the cause of the reduction in groundwater levels that trigger a pumping curtailment, the BVGSA may choose to combine the curtailment with actions to make supplemental surface water available to the affected area to substitute for the reduced access to groundwater.

Well Rehabilitation

The BVGSA will maintain a fund for the purpose of deepening or otherwise rehabilitating wells whose production has been substantially reduced by chronic lowering of groundwater levels.

Losses in well production believed to result from lowering of groundwater levels will be reported to the BVSGA and reporting will trigger the following actions:

1. Within five business days, a representative of the GSA will meet with the claimant to develop a full understanding of the basis for the reported impact.

2. The GSA, and, if necessary, a technical specialist, will investigate the reported impact to assess the extent of the impact and determine whether the impact is the result of lowered groundwater elevations or other factors unrelated to groundwater elevations such as deterioration of the well, pump and motor. This investigation will include analysis of groundwater elevations, pumping data, and inspection of the well.

3. Based on the results of the investigation, if the reduction in pumping capacity is confirmed to have been caused by lowered groundwater levels, remediation measures will be developed and promptly implemented. These measures may include: deepening or replacement of the well; lowering of pump bowls; and other corrective measures. During the period of discussion, investigation and remediation, the owner of the affected well may receive deliveries of water from other sources, or other measures necessary to relieve the reduction in pumping capacity. Mitigation measures will be developed through consultation with the claimant and will be approved by the GSA and the County of Kern. The BVGSA will strive to develop and implement the agreed upon mitigation measures as quickly as reasonably possible.

4. Implementation of remediation measures will be confirmed, and the results of the implementation program will be monitored.

The BVGSA will maintain adequate financial resources to cover impact assessment studies, well repairs and other reasonably anticipated remediation needs.

7.4.1.2 Public Notice and Outreach Process

The outreach process used for implementation of adaptive management actions will follow the BVGSA's normal public notice and outreach process as well as complying with the public notification requirements of CEQA.

7.4.1.3 Permitting and Regulatory Process

No major permits or third-party approvals are expected to be required from local, State, or federal agencies for implementation of adaptive management actions.

7.4.1.4 Benefits and Affected Sustainability Indicators

Implementation of the suite of adaptive management actions will be triggered by groundwater elevations that fall below minimum thresholds at sites in the BVGSA's monitoring network that are determined to be the result of groundwater extraction within the GSA. These actions will directly affect two sustainability indicators:

- Chronic lowering of groundwater levels, and
- Reduction of groundwater storage.

These actions have not been designed to be triggered by or to correct degradation in water quality. While the Groundwater Quality Monitoring Network is intended to detect exceedances in contaminant concentrations, management actions to correct exceedances will be implemented under the auspices of the Irrigated Lands Regulatory Program or permits held by individual industrial users and by the Community of Buttonwillow.

7.4.1.5 Source and Reliability of Water

Two of these adaptive management actions are mechanisms to reduce demand that do not depend on sources of water or reliability of supply. The third, use of transfers or exchanges to augment water supplies, would be a combination of "spot market" transactions and agreements with banking partners that would enable the GSA to rapidly access banked water in exchange for long-term repayment.

7.4.1.6 Legal Authority Required

The Board of Directors of the BVWSD has the legal authority to institute each of the adaptive management practices described in this section.

7.4.1.7 Costs and Funding

Implementation of adaptive management actions would be paid for using a reserve fund established by the BVGSA specifically to support these actions.

7.4.1.8 Schedule

The schedule for implementation of adaptive management actions will be determined by the occurrence of conditions that trigger implementation of these actions.

7.4.1.9 CEQA/NEPA Considerations

CEQA requirements will vary with the nature and extent of the adaptive management action. Each of these actions have been successfully used in previous water transfer, water conservation and water banking programs so no obstacles are seen to CEQA compliance. NEPA compliance will also be based on precedents, with the need for NEPA depending on the existence of a federal nexus.

7.4.1.10 Uncertainty Assessment

The adaptive management actions are direct approaches to correcting symptoms of unsustainable groundwater management by targeting the causes. The mechanisms used by these actions are the following:

- Reducing demand for water by reducing irrigated acreage through land fallowing,
- Reducing demand for groundwater by providing a substitute water source through transfer and exchanges, and
- Reducing extraction of groundwater within the GSA boundaries by curtailing pumping.

Each of these actions will improve adverse groundwater conditions with a high degree of certainty. Groundwater modeling will be used to predict the degree of improvement likely to result from given levels of demand reduction and pumping curtailment. Groundwater level observations taken at affected monitoring sites will determine whether the actions have generated the intended result and whether the actions should be continued, expanded or relaxed.

7.5 Summary

7.5.1 Table of Projects, Management Actions, and Adaptive Management Actions

Table 7-1 is a summary of the projects and management actions described above.

Table 7-1. Summary of Projects and Management Actions

Project	Status
Water Measurement	
Magnetic flow meters on all production wells	Completed
Magnetic flow meters on pipeline turnouts	Progressing with construction of pipeline projects
Upgrading delivery gates	Under construction
Sustainability Monitoring	
New monitoring wells	To be implemented as required
Water Distribution System Improvement	
Northern Area Pipeline	Completed
Northern Area Pipeline - Southern Extension	Completed
Northern Area Pipeline - Eastern Extension	Completed
7th Standard Road Project	Under construction
Belridge Pipeline	Planned
Groundwater Recharge and Recovery	
Palms Project	Under development
Corn Camp Water Bank	Under development
McAllister Ranch Banking Project	Under development
Conservation and Water Treatment	
Brackish Groundwater Remediation Project	Completed
Management Actions	
None	
Adaptive Management Actions	
Curtailment of transfers and exchanges from GSA	To be implemented as required
Land fallowing	To be implemented as required
Expansion of transfers and exchanges to GSA	To be implemented as required
Pumping curtailment	To be implemented as required
Deepen/rehabilitate wells	To be implemented as required

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8. GSP Reporting

8.1 Annual Reports

As part of GSP implementation, the BVGSA will submit annual reports to DWR by April 1st of each year following the adoption of the plan. The goal of these reports is to provide updates on conditions within the BVGSA, including groundwater elevations, groundwater extraction, groundwater quality, surface water deliveries, total water use, and change in groundwater storage. In addition to groundwater conditions, a description of progress on implementation of the plan will compare data on existing conditions with interim milestones (established in Section 5 – Thresholds, Objectives, Milestones) and provide updates regarding the status of projects and management actions, and any adaptive management actions instituted during the reporting period.

8.1.1 BVGSA Conditions

Annual Reports of groundwater conditions in the BVGSA will rely on data collected from the monitoring networks described in Section 4 – Monitoring Networks. Data that is not specific to monitoring wells (e.g. surface water deliveries) will be measured using the same methods as were used for collecting data input into the BVGSA budget presented in Section 6 – Water Supply Accounting with the exception of groundwater extraction data that will be measured directly using the magnetic flow meters and totalizers now installed on all production wells in the BVGSA. When applicable, groundwater conditions will be compared to minimum thresholds, measurable objectives, and interim milestones.

8.1.1.1 Groundwater Elevation

Groundwater elevations collected at each of the locations in the groundwater level monitoring network will continue to be measured quarterly, and the hydrograph for each monitoring well will be updated using data collected during the most recent measurement cycle. Trends observed in the groundwater level measurements will be analyzed and used to inform decisions on modification of operations or the need to institute adaptive management actions to achieve sustainable groundwater management.

In addition to updating hydrographs, contour maps will be generated from the seasonal high and seasonal low groundwater elevations at each monitoring well. These maps will be compared with maps generated during the same period of the previous year to detect changes in conditions that will be described in the reporting.

8.1.1.2 Groundwater Extraction

Magnetic flow meters and totalizers are installed on all production wells in the BVGSA. Therefore, reporting of volume of groundwater extraction will be based on direct measurement.

The cumulative volume from all wells will be reported to DWR and will also be used to update and refine the GSA water budget.

To gain understanding of the spatial distribution of pumping, wells will be assigned to polygons within the BVGSA and the relative pumping density will be indicated by color for each polygon.

8.1.1.3 Surface Water

Surface water deliveries to the BVGSA will continue to be measured and reported using the methods described in Section 6 – Water Supply Accounting. Surface water that enters the BVGSA is measured on the East Side Canal and at each of the turnouts from the California Aqueduct. Surface water entering the BVGSA will be partitioned into the following categories in annual reports:

- Deliveries to fields,
- Delivery to other districts and Main Drain Canal outflows, and
- Recharge through canal seepage and spreading basins.

8.1.1.4 Total Water Use

The total water used consumptively by the BVGSA will be reported to DWR. Total water use will be displayed in tabular format to summarize the total water use by sector, water source type, and identifies the method of measurement (direct or indirect).

8.1.1.5 Change in Groundwater Storage

Based on groundwater elevations observed at each of the BVGSA monitoring wells, groundwater contours will be generated to estimate the depth to groundwater beneath the BVGSA boundary. These contours and the contours presented in the preceding annual report will be used to generate a map of the change in groundwater storage. Applying the specific yield discussed in Section 5 – Minimum Thresholds, Measurable Objectives, and Interim Milestones, a volume of water between the two surfaces will be calculated that will represent the change in storage.

In addition to this map, a table summarizing water year type, groundwater use, annual change in groundwater storage, and cumulative change in groundwater storage (beginning in January 1, 2015) will be provided in the annual reporting.

8.1.2 Description of Plan Implementation Progress

The annual report will include a description of progress towards implementing projects and management actions described in the Buena Vista Groundwater Sustainability Plan. Reporting will describe progress toward attainment of interim milestones and implementation of projects or management actions since the preceding annual report.

8.1.2.1 Interim Milestones

As discuss in Section 5 – Minimum Thresholds, Measurable Objectives and Interim Milestones, because of groundwater conditions in the BVGSA, interim milestones set at most monitoring locations do not vary between the 5-year reporting periods as the purpose of the milestones is to confirm that water levels are being maintained at representative monitoring sites in the face of the predicted increases in demand for water and declines the reliability of surface water supplies.

In the event groundwater elevations are not maintained, the BVGSA will rectify this trend by implementing additional projects and/or the program of management actions described in Section 7 – Projects, Management Actions and Adaptive Management Actions. Should interim milestones be introduced in the future, GSP reporting will assess the progress the GSA is achieving in attaining the measurable objectives introduced to support the GSA's 2040 sustainability goals. Any new interim milestones will be established in 5-year increments and current groundwater levels will be benchmarked to the upcoming or current milestone.

8.1.2.2 Implementation of Projects

Projects identified in Section 7 – Projects, Management Actions and Adaptive Management Actions will be implemented as the Buena Vista WSD secures funding, whether internally or from State and Federal grant programs. The annual report will inform DWR of the progress for each of the projects described in the GSP, including any additional projects that have been identified or started outside of those established in the initial Plan. Updates will include, but are not limited to: planned start date, planned completion date, and project status / phase (feasibility, design, construction, etc.).

Commentary will be included to discuss the observed benefits from implementation and any changes in groundwater conditions believed to be attributed to the implementation of projects undertaken by the GSA.

8.1.2.3 Implementation of Adaptive Management Actions

To respond to adverse water elevation or water quality conditions, the BVGSA has developed a program of adaptive management actions presented in Section 7 – Projects and Management Actions. This suite of temporary actions is designed to:

- Reduce demand,
- Bolster surface water supplies, and
- Curtail groundwater use.

Adaptive management actions that are put into effect during the reporting year will be brought to DWR's attention by describing 1) the management action that was taken, 2) when the management action was taken, and how long it is anticipated to last, and 3) the action's performance with respect to relieving the adverse condition that triggered its implementation.

8.2 5-Year Evaluation by Agency

In accordance with the SGMA regulations, the BVGSA will evaluate its GSP every 5 years and whenever the plan is amended and provide a written assessment to DWR. The purpose of these updates is to describe whether plan implementation, including projects and management actions, is meeting the sustainability goal(s) set forth in the GSP.

8.2.1 Sustainability Evaluation

Each 5-year Evaluation will be based on data collected through the monitoring networks described in Section 4 – Monitoring Networks. Data collected by the monitoring networks will be used to compare conditions observed during the reporting period with the sustainable management criteria defined at each of the monitoring locations and presented in Section 5 – Minimum Thresholds, Measurable Objectives and Interim Milestones.

8.2.2 Reconsideration of GSP Elements

8.2.2.1 Basin Setting

Section 2 – Basin Setting provides a conceptual understanding of subsurface conditions based on the numerous descriptions of geologic and hydrogeologic conditions available for the Kern County Subbasin. One of the benefits of SGMA will be to increase understanding of the Kern County Subbasin's geologic structure, hydrogeologic conditions and water use.

The BVGSA will use the 5-year evaluations as an opportunity to apply the improved understanding of the Subbasin to fill data gaps identified in preceding versions of the GSP and to update data and assumptions presented in the Basin Setting. Therefore, 5-year updates may present new information on elements of the Basin Setting including: soil properties, aquifer parameters, water quality trends, and land and water use. Any time series data presented in the Basin Setting will be updated.

8.2.2.2 Management Areas

As described in earlier sections of this GSP, the BVGSA is divided into two management areas. The Buttonwillow Management Area (BMA) is the focus of this GSP. The smaller, Maples Management Area (MMA) is separated by about 15 miles from the BMA, lies entirely within the Kern River GSA (KRGSA) and will be managed in a way that conforms with the management objectives of this GSA. Therefore, data reported for the MMA will be collected by the BVGSA, but data will be submitted as part of the KRGSA's reporting.

If conditions change within the BVGSA, or it is determined that the BMA can be better managed by subdivision into management areas, the 5-year evaluations will provide the opportunity to make required adjustments.

8.2.2.3 *Undesirable Results Narrative*

Section 3 – Sustainability Goal and Undesirable Results describes the six sustainability indicators used to warn of groundwater conditions occurring throughout a subbasin that, when significant and unreasonable, lead to undesirable results. Of these six, four or recognized as undesirable results that could occur within the BVGSA:

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued;
2. Significant and unreasonable reduction of groundwater storage;
3. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies, and;
4. Significant and unreasonable land subsidence that substantially interferes with surface land uses.

The 5-year evaluation will be used to assess these sustainability indicators, and any updates will be applied to the narrative describing the sustainability indicators and their relationship to undesirable results.

8.2.2.4 *Monitoring Network, Minimum Thresholds, Measurable Objectives, and Interim Milestones*

Should the sustainability evaluation described in Section 8.2.1, above, reveal an inadequacy with a minimum threshold or a measurable objective or a deficiency in a monitoring network, the BVGSA will utilize the 5-year update to document modifications that have been put in place.

Monitoring over the 5-year interval between plan updates will reveal trends and data gaps, which will inform the need to modify the monitoring networks and to revise the sustainable management criteria. Changes to the monitoring networks may include, but would not be limited to, the addition of monitoring in areas of concern, increased spatial density of monitoring sites, or increased frequency of data collection. The initial values for minimum thresholds, measurable objectives, and interim milestones are not anticipated to be changed, but the 5-year evaluation will document changes in groundwater conditions and modifications to the sustainable management criteria that may be recommended.

8.2.3 Monitoring Network Description

A description of the monitoring networks within the BVGSA will be provided, focusing on any modifications that have taken place during the reporting periods and data gaps or areas within the BVGSA that have been identified as represented by data that do not satisfy the requirements of Sections 352.4 and 354.34(c).

8.2.3.1 Data Gaps

An assessment of monitoring network function, as described in Section 4 – Monitoring Networks, will be conducted as part of the 5-year evaluation. The goal of this assessment is to analyze data collected to date, identify data gaps, and describe the actions that will be taken by the BVGSA to improve the monitoring network in ways that will fill data gaps, consistent with the requirements of Section 354.38 of the GSP Regulations.

8.2.3.2 Plan to Fill Data Gaps

If BVGSA identifies data gaps, the 5-year evaluation will describe a program for the acquisition of additional data. This program will include the timing of the data acquisition and when the newly obtained information will be incorporated into the GSP. In the formation of this program, the BVGSA will prioritize the installation of new data collection facilities and analysis of new data based on the needs of the GSA.

8.2.4 New Information and Plan Amendments

The 5-year evaluation will provide a description of any significant new information that has become available since the GSP adoption, or since the last 5-year evaluation. If the new information warrants changes or amendments to the GSP, the BVGSA will explain what changes will be made. New information may warrant changes to the basin setting, measurable objectives, minimum thresholds, or the criteria defining undesirable results.

The BVGSA will also provide details of any amendments to the GSP, describing what the amendment is and how it will further the sustainability goal of the GSA.

8.2.5 Legal and Enforcement Actions

Information describing any enforcement and/or legal actions taken by the BVGSA to ensure the achievement of the GSP’s sustainability goals will be provided in the 5-year evaluation.

8.2.6 Coordination

The BVGSA coordinated with surrounding GSAs in the development of the BVGSP, and continued coordination will occur with GSAs throughout the Kern County Subbasin. A summary of coordination that occurred between other Kern County Subbasin GSAs and BVGSA will be documented as part of the 5-year evaluation.

9. Communication and Engagement Plan

9.1 Introduction

SGMA is groundbreaking, not only in its regulation of groundwater but also for the process it outlines to sustainably manage the resource. Under SGMA, groundwater basins are required to establish Groundwater Sustainability Agencies (GSAs) responsible for developing Groundwater Sustainability Plans (GSPs). GSAs have broad powers over local water- and land-use management that will impact a wide range of stakeholders, including agricultural, industrial, recreational, Tribal, and environmental interests; large and small drinking water systems; and individual homeowners relying on private wells.

Because SGMA requires that these parties participate in the implementation process, GSAs need to engage these varied interests to determine how their input will be integrated into the decision-making, coordination, and management processes necessary to form GSAs and to craft and implement GSPs.

9.2 Geography and Surrounding Basins

9.2.1 GSA Overview

The Buena Vista GSA is comprised almost entirely of irrigated farmland with the Community of Buttonwillow being the only municipality within its boundaries. Groundwater is the Community of Buttonwillow's sole source of water supply while agricultural water is diverted from the Kern River and the State Water Project. Groundwater serves as a supplemental supply with the level of extraction varying with demand and hydrologic conditions. Since the BVGSA lies within a high-priority basin in a critical condition of overdraft, it is required to develop and adopt a GSP by January 31, 2020, and, through implementation of the GSP, to achieve sustainability by 2040.

9.2.2 GSA Extents

The Buena Vista Groundwater Sustainability Agency (BVGSA) is located in the western part of the Kern County Subbasin (Subbasin) whose boundaries correspond closely to those of the Buena Vista Water Storage District (BVWSD). The BVGSA lies within the Tulare Lake Basin and the Kern County Subbasin as defined by the California Department of Water Resources (DWR) as shown in Figure 1-1 – Buena Vista GSA Boundaries. (Figure 1-1 – Refer to Figures Tab)

The BVGSA shares parts of its northern, eastern, and southern boundaries with the Semitropic- and Rosedale-Rio Bravo water storage districts (SWSD and RRBWSD), the Kern-Delta Water District (KDWD), the Kern Water Bank Authority (KWBA) and the West Kern Water District

(WKWD). The GSA shares its western boundary with undistricted lands which separate the GSA from the Belridge Water Storage District and oilfield properties farther to the west. SGMA compliance for these undistricted lands falls within the jurisdiction of the County of Kern and the Kern County Water Agency (KCWA).

9.2.3 Surrounding Basins

The Kern County Subbasin comprises of 24 agencies, including 3 cities, with groundwater management responsibilities. By the GSA formation deadline, these agencies had formed 11 GSAs, as illustrated in Figure 1-2 – GSAs within Kern County Subbasin (Figure 1-2 – Refer to Figures Tab). The 11 GSAs are listed in Table 9-1.

Table 9-1. Kern Subbasin GSAs

	District	GSA
1.	Buena Vista Water Storage District	BVGSA
2.	Cawelo GSA*	KGA
3.	Kern River GSA	KRGSA
4.	Olcese GSA	OGSA
5.	Pioneer GSA*	KGA
6.	Greenfield County Water District	KRGSA
7.	Henry Miller Water District	HMGSA
8.	Kern Groundwater Authority GSA*	KGA
9.	McFarland GSA*	KGA
10.	Semitropic Water Storage District*	KGA
11.	West Kern Water District*	KGA

The GSAs marked with an asterisk (*) agreed to work directly with the Kern Groundwater Authority GSA (KGA) to submit one high-level ("umbrella") GSP with individual chapters for each GSA. Kern County is responsible for the remaining "white areas," which are areas not covered by one of the above GSAs. Although the BVGSA is an independent agency and not a member of the KGA, the BVGSA engages actively with neighboring GSAs including agencies who are under the KGA umbrella. The GSAs preparing individual GSPs in the Kern County Subbasin are the following, and a map of these GSPs is included in Appendix A – Coordination Agreement:

- Buena Vista GSA;
- Kern River GSA;
- Henry Miller GSA;
- Olcese GSA, and
- Kern Groundwater Authority GSA.

9.3 Goal and Objectives of Stakeholder Engagement Plan

9.3.1 Purpose

Stakeholder engagement is defined as efforts made to understand and involve stakeholders and their concerns in the activities and decision-making of an organization or group and is an important tool for fostering acceptance, trust, and compliance in decision-making settings.

While stakeholder engagement requires time and resources in the short term, the benefits of improved outcomes, optimized allocation of resources, broad support and reduced conflict can make these efforts invaluable in the long term. As such, stakeholder engagement and collaboration are key components to achieving the objectives of the BVGSA.

9.3.2 Goal

The goal of this Stakeholder Engagement Plan is to enable the BVGSA to involve stakeholders in developing a comprehensive understanding of issues relevant to sustainable management of groundwater and to guide BVGSA leadership in its efforts to coordinate with other GSAs in the Subbasin.

9.3.3 Desired Outcomes

To meet the goal of transparent development and coordinated leadership, the BVGSA has adopted this Stakeholder Engagement Plan to achieve the outcomes listed below:

- Underscore the importance of stakeholder participation while clearly communicating how public input will be used in GSP development;
- Encourage active involvement of diverse social, cultural, and economic elements of the population by identifying and providing multiple and varied opportunities for public participation;
- Educate the public about SGMA and the reason for a GSP; providing comprehensive, accurate, and timely information about GSP development;
- Provide a roadmap for BVGSA leadership to follow regarding stakeholder engagement, with the aim of developing widespread support for adoption and implementation of the BVGSA's GSP, and
- Ensure that public participation is facilitated by the implementation of an inclusive Stakeholder Engagement Plan and that meaningful public input is sustained.

Figure 9-1 – Objectives of Stakeholder Engagement Plan, illustrates both the objectives and the continuous process necessary for successful stakeholder engagement.

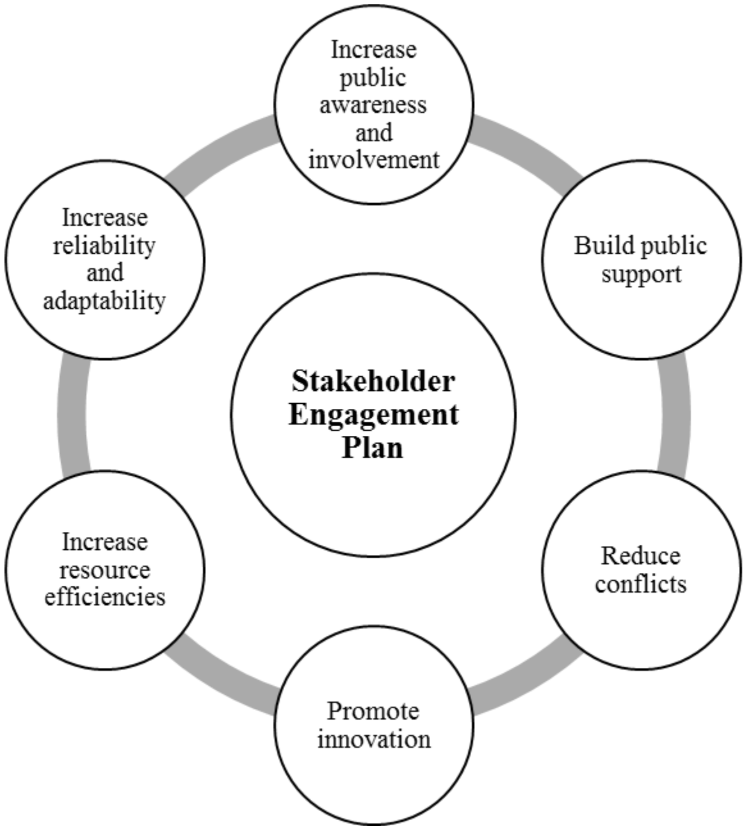

Figure 9-1. Objectives of Stakeholder Engagement Plan

9.4 Plan Requirements

SGMA has established statutory requirements for public notice and participation through public hearings and development and maintenance of an interested parties list. Within this framework, the SGMA legislation allows individual GSAs to develop the mechanisms that will enable these agencies to "consider the interests of all beneficial uses and users of groundwater" and to "encourage the active involvement of diverse social, cultural, and economic elements of the population" with these mechanisms being expressed through the Stakeholder Engagement Plan. The Stakeholder Engagement Plan described in this section offers a spectrum of options from notifying the public of intended actions to more active forms of engagement such as stakeholder consultation and establishing collaborative decision-making models.

9.4.1 Statutory Specifications

According to the DWR's "Guidance Document for GSP Stakeholder Communication and Engagement", (DWR, 2018) and the Community Water Center's paper "Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation" (Community Water Center, 2015), the following statutory requirements for Stakeholder Engagement under SGMA have been outlined:

- A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing (CA Water Code Sec. 10728.4).

- Prior to imposing or increasing a fee, a groundwater sustainability agency shall hold at least one public meeting (CA Water Code Sec. 10730(b)(1)).

- The groundwater sustainability agency shall establish and maintain a list of persons interested in receiving notices regarding plan preparation, meeting announcements, and availability of draft plans, maps, and other relevant documents (CA Water Code Sec. 10723.4).

- Any federally recognized Indian Tribe… may voluntarily agree to participate in the preparation or administration of a groundwater sustainability plan or groundwater management plan … A participating Tribe shall be eligible to participate fully in planning, financing, and management under this part (CA Water Code Sec. 10720.3(c)).

- The groundwater sustainability agency shall make available to the public and the department a written statement describing the manner in which interested parties may participate in the development and implementation of the groundwater sustainability plan (CA Water Code Sec. 10727.8(a)).

- The groundwater sustainability agency shall consider the interests of all beneficial uses and users of groundwater (CA Water Code Sec. 10723.2).

- The groundwater sustainability agency shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin (CA Water Code Sec. 10727.8(a)).

9.4.1.1 Public Notice and Participation

SGMA requires GSAs to communicate directly with interested persons, be they individuals or organizations/agencies, by creating, maintaining, and employing a list of interested persons, which the GSA must submit to DWR. BVGSA's list of interest parties is presented in Section 9.6.7 below.

9.4.1.2 Beneficial Users

Broad public participation and transparency are critical to fostering the benefits of stakeholder engagement, and opportunities for engagement that extend beyond the baseline of 'inform and consult' are essential. The following ten categories of beneficial users to be included in stakeholder communication and engagement are described in Section 10723.2 of the SGMA regulations:

- Holders of overlying groundwater rights, including agricultural users and domestic well owners;

- Municipal well operators;

- Public water systems;

- Local land use planning agencies;
- Environmental users of groundwater;
- Surface water users, if there is a hydrologic connection between surface and groundwater bodies;
- The federal government, including, but not limited to, the military and managers of federal lands;
- California Native American Tribes;
- Disadvantaged communities (DACs), including, but not limited to, those served by private domestic wells or small community water systems, and
- Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.

9.4.2 Principles for Effective Stakeholder Engagement

In addition to the statutory requirements for public notification and participation and engagement of all beneficial users, the SGMA regulations include broader, overarching substantive requirements meant to lead to the engagement of all stakeholders. Unlike the public notice requirements, these requirements are not prescriptive. Rather, GSAs are given the latitude to tailor their approach to fit local needs.

Because of the small geographic area and limited population of the BVGSA, the approach to communication and engagement will rely heavily on face-to-face meetings between stakeholders and GSA decision makers. This emphasis on direct communications has been successful in developing a cooperative relation between key stakeholders including the Community of Buttonwillow and landowners in the formation of the BVGSA and in the development of the GSP. Concepts adopted by the BVGSA to achieve effective stakeholder engagement are:

- Conduct periodic stakeholder identification and assessments and update the list of interested parties;
- Expand the reach of stakeholder engagement and communication to new and diverse groups;
- Hold regular, broadly advertised public hearings, workshops, and meetings;
- Regularly update the C&E Plan so opportunities for engagement continue to meet the changing needs of stakeholders including vulnerable and under-represented groups;
- Ensure that decision makers engage directly with advisory committees and in other forums where recommendations are made;
- Seek feedback on engagement, outreach, and communication efforts;

- Offer options for communication and information sharing beyond electronic communications;
- Engage stakeholders in technical issues;
- Use online databases and documents to increase access to information and to make information used to develop and implement the GSP readily accessible;
- Provide for extended comment periods on documents and proposals and actively encourage feedback by creating varied opportunities and methods;
- Provide stakeholders opportunities to meet and discuss issues collectively with the GSA as well as allowing stakeholders the ability to communicate individually with decision makers. Establish formal collaborative fact finding conducted by a technical advisory committee (TAC). The role of the TAC will be to solicit and incorporate stakeholder feedback throughout plan development and implementation.

The BVGSA's approach to communication and engagement is designed to encourage multi-stakeholder dialogue as well as allowing stakeholders direct access to decision makers. Providing a variety of channels for communication between stakeholders and decision makers has proven to be effective in administration of the Buena Vista Coalition for implementation of the Irrigated Lands Regulatory Program by providing settings for both vocal and reticent stakeholders to present their views.

9.5 Outreach Efforts

9.5.1 Previous and Current Efforts

The BVGSA is an exclusive GSA engaged in coordination and outreach efforts across the Kern County Subbasin, as well as within the GSA's boundaries. The BVGSA actively participates in technical and planning meetings and forums with other GSAs in the Subbasin and holds monthly GSA governance meetings to support planning and implementation of the GSP. These meetings welcome public input and began with an initial workshop in 2018, which focused on public involvement and sought input on approaches, such as formation of a Technical Advisory Committee, to regularly acquire feedback from a wide variety of public stakeholders including the disadvantaged Community of Buttonwillow.

9.5.2 On-going and Future Activities

Although the SGMA legislation defines interests are to be considered by the BVGSA's C&E Plan, the form that this engagement takes is determined by the GSA. As noted above, the BVGSA's approach to public engagement is tailored to the size and demographics of the area, factors have enabled the GSA to engage directly with local stakeholders who are well informed on local water management issues. The GSA will also communicate actively with stakeholders not familiar with the area to educate these stakeholders about the physical conditions and water management practices that distinguish the BVGSA from neighboring areas.

As documented in preceding sections, due to the BVGSA's setting and its conjunctive management of surface water and groundwater, the area is characterized by groundwater elevations that have shown little fluctuation between wet periods and droughts. As a result, the GSA does not need to construct projects and introduce management actions to correct historic or current unsustainable groundwater use. However, Section 7 – Projects, Management Actions, and Adaptive Management Actions presents a program of measures that will enable the GSA to continue to manage groundwater effectively to support local water users and to advance groundwater sustainability in the Kern County Subbasin in the face of changing conditions. Foreseeable changes include both increasing demands within the BVGSA and external forces likely to change the timing and volume of surface water supplied from the Kern River and the State Water Project.

The measures described Section 7 were developed by the BVWSD and by stakeholders. While each of these actions addresses sustainability indicators presented by SGMA, none were formulated specifically as responses to SGMA. For example, the BVWSD's program to install meters on all production wells was completed before the formation of the BVGSA. In short, sustainable groundwater management is not a concept that has been introduced by SGMA, but rather is an expression of the BVWSD's mission to serve its water users through good stewardship of the resources the District, and now the GSA, have been charged to manage. Important contributions of the SGMA legislation have been to require the BVGSA to quantify the performance of its conjunctive management program through establishment and monitoring of minimum thresholds and measurable objectives and to coordinate with other GSAs to promote sustainable groundwater management throughout the Kern County Subbasin.

9.6 Roadmap for Stakeholder Engagement

9.6.1 Roles and Responsibilities

Responsibility for implementation of the C&E Plan lies with the Governance Committee of the BVGSA which is composed of members of the Buena Vista Water Storage District's Board of Directors. The point of contact is Tim Ashlock, 525 North Main Street, Buttonwillow, CA 93206 who can be reached at (661) 764-2901 or tim@bvh2o.com.

The Governance Committee is the ultimate decision-making body for the GSA, and individuals on this committee are the principal points of contact between the GSA and stakeholders. Committee members will consider and record input from interested stakeholders and will weigh the interests of all beneficial uses and users of groundwater in decision making.

The following technical experts will be available to the governance committee to communicate facts about the GSA and adjacent areas and will advise on benefits and consequences of potential projects and adaptive management actions:

9.6.2 Decision-Making Process

The primary decision makers for the BVGSA are the members of the Governance Committee. The decision-making progress will be informed by input from the C&E program as successful stewardship of the resources managed by the BVWSD and successful implementation of the GSP by the BVGSA both require a program of projects and adaptive management actions that is broadly understood and accepted by the GSA's stakeholders and that does not conflict with projects and management actions taken by other GSAs in the Kern County Subbasin.

9.6.3 Stakeholder Engagement Opportunities

The BVGSA's approach to stakeholder engagement is tailored to the size and demographics of the area, factors that enable the GSA to engage directly with stakeholders who are well informed on local water management issues. The GSA will also communicate actively with stakeholders not familiar with the area to educate these parties about the physical conditions and water management practices that distinguish the BVGSA from neighboring areas.

The primary opportunities for the BVGSA to engage with stakeholders will be the monthly Governance Committee meetings to be held on the 3rd Wednesday of each month at the office of the BVWSD in Buttonwillow. These regularly scheduled meetings will be supplemented by public workshops to be convened at major milestones during implementation of the GSP. Among these milestones are GSP adoption and amendment and consideration of modifications to the GSP to be documented in 5-year updates. Noticed public workshops and hearing will also be held before imposing or increasing fees and before implementing adaptive management actions that may restrict groundwater extraction or otherwise affect stakeholders. A key goal of each of these interactions is to solicit public comments that will be used to inform the GSP development process and implementation of projects and adaptive management actions presented in the GSP.

In addition to formal meetings and workshops, the BVGSA Governance Committee is open to meeting with stakeholders interested in expressing concerns or perspectives in a one-on-one setting and to targeted outreach to encourage involvement from groups such as residents of the Community of Buttonwillow who form a distinct population within the GSA.

The BVGSA has already begun a series of educational workshops for interested parties and the general public living, working and operating farms and businesses within its boundaries. These workshops are designed to educate attendees on the overall role and purpose of the GSA, describe the method and process used to develop the GSP and solicit input on the plan and its objectives.

Unlike many agricultural areas, the interests of private pumpers are represented by those of the agricultural landowner community at large, with all privately-owned wells being metered and providing data to the BVGSA. Similarly, the DAC community is largely represented by the Community of Buttonwillow, so outreach targeted at residents of Buttonwillow will be an effective vehicle for communication with disadvantaged households. Tribal governments will be contacted as part of the CEQA process necessary for implementation of projects, but no tribal lands lie within the BVGSA.

9.6.4 Communication Tools and Information Materials

The BVGSA has established a link on the BVWSD website at: http://bvh2o.com. This website is already actively in use and will provide the public with key information regarding the GSA and the GSP development process including the dates of public meetings and workshops. The BVGSA website also makes its resource planning and GSP documents available to the public.

Communication and engagement will be conducted through the website, mailings and the various types of meetings described above. C&E activities and participation in these activities will be recorded through meeting minutes, sign-up sheets and other standard communication and reporting tools. The BVGSA's website will be used to post a groundwater calendar, and occasional fact sheets, FAQs, and newsletters.

9.6.5 Communication and Engagement Schedule

The principal events in the BVGSA's schedule for stakeholder communication are the monthly Governance Committee meetings. As described above, other workshops and educational events will be held to address particular issues, inform stakeholders on GSP development and implementation, present the status of updates to the GSP and solicit stakeholder feedback. Should the GSA need to introduce any of the adaptive management actions described in Section 7, the GSA will hold special outreach events to coordinate implementation of these actions with affected stakeholders. All events will be displayed on the groundwater calendar posted on the BVGSA webpage and public meetings and hearings will be advertised as appropriate.

9.7 Interested Parties List, Stakeholder Survey and C&E Assessment

9.7.1 Interested Parties List

The goal of stakeholder engagement will be to develop an understanding of the positions held by various stakeholders regarding water management priorities and to convey to stakeholder's information about the development and implementation of the GSP, the establishment of metrics such as minimum thresholds and the long-term objectives of the BVGSA. Stakeholders will include beneficial users of groundwater, and parties affected by groundwater within the BVGSA and in areas neighboring the GSA.

The interested parties list, presented in Appendix K – Interested Parties List, will be maintained by the BVGSA and parties on this list will be notified in advance of all public meetings hosted by the GSA and will be alerted when the GSA posts documents to its website. Interested parties can add themselves to the interested parties list through the BVGSA website.

9.7.2 Stakeholder Survey

The BVGSA will conduct one-on-one stakeholder meetings where stakeholders will be asked a prepared set of questions designed to determine issues, interests, and challenges related to SGMA held by individual stakeholders. The questions posed to stakeholders will be based on the survey template available on the DWR SGMA website and will be tailored to characteristics of the BVGSA. Information collected through this survey process will be used to inform the GSA Governance Committee on stakeholder interests and concerns.

9.7.3 Evaluation and Assessment

The BVGSA will evaluate the success of the C&E efforts on an on-going basis. The two general yardsticks that will be used to assess the C&E program will be feedback from stakeholders and the success of the overall implementation of the GSP. Both measures will be used to modify the GSP with adjustments to the plan being incorporated as needed and documented in the 5-year updates.

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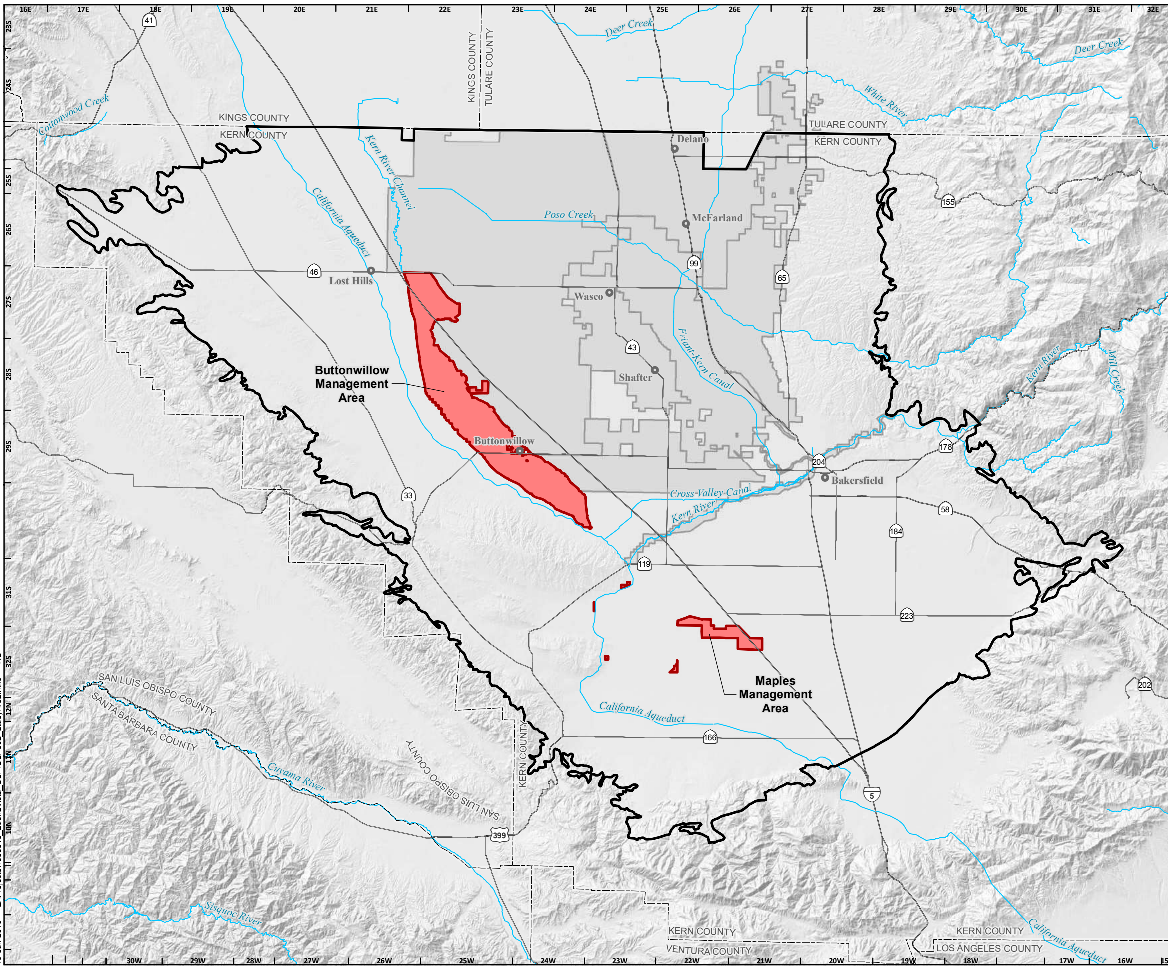
Figures Tab



BVGSA BOUNDARIES

GSA Boundaries

- Buena Vista GSA
- Water District
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway

0 4 8 16
Miles

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

GEI Consultants

SEPTEMBER 2019

FIGURE 1-1

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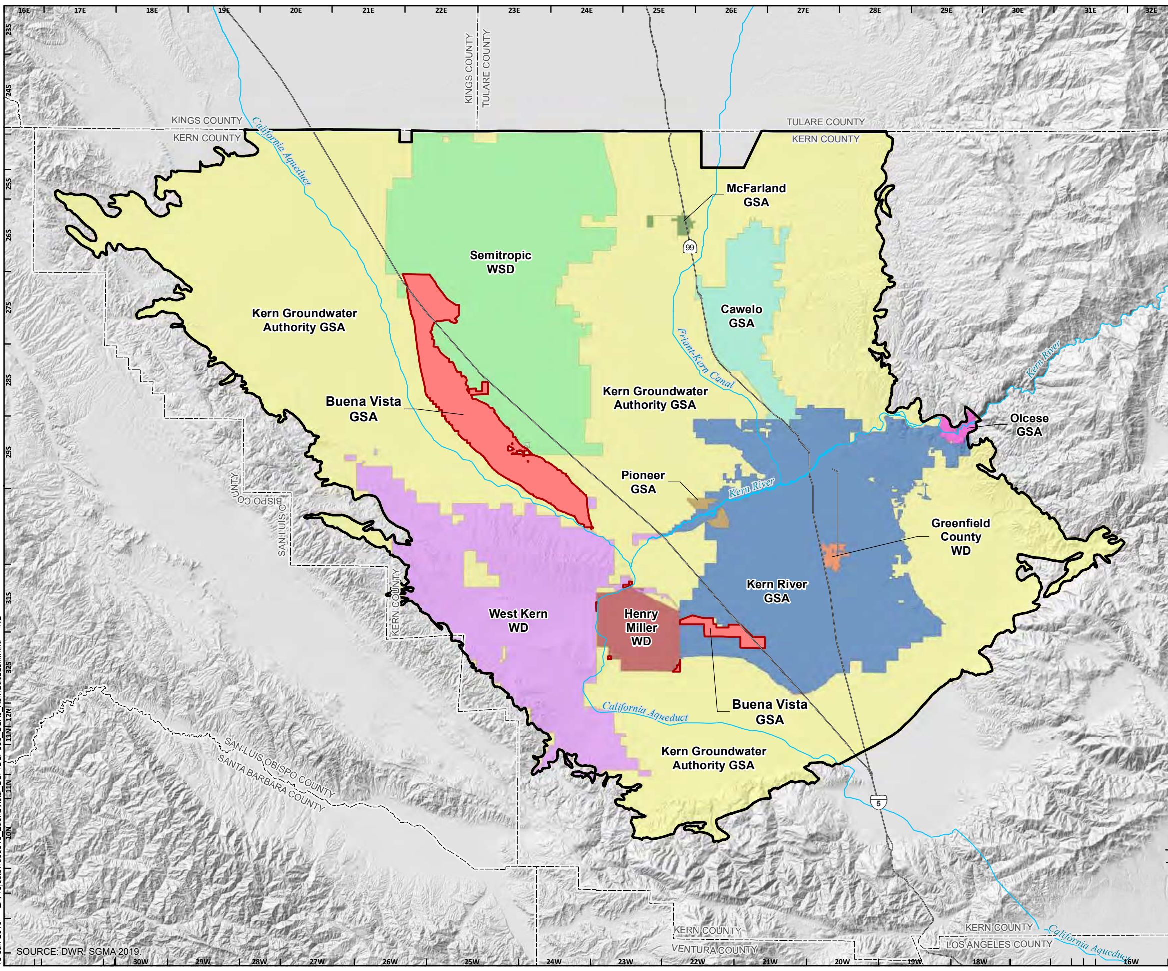

GSAS WITHIN
KERN COUNTY SUBBASIN

Kern Subbasin Boundary

GSA Boundaries

- Buena Vista GSA
- Cawelo GSA
- Greenfield County WD
- Henry Miller WD
- Kern Groundwater Authority GSA
- Kern River GSA
- McFarland GSA
- Olcese GSA
- Pioneer GSA
- Semitropic WSD
- West Kern WD

All Other Features

- Highway
- Waterway

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N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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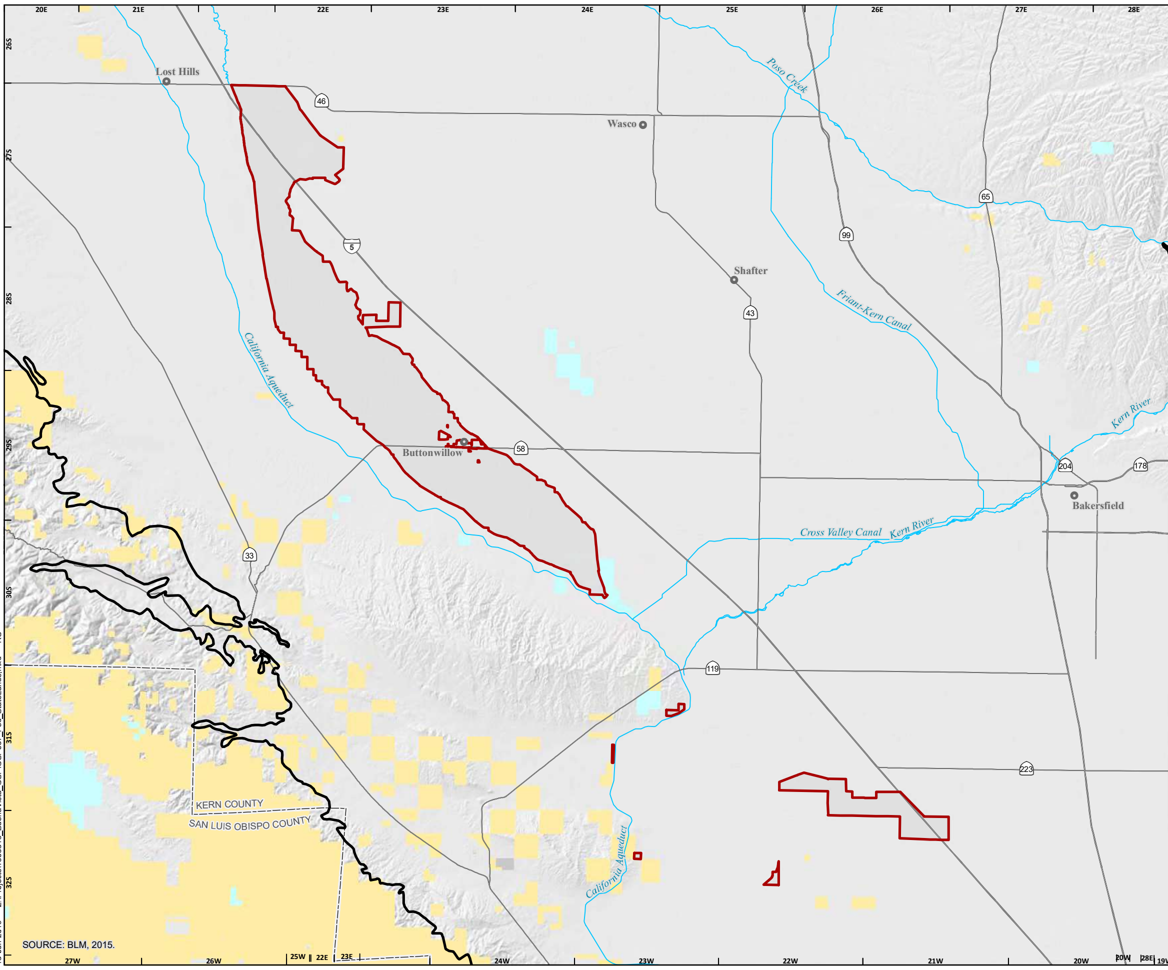
FIGURE 1-2

FEDERAL AND STATE LANDS WITHIN BVGSA



Government Lands

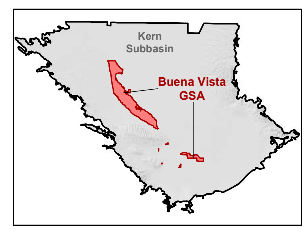
- Bureau of Land Management
- Other Federal
- State
- Local Government

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



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Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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FIGURE 1-3

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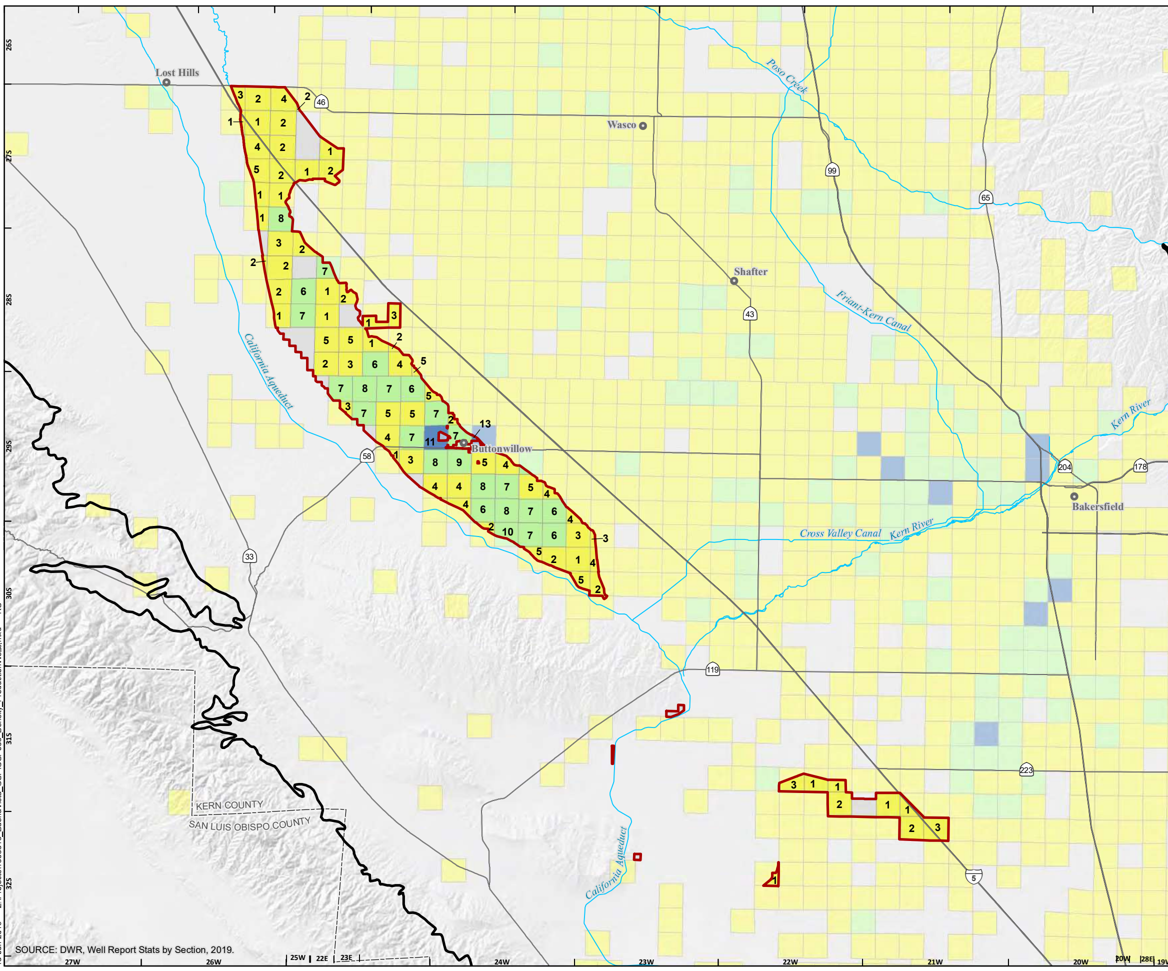


DENSITY OF PRODUCTION WELLS PER SQUARE MILE

Density of Production Wells per Square Mile

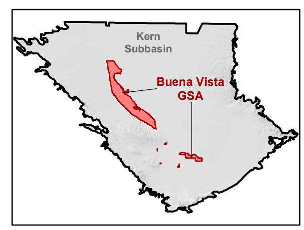
- > 10
- 6 - 10
- 1 - 5

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



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Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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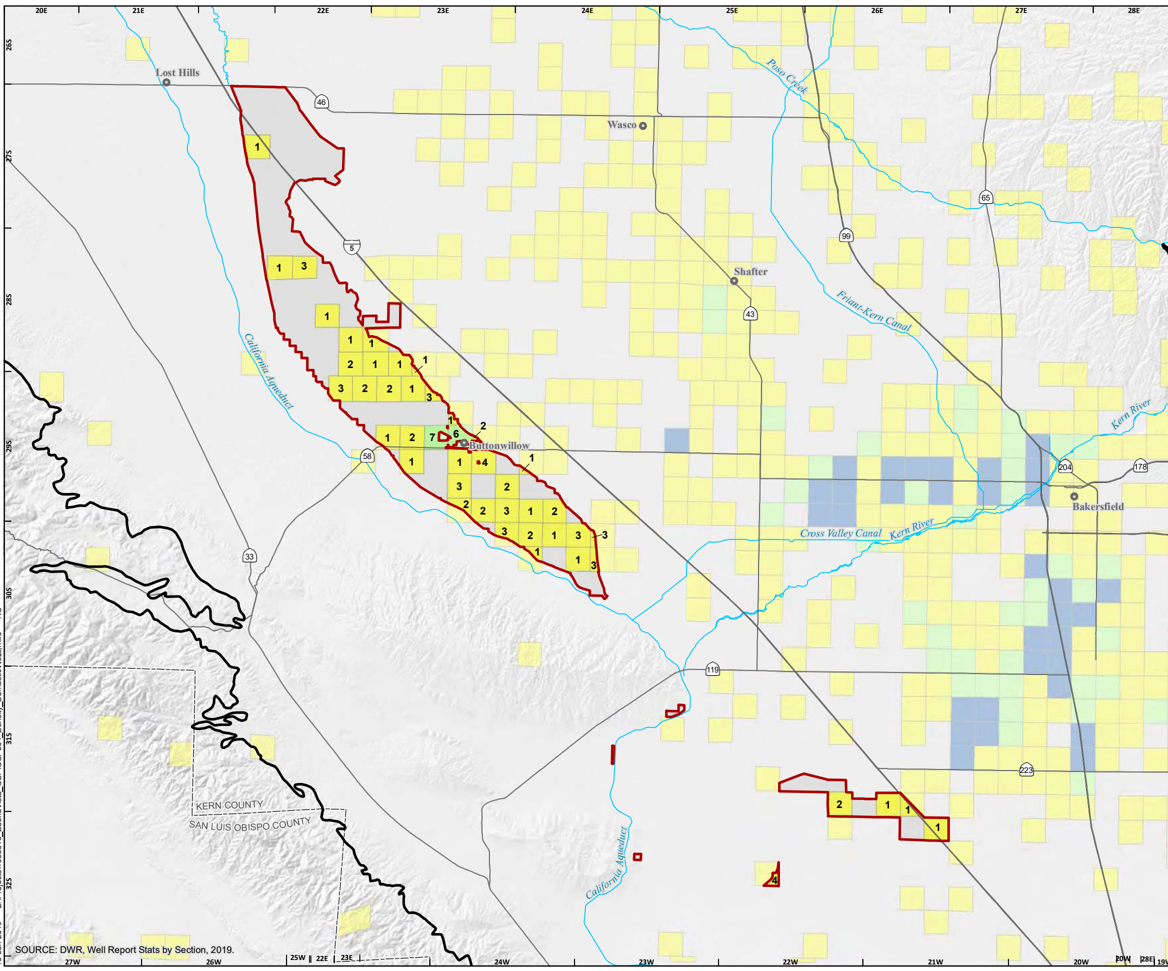
FIGURE 1-4A

DENSITY OF DOMESTIC WELLS PER SQUARE MILE



Density of Domestic Wells per Square Mile

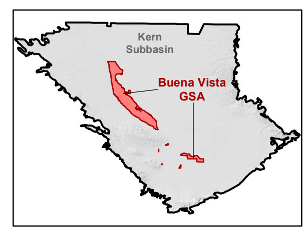
- > 10
- 6 - 10
- 1 - 5

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



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Miles

N

Buena Vista Groundwater Sustainability Plan
Kern County, California

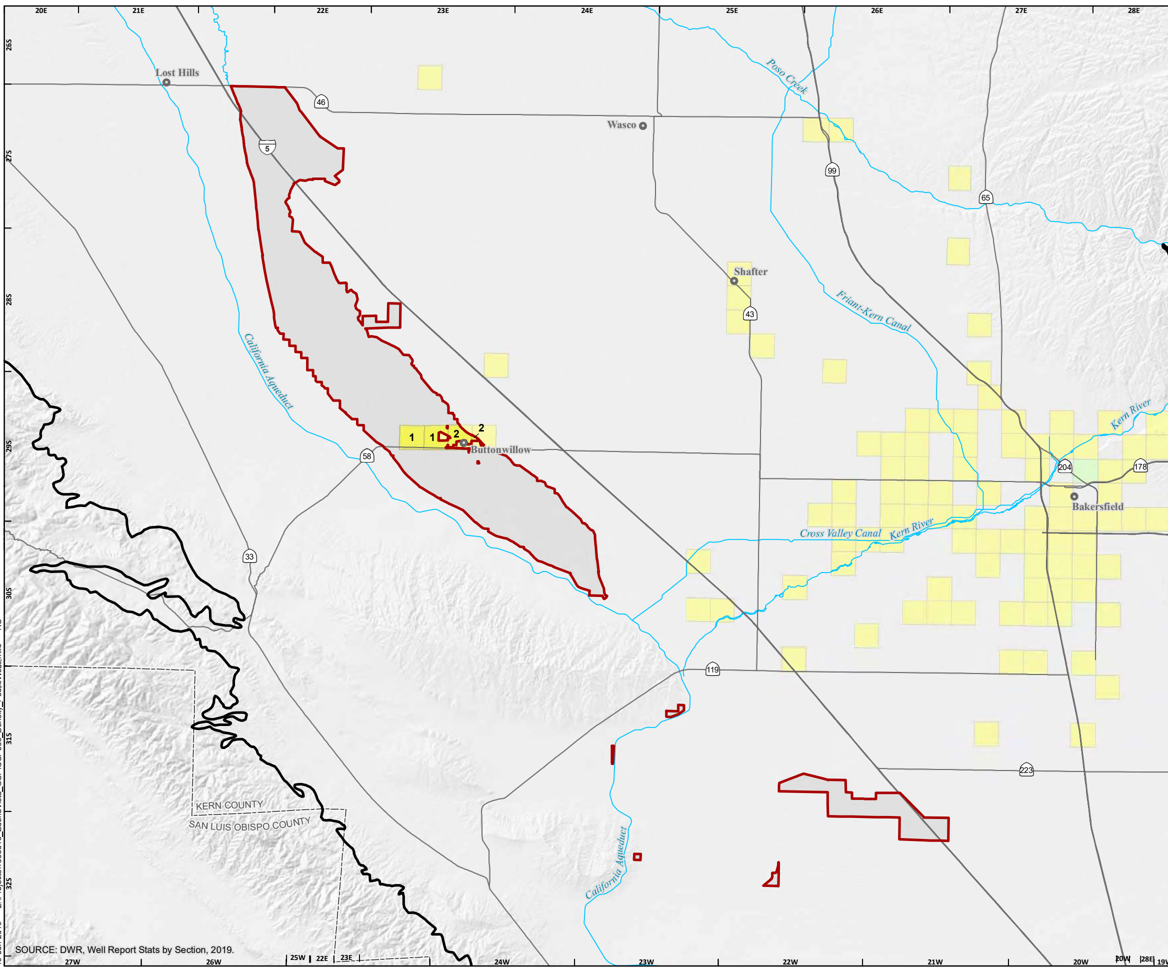
Buena Vista GSA

GEI Consultants

SEPTEMBER 2019

FIGURE 1-4B

DENSITY OF MUNICIPAL WELLS PER SQUARE MILE



Density of Municipal Wells per Square Mile

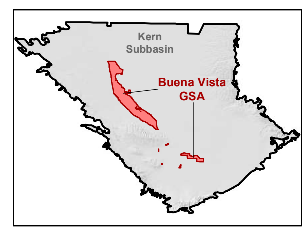
- > 10
- 6 - 10
- 1 - 5

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2 4 8
Miles

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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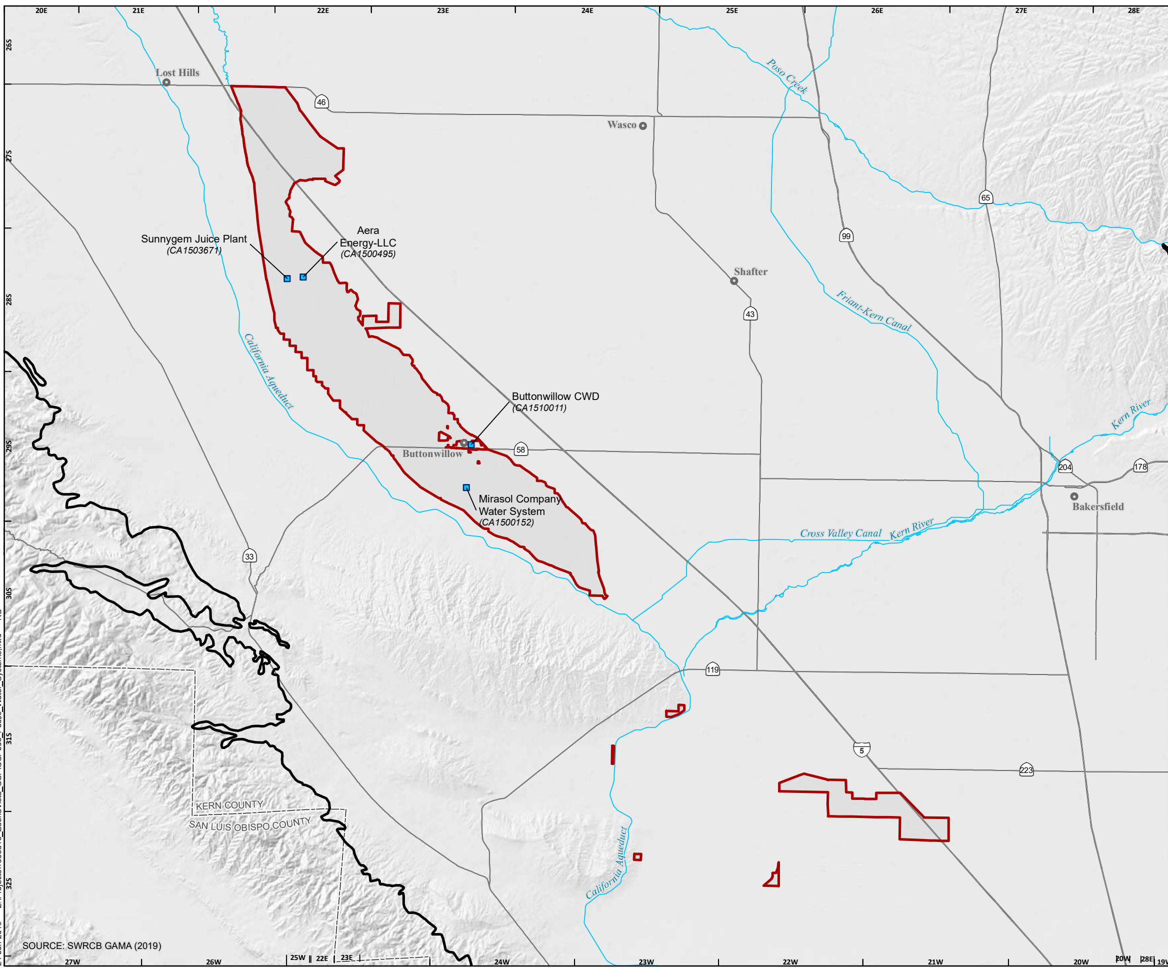
FIGURE 1-4C



REGIONAL PUBLIC WATER SYSTEMS

Public Water Service Area (generalized location)

GSA Boundaries

Buena Vista GSA

Kern Subbasin Boundary

All Other Features

Highway

Waterway

Kern Subbasin

Buena Vista GSA

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Miles

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Kern County, California

Buena Vista GSA

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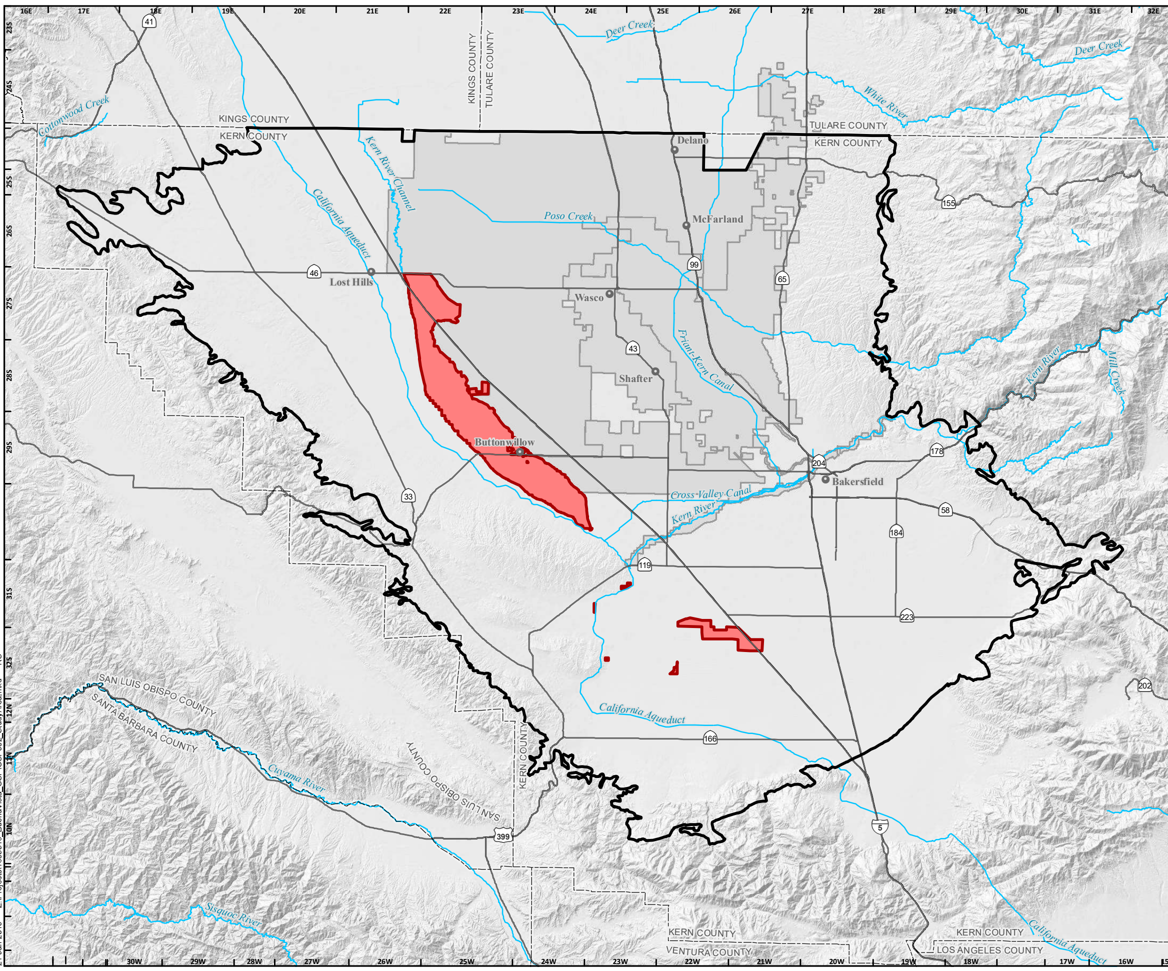
FIGURE 1-5



STUDY AREA

GSA Boundaries

- Buena Vista GSA
- Water District
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway

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Miles

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Kern County, California

Buena Vista GSA

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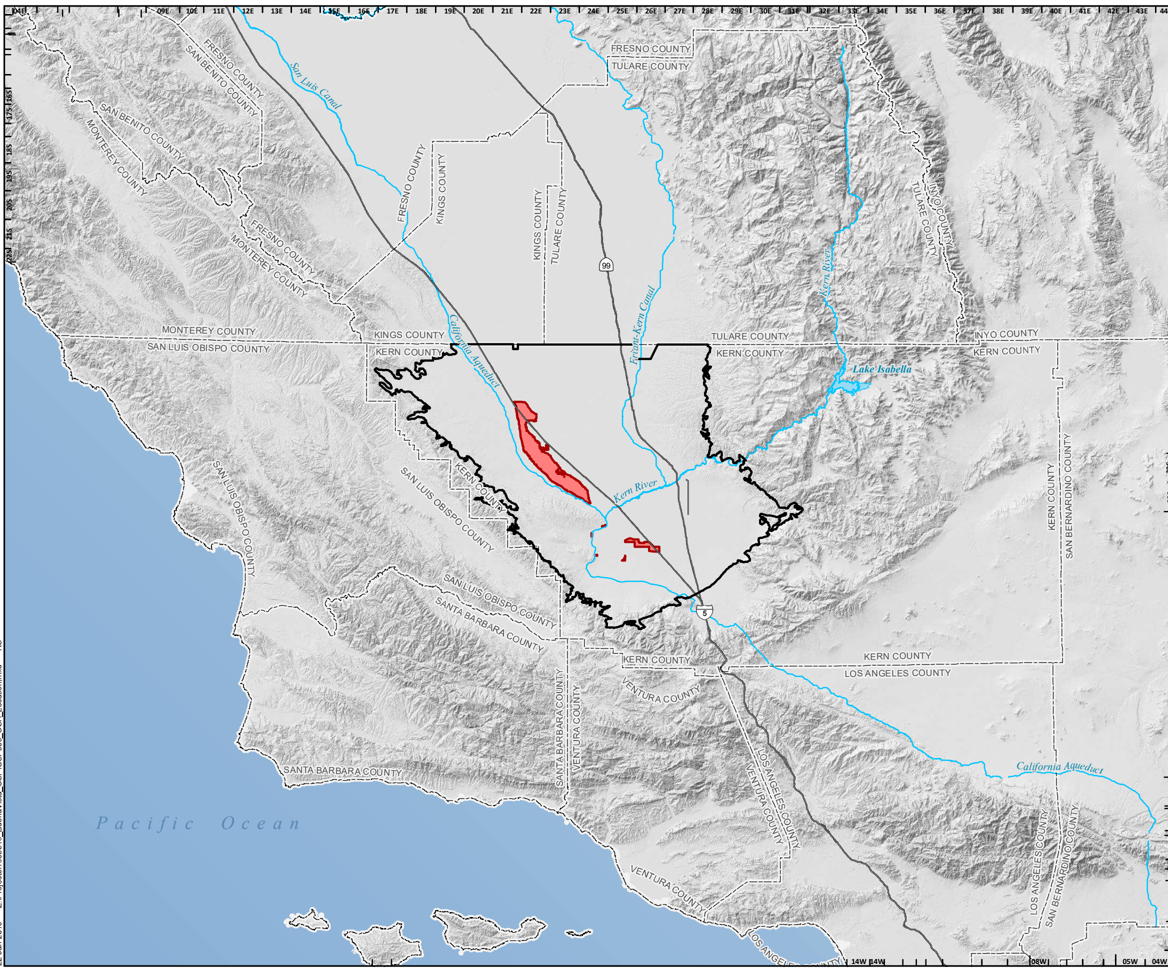
FIGURE 2-1

BUENA VISTA GSA LOCATION



GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway
- Lake

0 10 20 40
Miles

N

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Kern County, California

Buena Vista GSA

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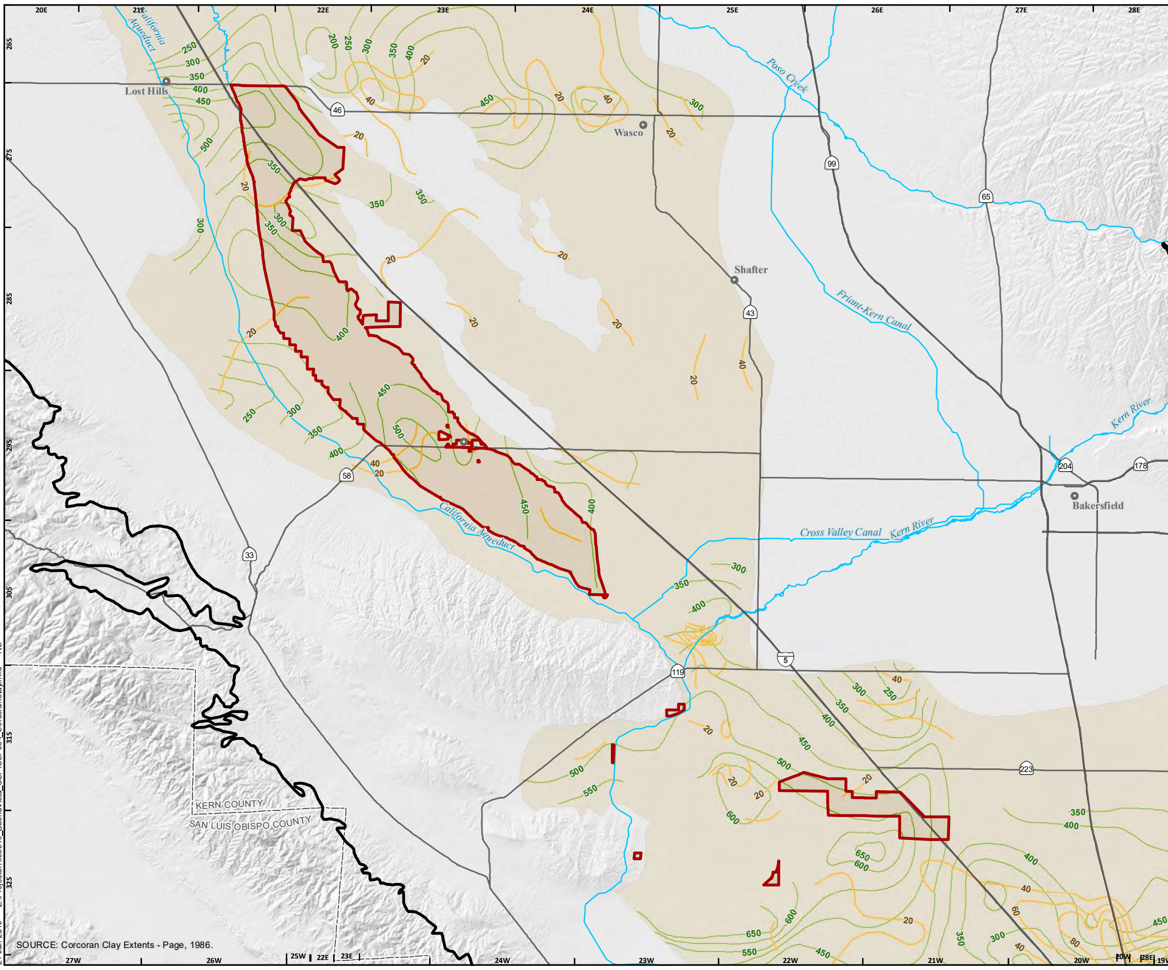
FIGURE 2-2



APPROXIMATE THICKNESS AND EXTENT OF CORCORAN CLAY

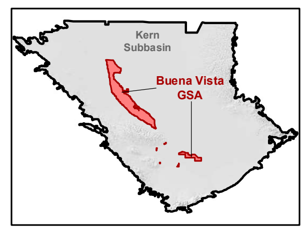
USGS Corcoran Clay Thickness (ft)
USGS Corcoran Clay Depth (ft)
USGS Extent of Corcoran Clay

GSA Boundaries

Buena Vista GSA
Kern Subbasin Boundary

All Other Features

Highway
Waterway



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Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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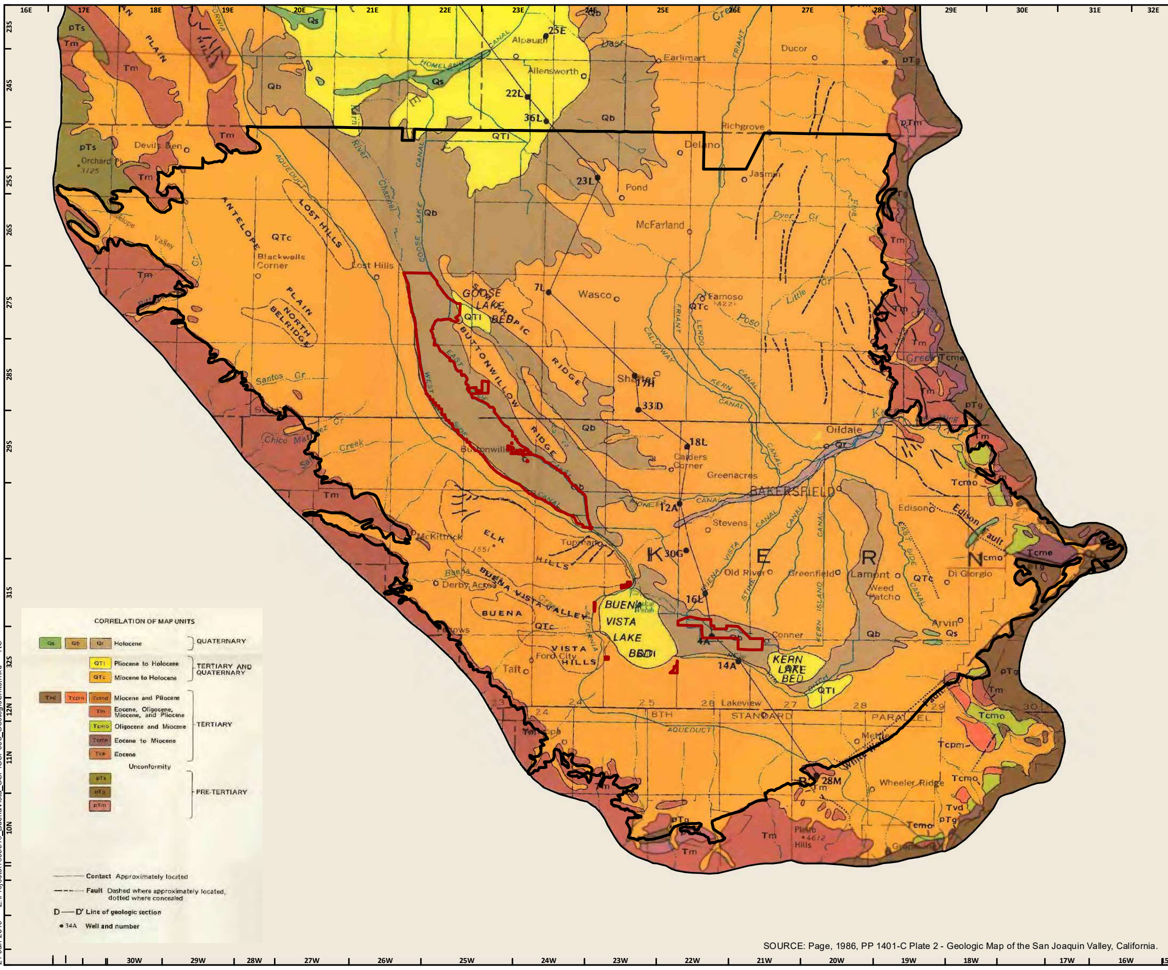
FIGURE 2-3



GEOLOGIC UNITS

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

DESCRIPTION OF MAP UNITS

- **Qs** **Sand dunes (Holocene)** Windblown sand and dune sand
- **Qb** **Flood-basin deposits (Holocene)** Clay, silt, and some sand; near Stockton consist of muck, peat, and other organic soils. In places may include part of the Modesto Formation (Pleistocene)
- **Qr** **River deposits (Holocene)** Gravel, sand, silt, and minor amounts of clay; deposited along channels, flood plains, and natural levees of main streams. In places may include part of Modesto Formation (Pleistocene)
- **QTl** **Lacustrine and marsh deposits (Pliocene to Holocene)** Clay, silt, and some sand; in subsurface include three widespread clays: A clay (Pleistocene and Holocene?); C clay (Pleistocene); and modified E clay (Pleistocene), includes Corcoran Clay Member of Tulare and Turlock Lake Formations
- **QTc** **Continental rocks and deposits (Miocene to Holocene)** Heterogeneous mix of generally poorly sorted clay, silt, sand, and gravel; some beds of claystone, siltstone, sandstone, and conglomerate. Include some informal units: younger alluvium (Holocene), older alluvium (Pleistocene and Holocene?) and continental deposits (Pliocene and Pleistocene); three formations of Pleistocene age: Modesto, Riverbank, and Turlock Lake; Tulare Formation (Pliocene and Pleistocene) on western side of valley, Laguna Formation (Pliocene) on eastern side, and Kern River Formation (Miocene to Pleistocene?) on southeastern part
- **Tvd** **Volcanic rocks and deposits (Miocene and Pliocene)** Massive tuff with large fragments of vesicular basalt northwest of Tracy; tuff, and volcanic breccia at south end of valley
- **Tcpm** **Continental rocks and deposits (Miocene and Pliocene)** Gravel, sand, silt, clay, conglomerate, sandstone, siltstone, and claystone, contain andesitic material. Principally Mehrten Formation (Miocene and Pliocene) on eastern side of valley; include continental equivalents of Etchegoin Formation (Miocene and Pliocene) on western side of valley, and Chanac Formation (Miocene) on southern part
- **Tcmp** **Continental and marine rocks and deposits (Miocene and Pliocene)** Gravel, sand, silt, clay, silty sandstone, and siltstone. Include continental and marine equivalents of San Joaquin Formation (Pliocene) and Etchegoin Formation (Miocene and Pliocene)
- **Tm** **Marine rocks and deposits (Eocene, Oligocene, Miocene, and Pliocene)** Sand, clay, silt, sandstone, shale, mudstone, and siltstone. On western side of valley include the San Joaquin and Etchegoin Formations, Temblor Formation (Oligocene and Miocene) and Kreyenhagen Formation (Eocene). On southeastern side include the Santa Margarita Formation of various authors, the Round Mountain Silt, the Olcese Sand, the Freeman Silt, and the Jewett Sand (including the Pyramid Hill Sand Member) (all Miocene), and the Vedder Sand (Oligocene)
- **Tcmo** **Continental rocks and deposits (Oligocene and Miocene)** Gravel, conglomerate, sand, tuffaceous sand, clay, and sandy clay; contain rhyolitic material on eastern side of valley. Principally Valley Springs Formation (Oligocene and Miocene) on eastern side of valley; unnamed fanglomerates (Miocene) and Bena Gravel (Miocene) in the southern part
- **Tcme** **Continental rocks and deposits (Eocene to Miocene)** Conglomerate, sandstone, consolidated fanglomerate, claystone, tuff and tuff breccia; near Fresno consist of tuffaceous sand and gravel. Near Bakersfield include the Bealville Fanglomerate (Oligocene and Miocene) and the Walker Formation (Eocene to Miocene)
- **Tce** **Continental rocks and deposits (Eocene)** Conglomerate and sandstone; along eastern side of valley contain anauxite. Principally Ione Formation (Eocene) on eastern side of valley

Unconformity

- **pTs** **Marine rocks (Pre-Tertiary)** Sandstone, shale, siltstone, and some limestone, chiefly on western side of valley; in places contain abundant secondary gypsum. Include Moreno Formation (Cretaceous and Paleocene) and Panoche Formation (Cretaceous)
- **pTg** **Granitic rocks (Pre-Tertiary)** Chiefly granitic rocks on eastern side of valley, in places consists of mafic intrusive rocks
- **pTm** **Metamorphic rocks (Pre-Tertiary)** Metasedimentary, metavolcanic and other metamorphic rocks on eastern side of valley

0 4 8 16
Miles
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Kern County, California

Buena Vista GSA

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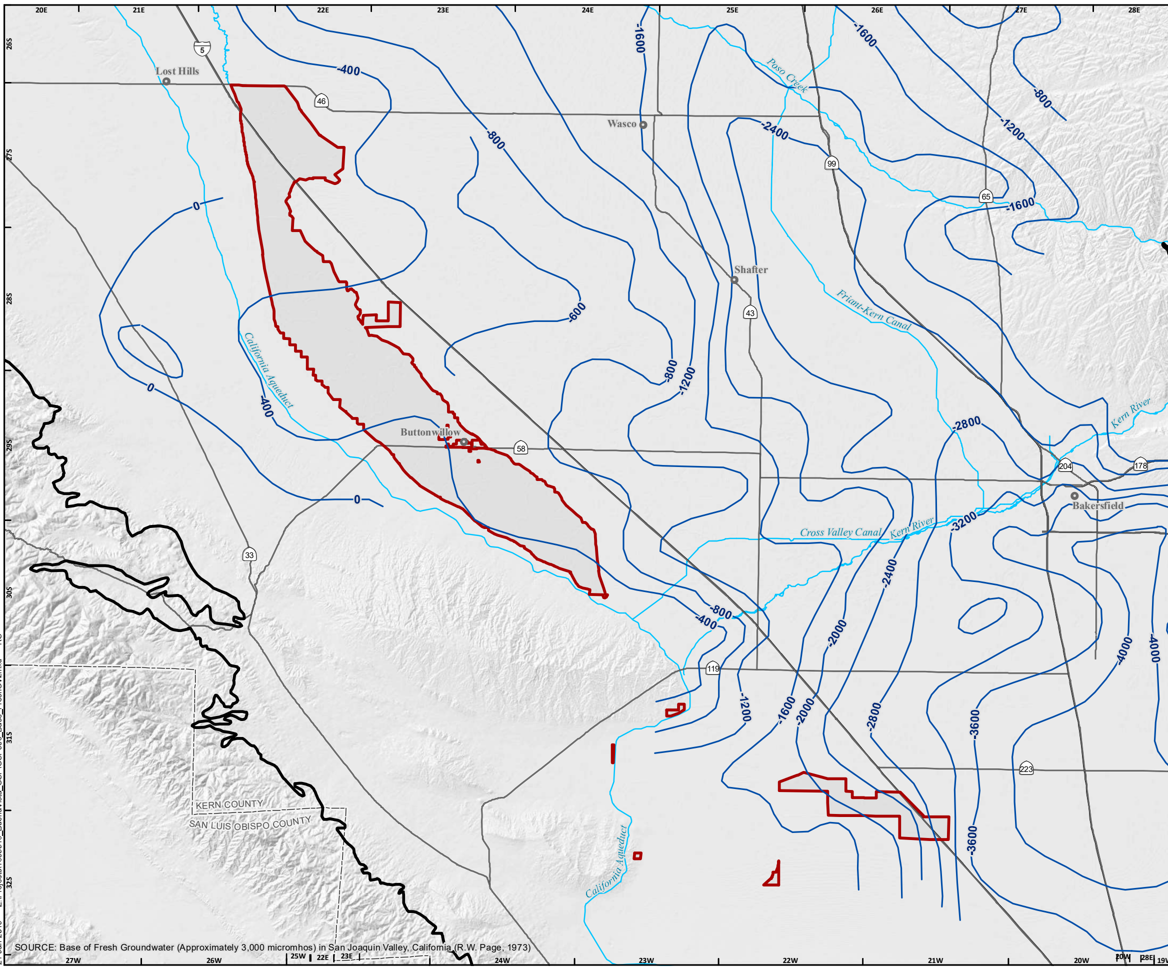
FIGURE 2-4

21-Jan-2019 Z:\Projects\1805518_BuenaVista_GSP\GSP005_GeologicUnits.mxd RS



BASE OF FRESH GROUNDWATER

Approx. elevation of base of fresh water (ft msl)

GSA Boundaries

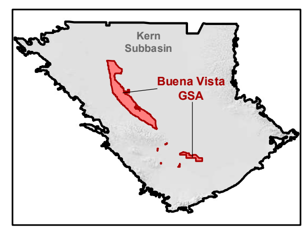
Buena Vista GSA

Kern Subbasin Boundary

All Other Features

Highway

Waterway



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Kern County, California

Buena Vista GSA

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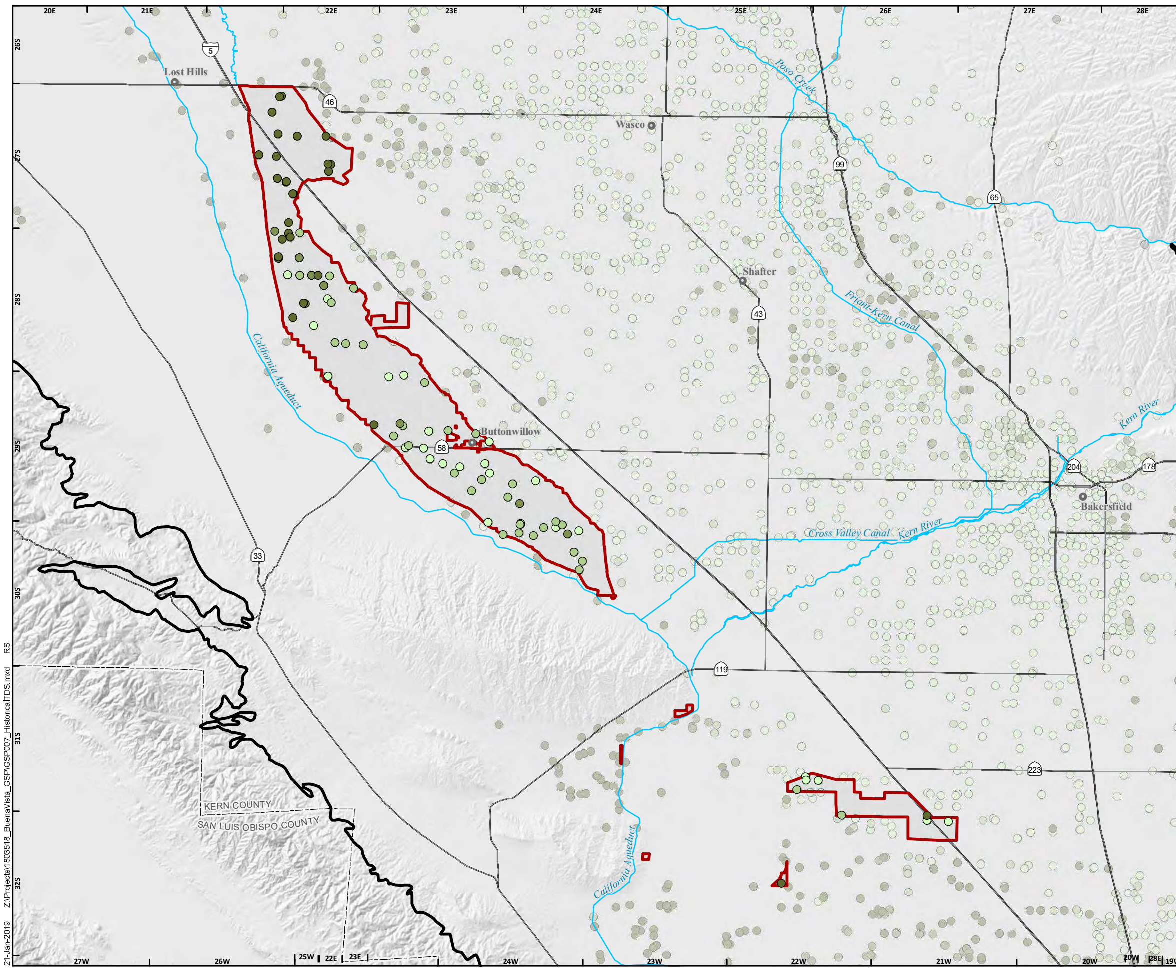
FIGURE 2-5



HISTORICAL TDS MONITORING RESULTS (2000 AND EARLIER)

Maximum Concentrations (TDS)

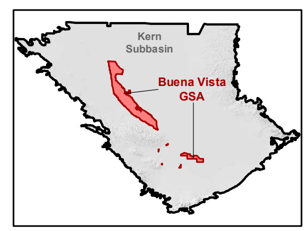
- Recommended Secondary MCL (<= 500 mg/L)
- Upper Secondary MCL (<= 1000 mg/L)
- Short Term MCL (<=1,500 mg/L)
- Above Short Term MCL (>1,500 mg/L)

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



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Miles

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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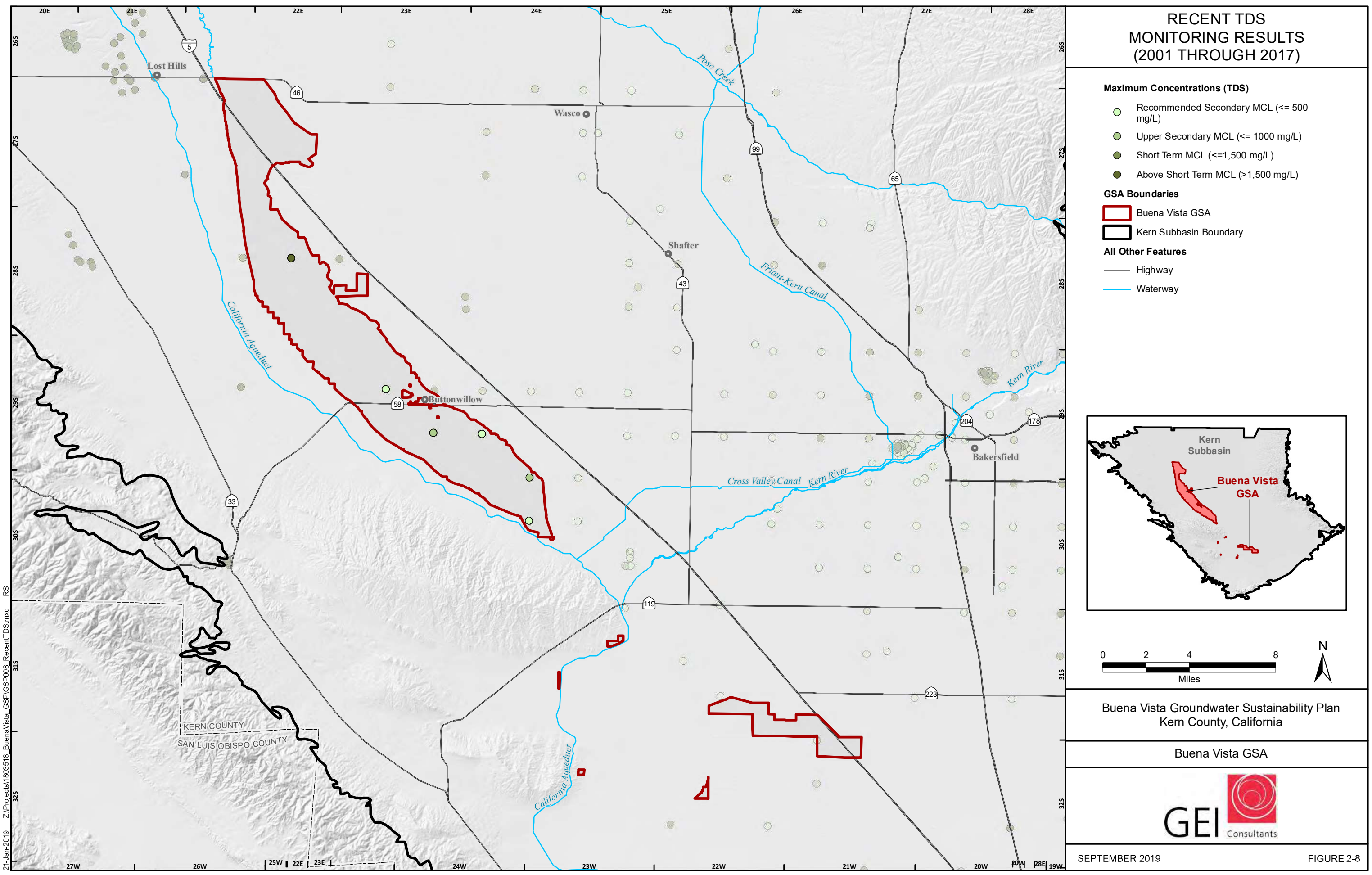
SEPTEMBER 2019 FIGURE 2-7



RECENT TDS
MONITORING RESULTS
(2001 THROUGH 2017)
Maximum Concentrations (TDS)
Recommended Secondary MCL (<= 500 mg/L)
Upper Secondary MCL (<= 1000 mg/L)
Short Term MCL (<=1,500 mg/L)
Above Short Term MCL (>1,500 mg/L)
GSA Boundaries
Buena Vista GSA
Kern Subbasin Boundary
All Other Features
Highway
Waterway
Kern Subbasin
Buena Vista GSA
0 2 4 8
Miles
N
Buena Vista Groundwater Sustainability Plan
Kern County, California
Buena Vista GSA
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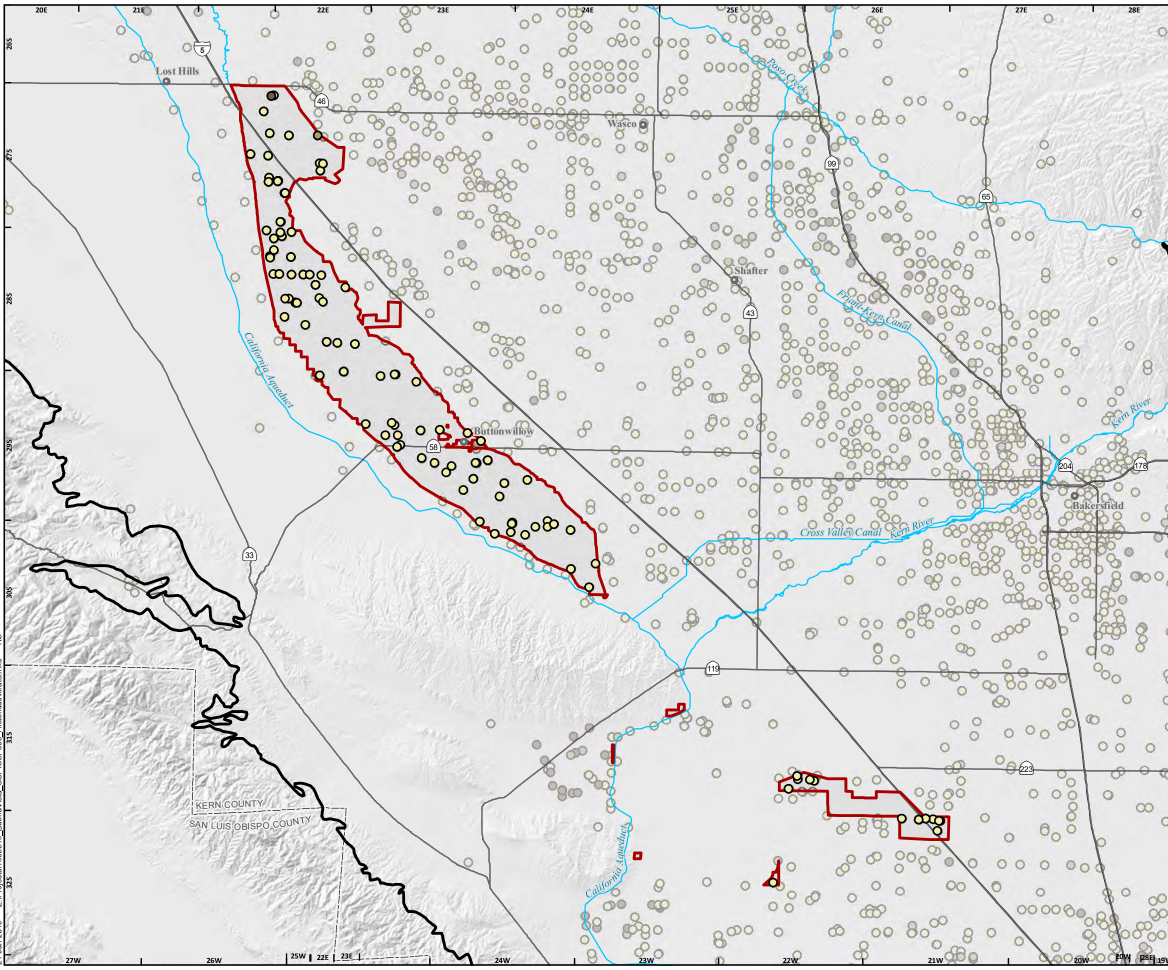
FIGURE 2-8
Lost Hills
Wasco
Shafter
Buttonwillow
Bakersfield
Poso Creek
Friant-Kern Canal
California Aqueduct
Cross Valley Canal
Kern River
KERN COUNTY
SAN LUIS OBISPO COUNTY
5
46
99
65
43
58
204
178
33
119
223
21-Jan-2019

HISTORICAL NITRATE MONITORING RESULTS (2000 AND EARLIER)



Maximum Concentrations (Nitrate as N)

MCL = 10 mg/L

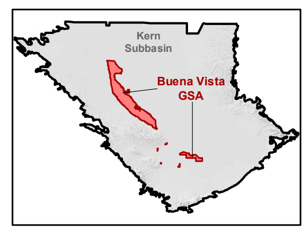
- 0 to 10 mg/L
- 10 to 20 mg/L
- 20+ mg/L

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2 4 8
Miles
N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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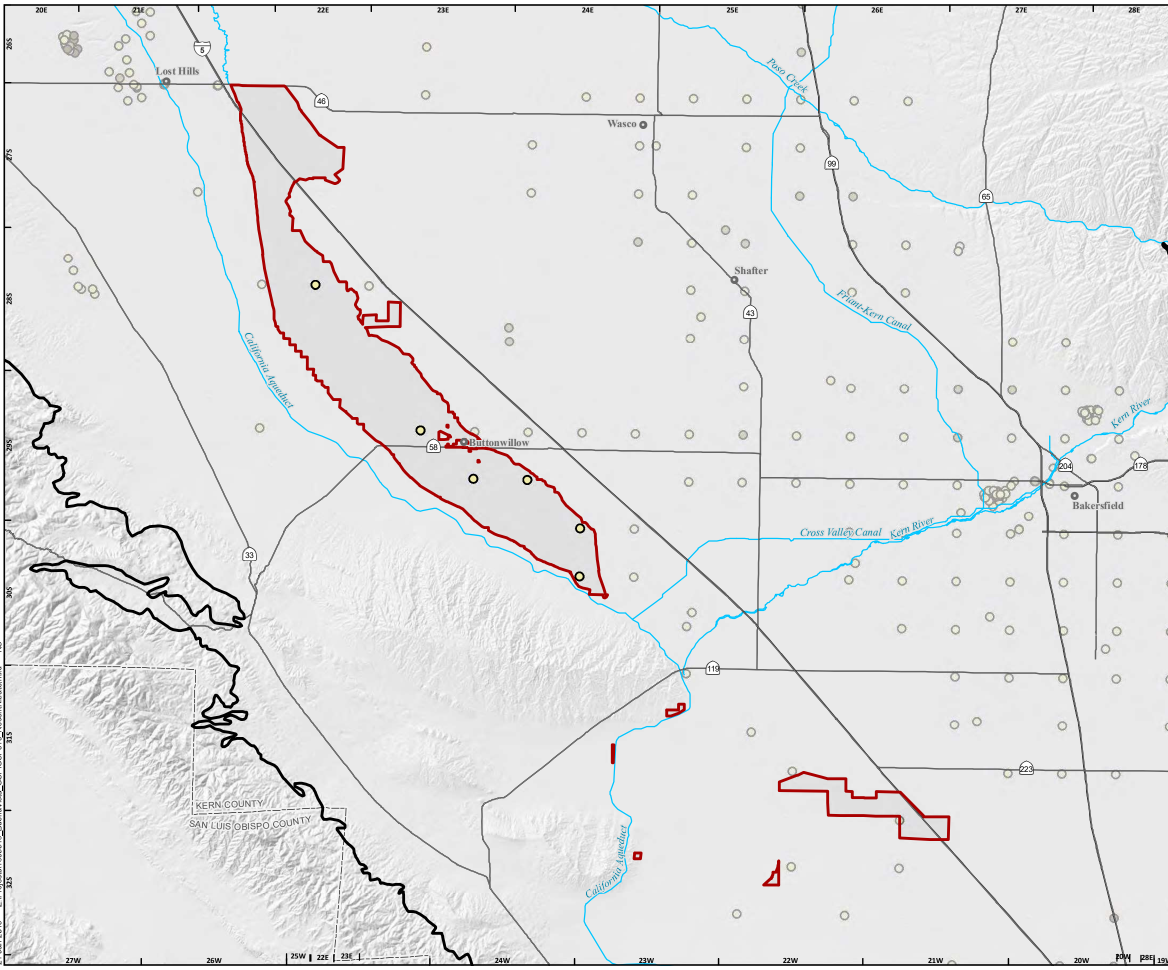
FIGURE 2-9

RECENT NITRATE MONITORING RESULTS (2001 THROUGH 2017)



Maximum Concentrations (Nitrate as N)

MCL = 10 mg/L

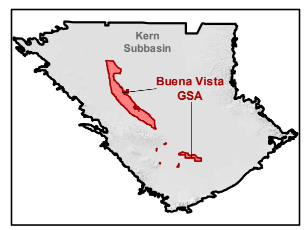
- 0 to 10 mg/L
- 10 to 20 mg/L
- 20+ mg/L

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



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Miles

N

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Kern County, California

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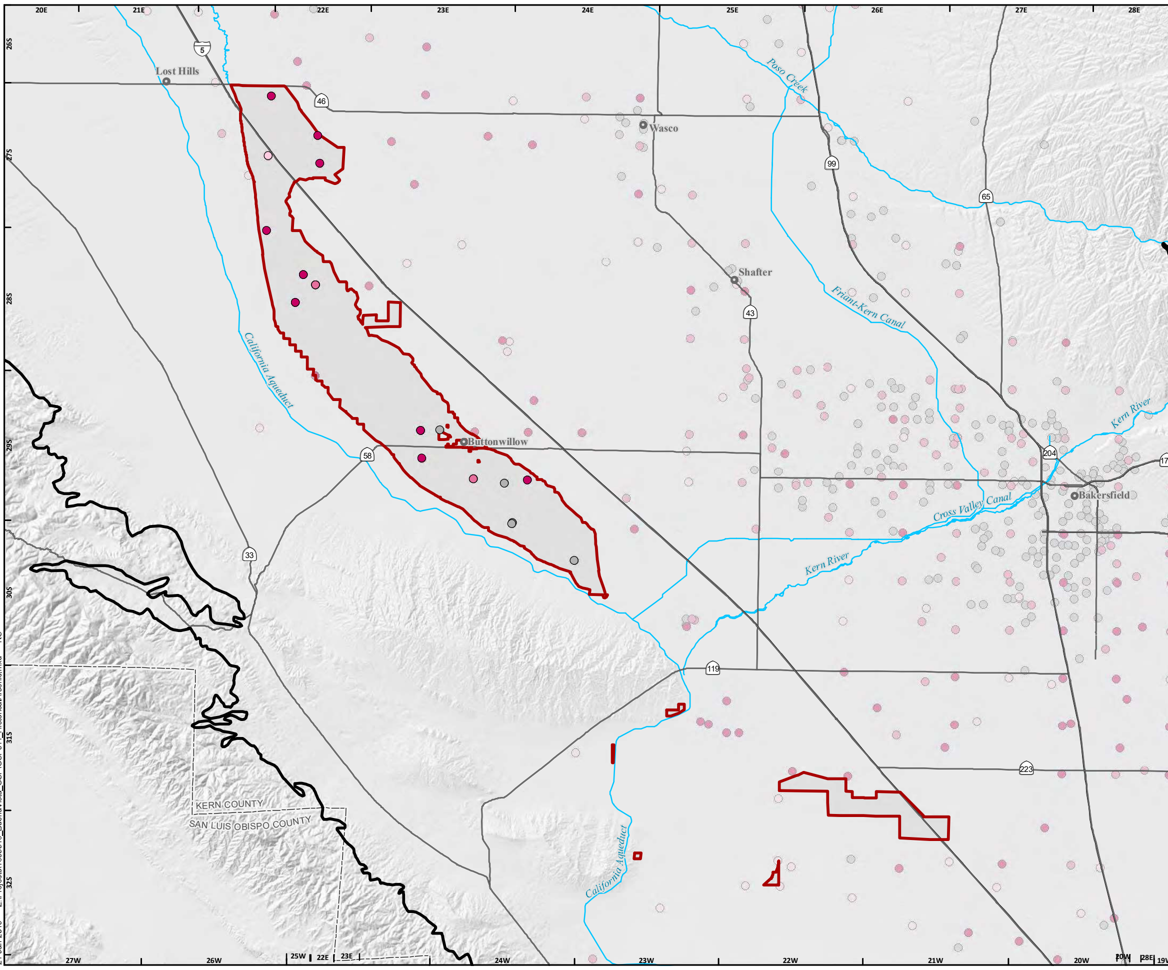
FIGURE 2-10

HISTORICAL ARSENIC MONITORING RESULTS (2000 AND EARLIER)



Maximum Concentrations (Arsenic)

MCL = 10 ppb

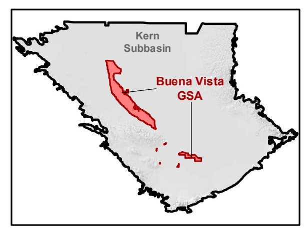
- Non-Detect
- 0 - 5 ppb
- 5 - 10 ppb
- 10+ ppb

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2 4 8
Miles

N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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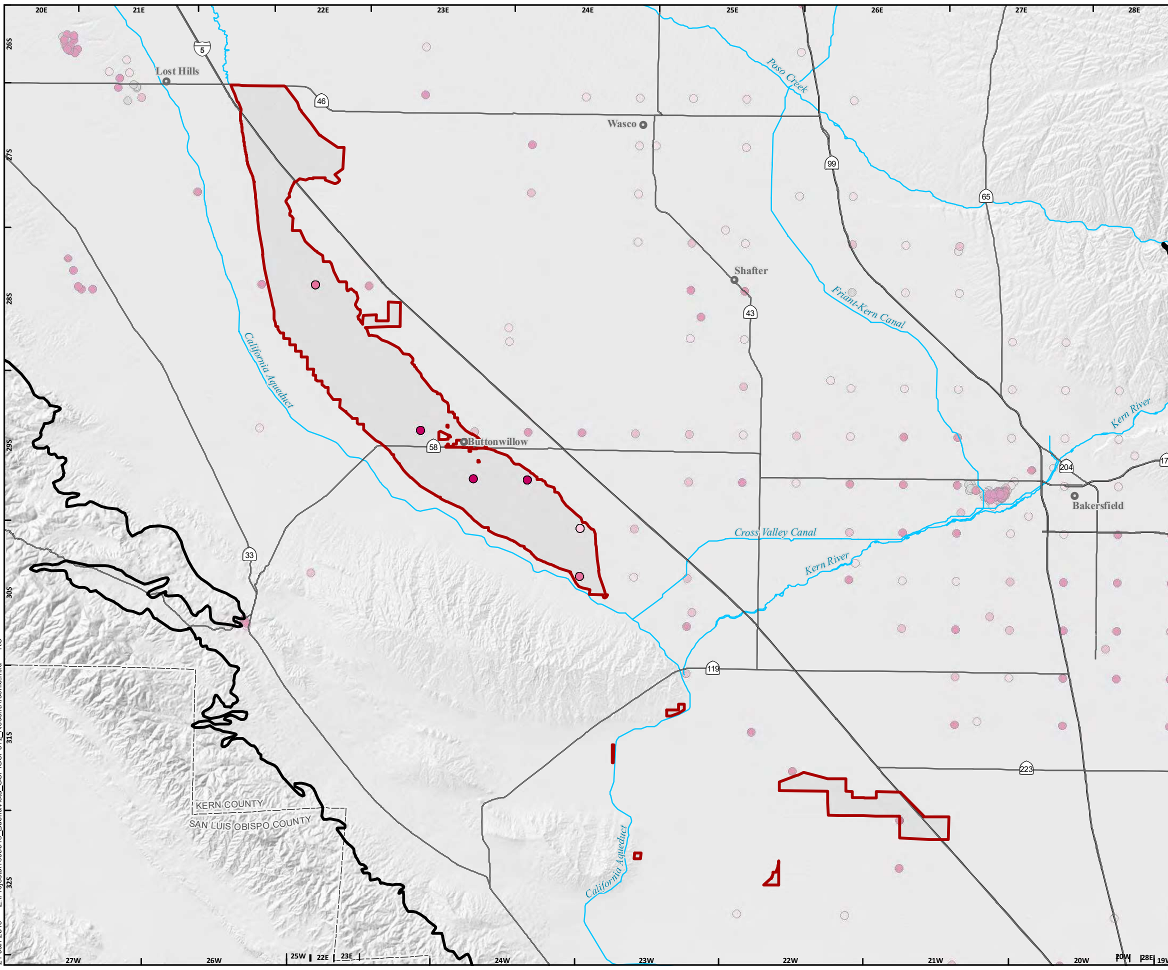
FIGURE 2-11



RECENT ARSENIC MONITORING RESULTS (2001 THROUGH 2017)

Maximum Concentrations (Arsenic)

MCL = 10 ppb

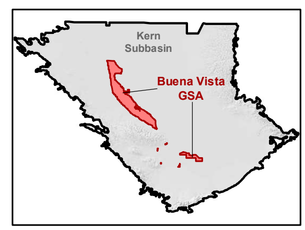
- Non-Detect
- 0 - 5 ppb
- 5 - 10 ppb
- 10+ ppb

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



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Miles

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Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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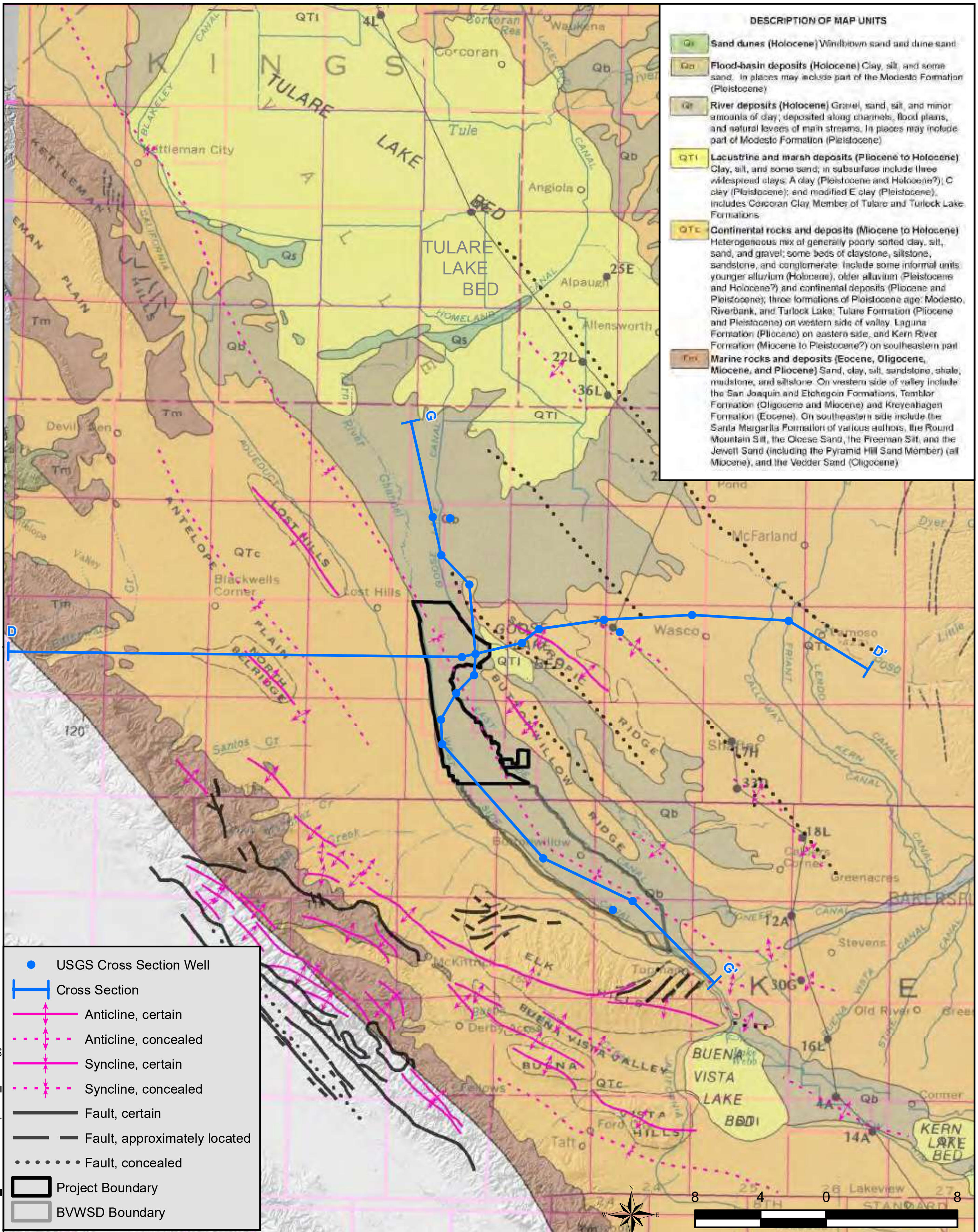
FIGURE 2-12

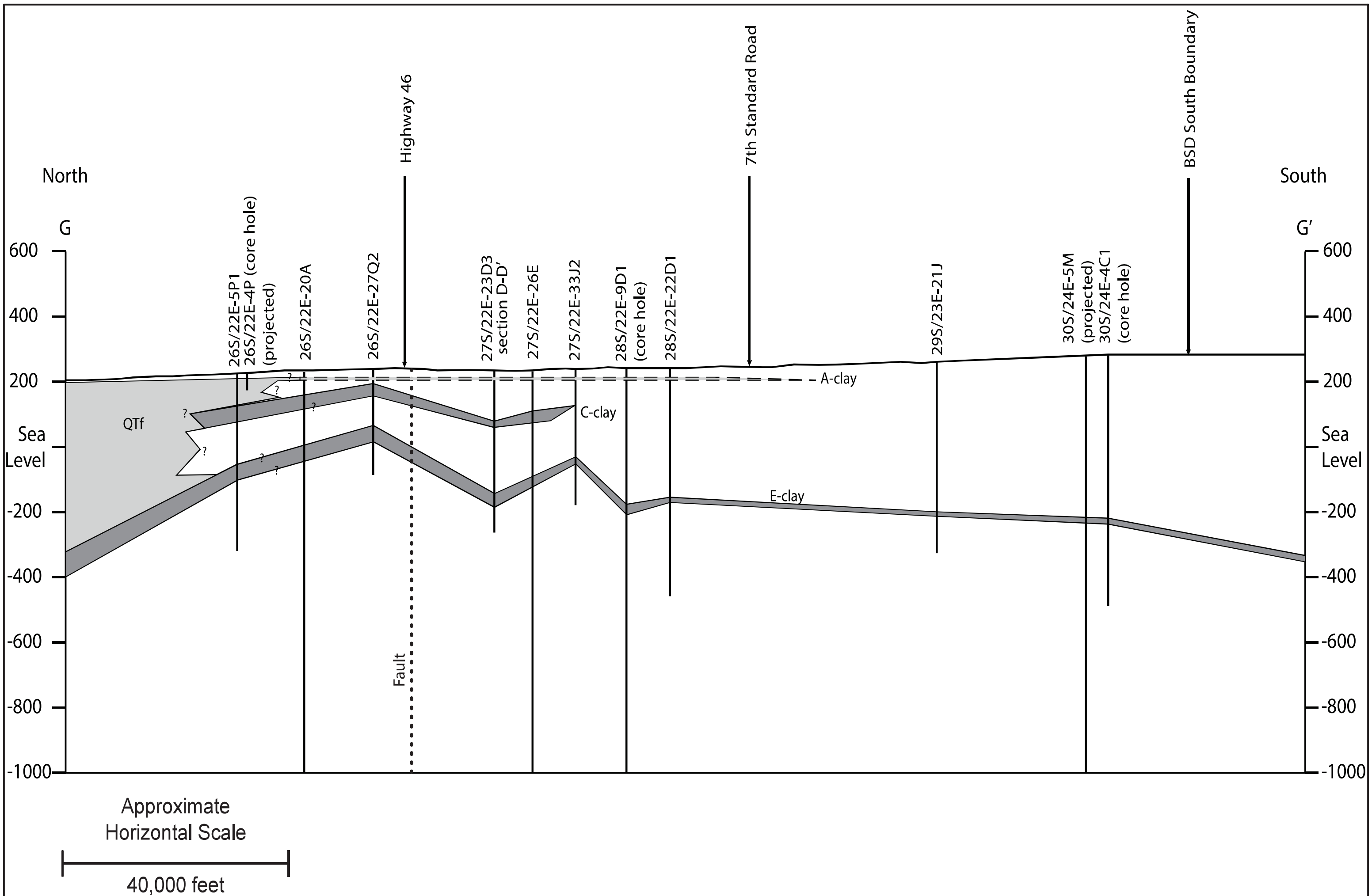


SOURCES: Background geology image from USGS 1986
Structures and Faults from USGS 2010
Cross Section Locations from USGS (1974) and Western Oil and Gas Association (1983), respectively

Z:\Projects\126580_McAllister\DeepWell_Geology.mxd DLF

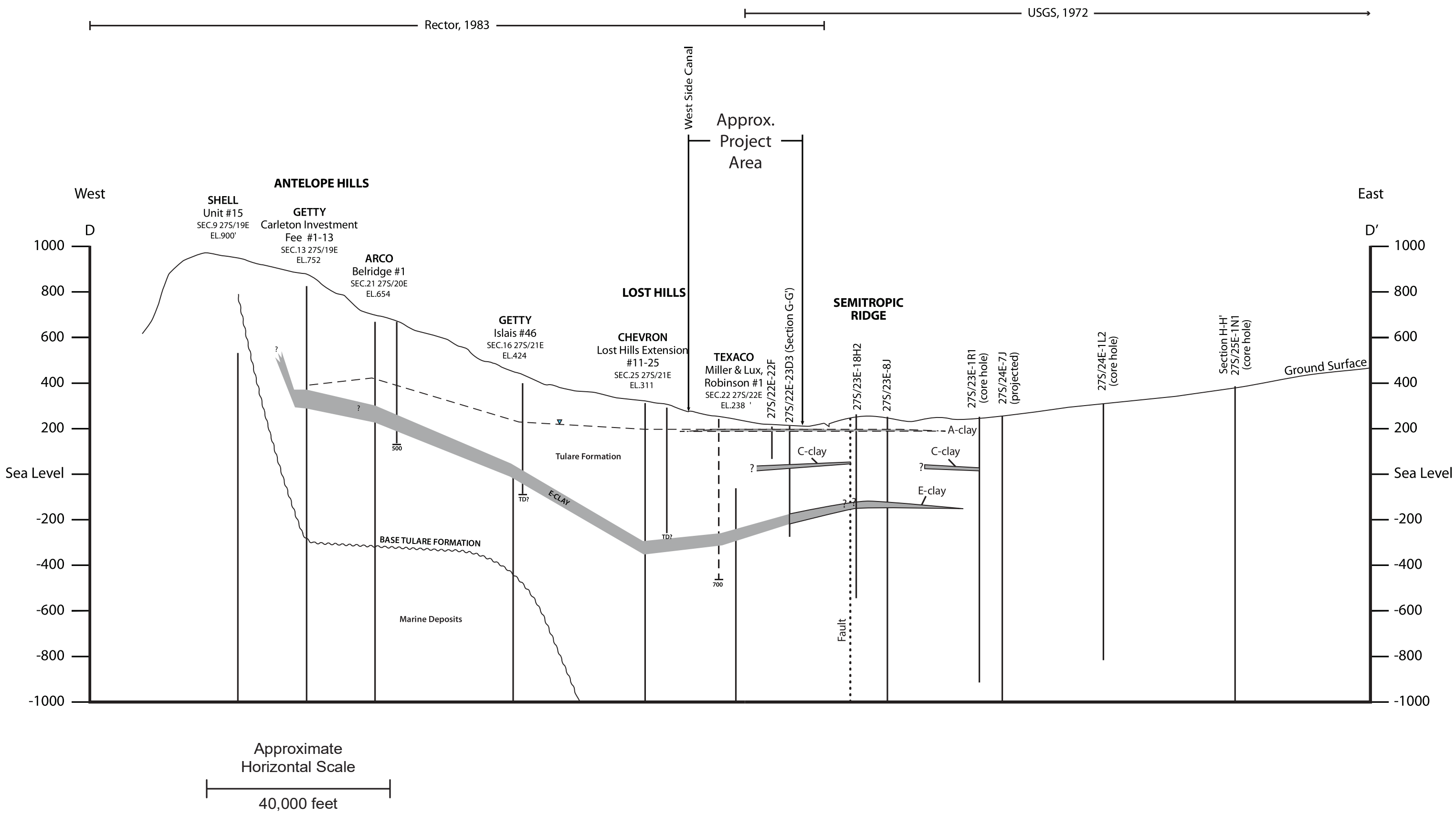
14-Sep-2016

Deep Well Groundwater Quality Management Plan	GEI Consultants	Regional Geology
Buena Vista Coalition		SEPTEMBER 2019 — FIGURE 2-13a



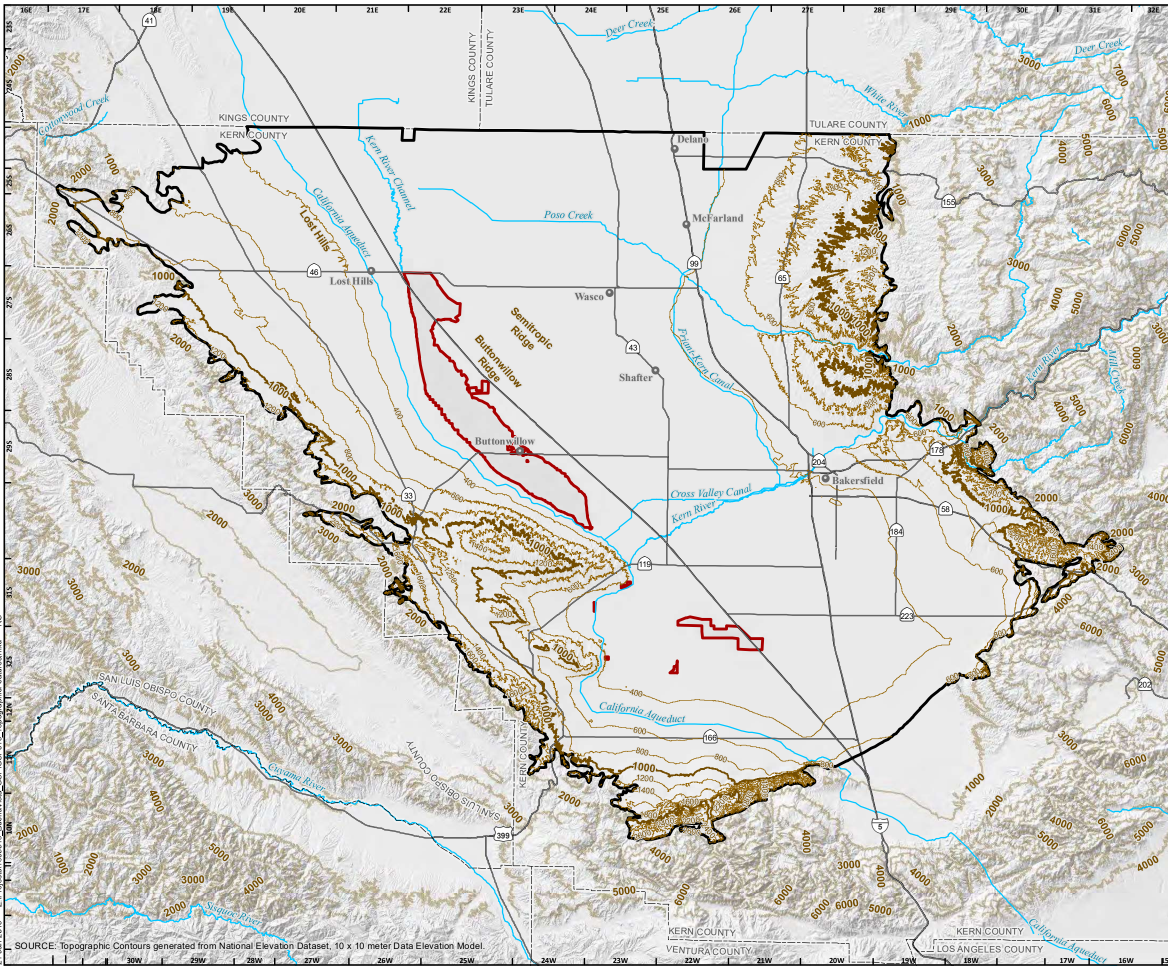
Source: Adapted from USGS Water Supply Paper 1999-H (Croft 1972)

Buena Vista Groundwater Sustainability Plan Kern County, California	GEI Consultants	North-South Cross Section G-G'
Buena Vista Groundwater Sustainability Agency		SEPTEMBER 2019 FIGURE 2-13b



Sources: Adapted from a combination of USGS Water Supply Paper 1999-H (Croft 1972) and Cross section 27S from Western Oil and Gas Association Westside Groundwater Study (Rector 1983)

Northern Pipeline Project Kern County, California	GEI Consultants	West-East Cross Section D-D'
Buena Vista Water Storage District		SEPTEMBER 2019 FIGURE 2-13c



TOPOGRAPHIC FEATURES

Elevation Contours

- Minor (200 ft)
- Major (1,000 ft)

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway

0 4 8 16
Miles

N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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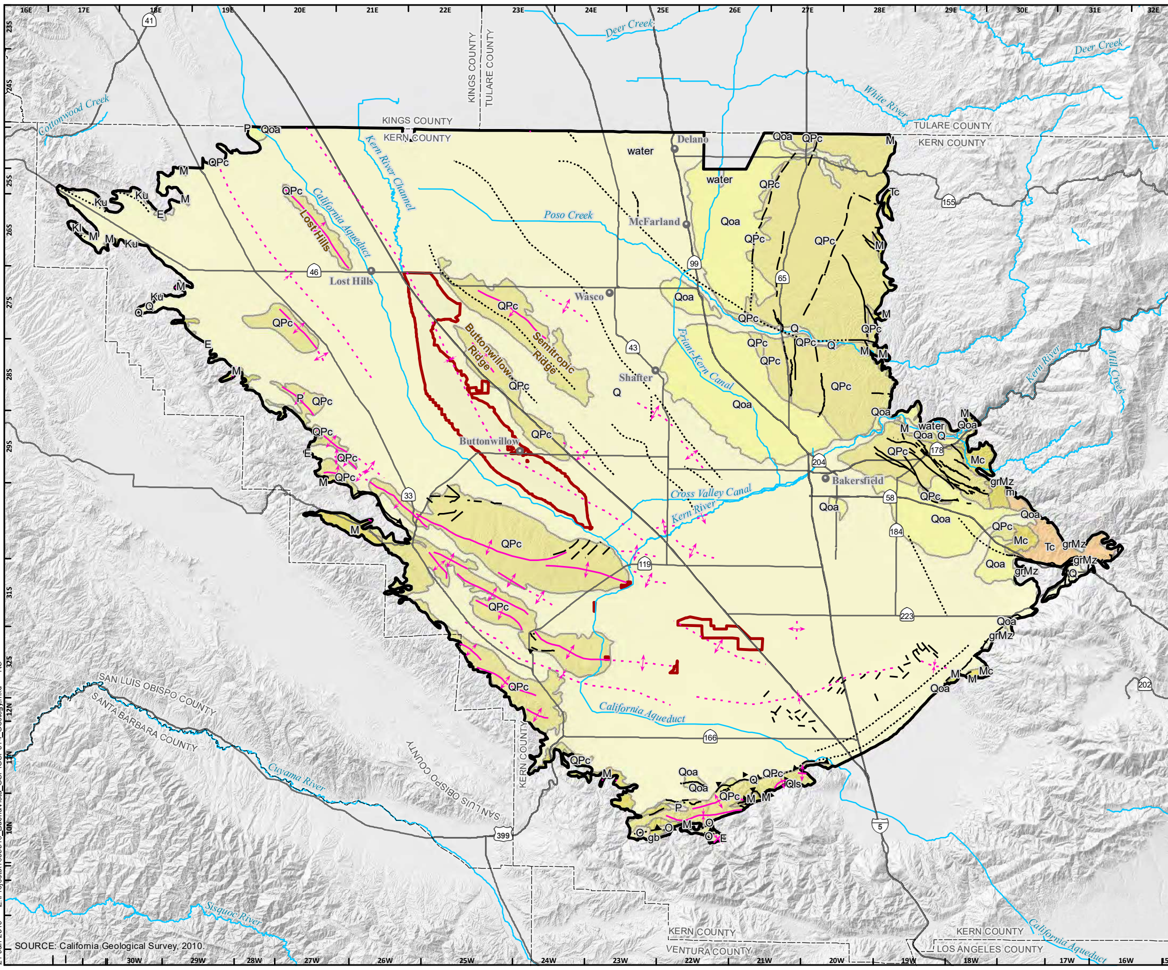
FIGURE 2-14



GEOLOGIC UNITS OF BV GSA AND SURROUNDING AREA

Geologic Features

- Fault, certain
- Fault, approx. located
- Fault, concealed
- Thrust fault, certain
- Thrust fault, approx. located
- Thrust fault, concealed
- Reverse fault, certain
- Anticline, certain
- Anticline, concealed
- Syncline, certain
- Syncline, concealed

Geologic Units

- **Q** - Pleisto-Holocene: alluvium, lake, playa and terrace deposits; unconsolidated and semi-consolidated
- **Qoa** - Quaternary: older alluvium, lake, playa and terrace deposits
- **QPc** - Plio-Pleistocene: sandstone, shale and gravel deposits; mostly loosely consolidated
- **P** - Pliocene: sandstone, siltstone, shale and conglomerate; mostly moderately consolidated
- **Mc/M** - Miocene: sandstone, shale, conglomerate and fanglomerate; moderately to well consolidated
- **O** - Oligocene: sandstone, shale and conglomerate; mostly well consolidated
- **TC** - Undivided Tertiary: sandstone, shale, conglomerate, breccia and ancient lake deposits

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway

0 4 8 16
Miles

N

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Kern County, California

Buena Vista GSA

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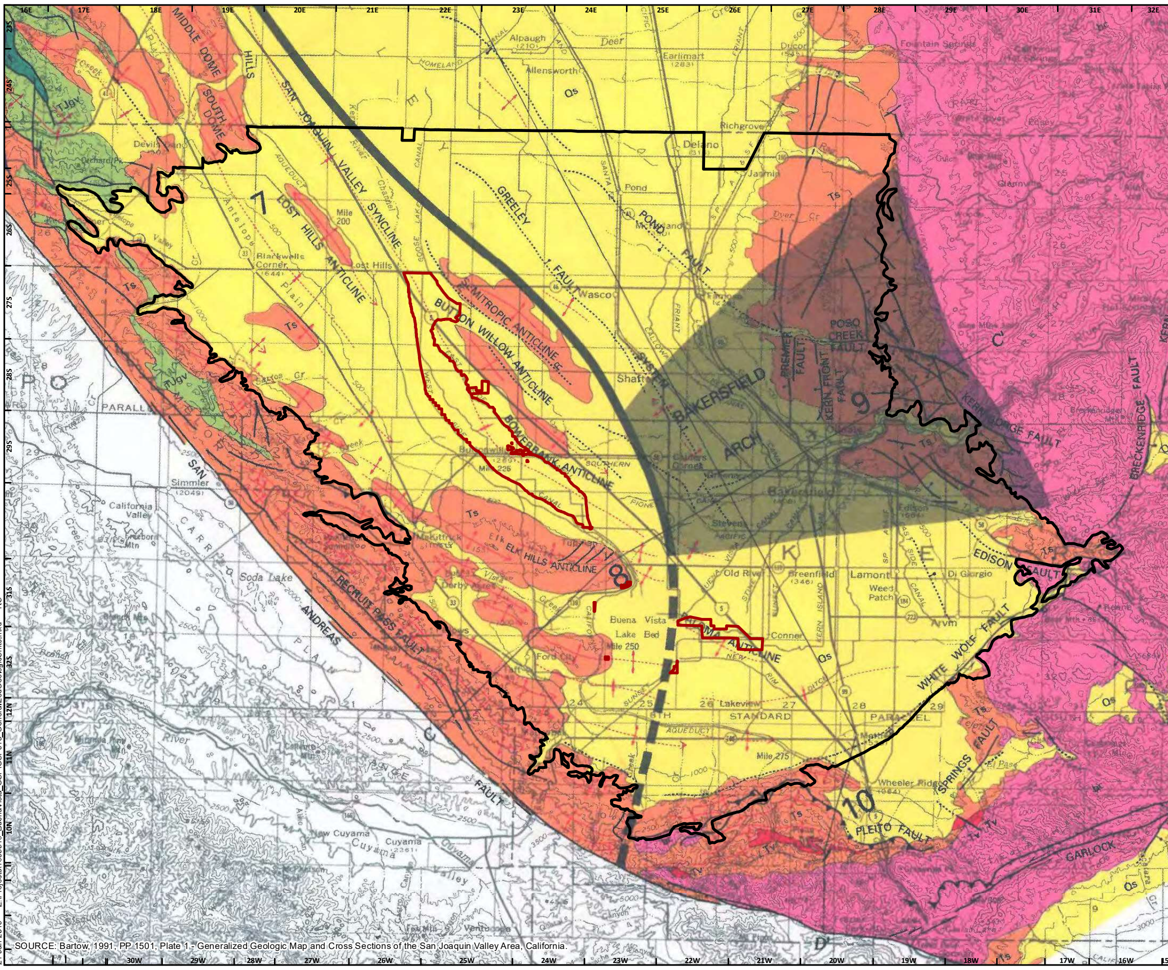
FIGURE 2-15

GENERALIZED GEOLOGIC UNITS



GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

CORRELATION OF MAP UNITS

Qs	QUATERNARY	CENOZOIC
Tv, Ts, QTs (Neogene / Paleogene)	TERTIARY	CENOZOIC
TJgv, f, um	CRETACEOUS AND JURASSIC	MESOZOIC
bc		MESOZOIC AND PALEOZOIC

DESCRIPTION OF MAP UNITS

- Qs — **Alluvial and lacustrine sediments (Quaternary)**
- QTs — **Alluvial deposits, sedimentary rocks, and minor volcanic rocks, undivided (Quaternary and Tertiary)**—Used on cross sections only and consists of units Qs and Ts. Dashed line shows approximate boundary between Paleogene and Neogene
- Tv — **Volcanic rocks (Tertiary)**
- Ts — **Sedimentary rocks (Tertiary)**—Marine and nonmarine rocks. Dashed line shows approximate boundary between Paleogene and Neogene
- TJgv — **Great Valley sequence (Tertiary to Jurassic)**—Melanges of sedimentary rocks
- f — **Franciscan Complex (Tertiary to Jurassic)**—Melanges of sedimentary rocks, serpentinite, and blueschist in a sheared matrix and coherent sedimentary rocks
- um — **Ultramafic rocks (Cretaceous and Jurassic)**
- bc — **Crystalline rocks of the basement complex (Mesozoic and Paleozoic)**
- **Approximate area of structural arch**
- **Contact**—Queried where uncertain in cross sections only
- **Fault**—Dashed where approximately located; dotted where concealed; queried where uncertain. Bar and ball on downthrown side; R on upthrown side of reverse fault; arrows indicate direction of relative movement. Relative lateral movement on cross sections only: A, away from observer; T, toward observer
- **Thrust fault**—Dotted where concealed. Sawteeth on upper plate
- **Fold**—Dotted where concealed. Showing approximate trace of axial plane; arrows indicate direction of plunge
  - **Anticline**
  - **Syncline**
- **Boundary of structural region (see text)**—Dashed where approximately located
- 5 **Location of stratigraphic column**—Number refers to column number on plate 2

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Miles

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Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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FIGURE 2-16

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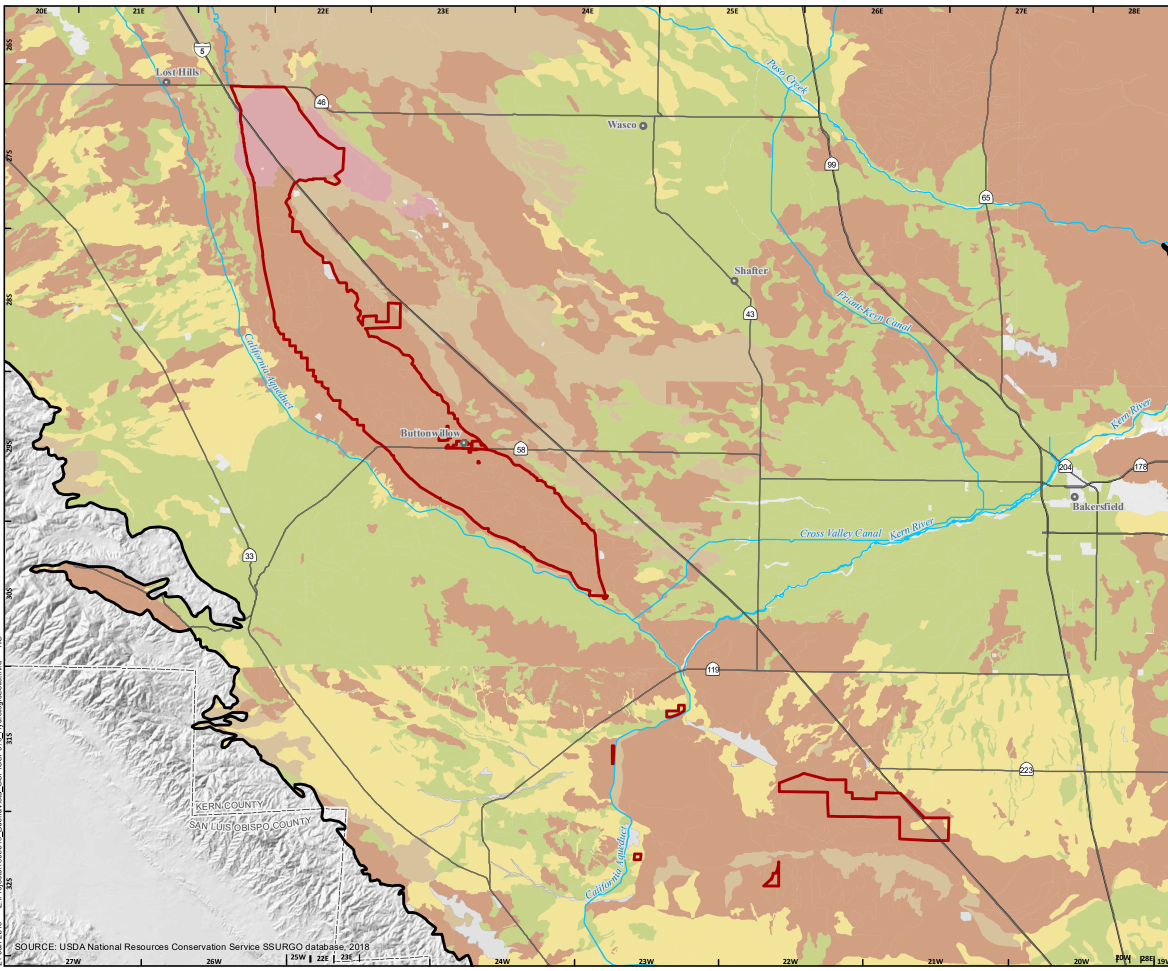


NRCS HYDROLOGIC SOIL GROUPS

Hydrologic Soil Groups (SSURGO)

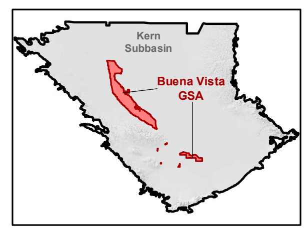
- A - High Infiltration (Sands or Gravels)
- B - Moderate Infiltration (Fine to Coarse Soils)
- B/D - Slow to Very Slow Infiltration
- C - Slow Infiltration (Moderately Fine to Fine Soils)
- C/D - Very Slow Infiltration (Clay Soils)
- D - Very Slow Infiltration Rate

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



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Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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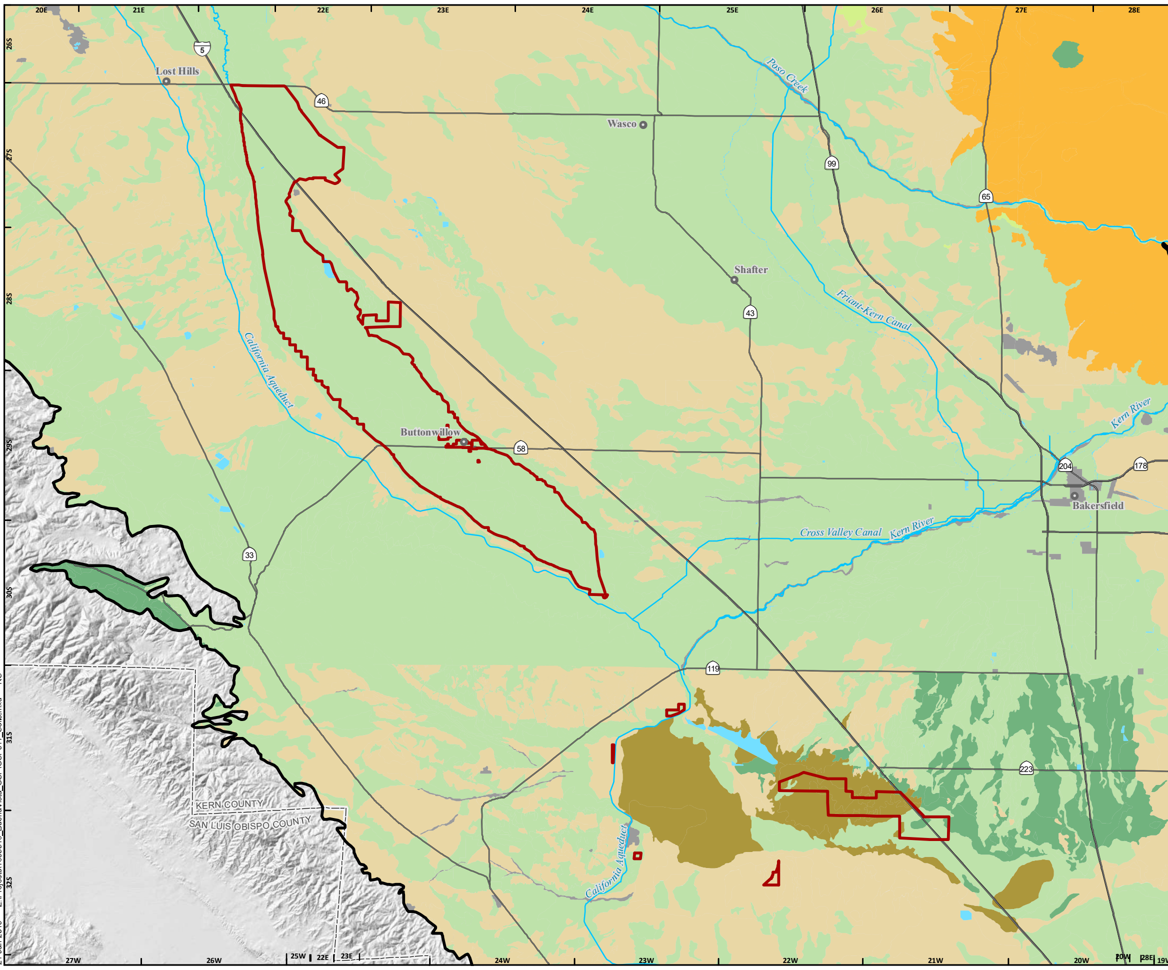
FIGURE 2-17

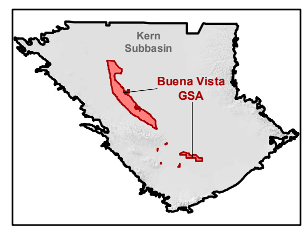


TAXONOMIC SOIL ORDERS OF THE KERN COUNTY SUBBASIN

Soil Classification
- Alfisols
- Aridisols
- Entisols
- Inceptisols
- Mollisols
- Vertisols
- No Soil Data
- Water

GSA Boundaries
- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features
- Highway
- Waterway



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Miles
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Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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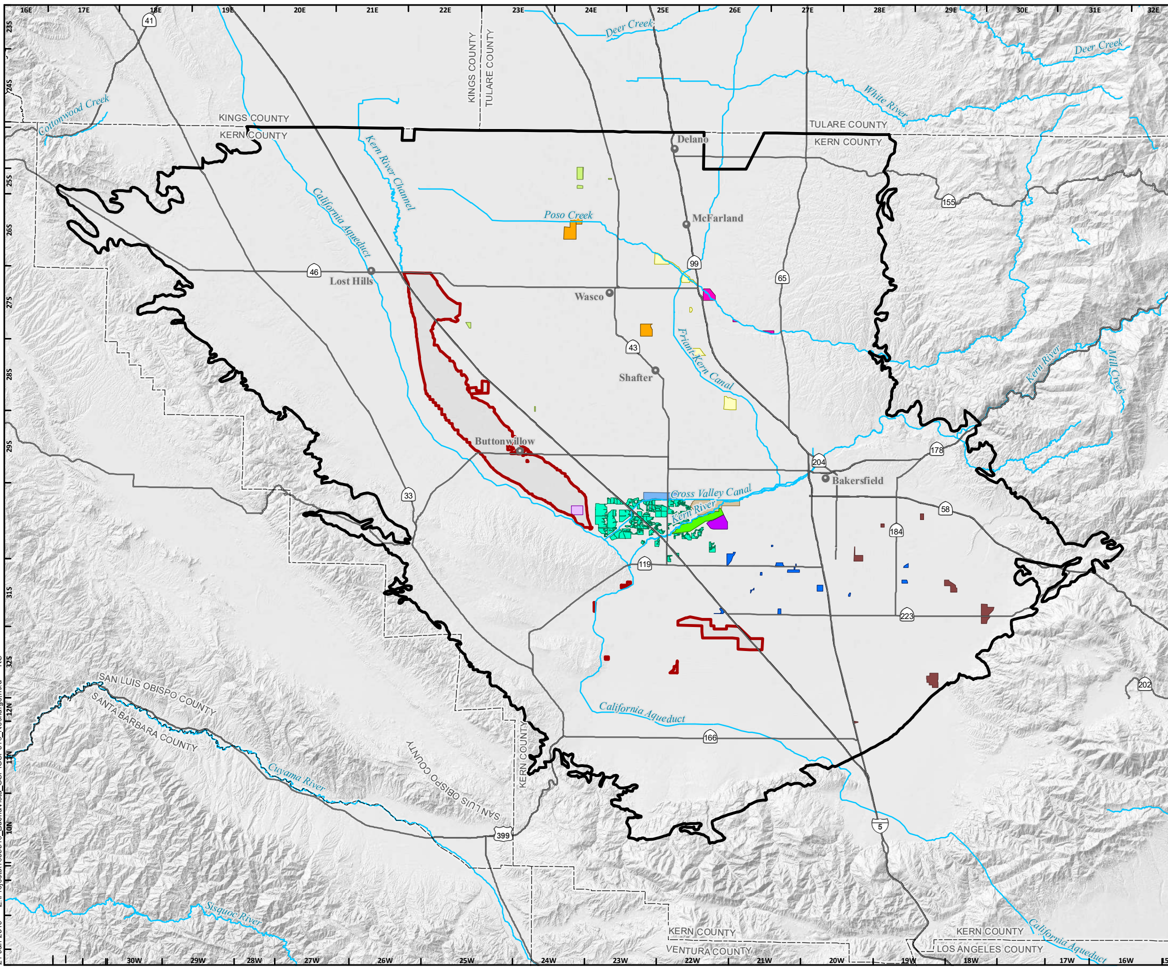
FIGURE 2-18



EXISTING RECHARGE AND SPREADING CENTERS

- Arvin-Edison WSD Recharge Basin
- Buena Vista WSD - Palms Recharge Project
- Cawelo WD Spreading Pond
- Kern Delta WD Recharge Basin
- Kern Water Bank Authority Recharge Basin
- North Kern WSD Spreading Pond
- Pioneer Central / City of Bakersfield 2800
- Pioneer North / Berrenda Mesa
- Pioneer South
- Rosedale-Rio Bravo Recharge Basin
- Semitropic WSD Spreading Basin
- Shafter-Wasco ID Recharge Basin

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway

0 4 8 16
Miles

N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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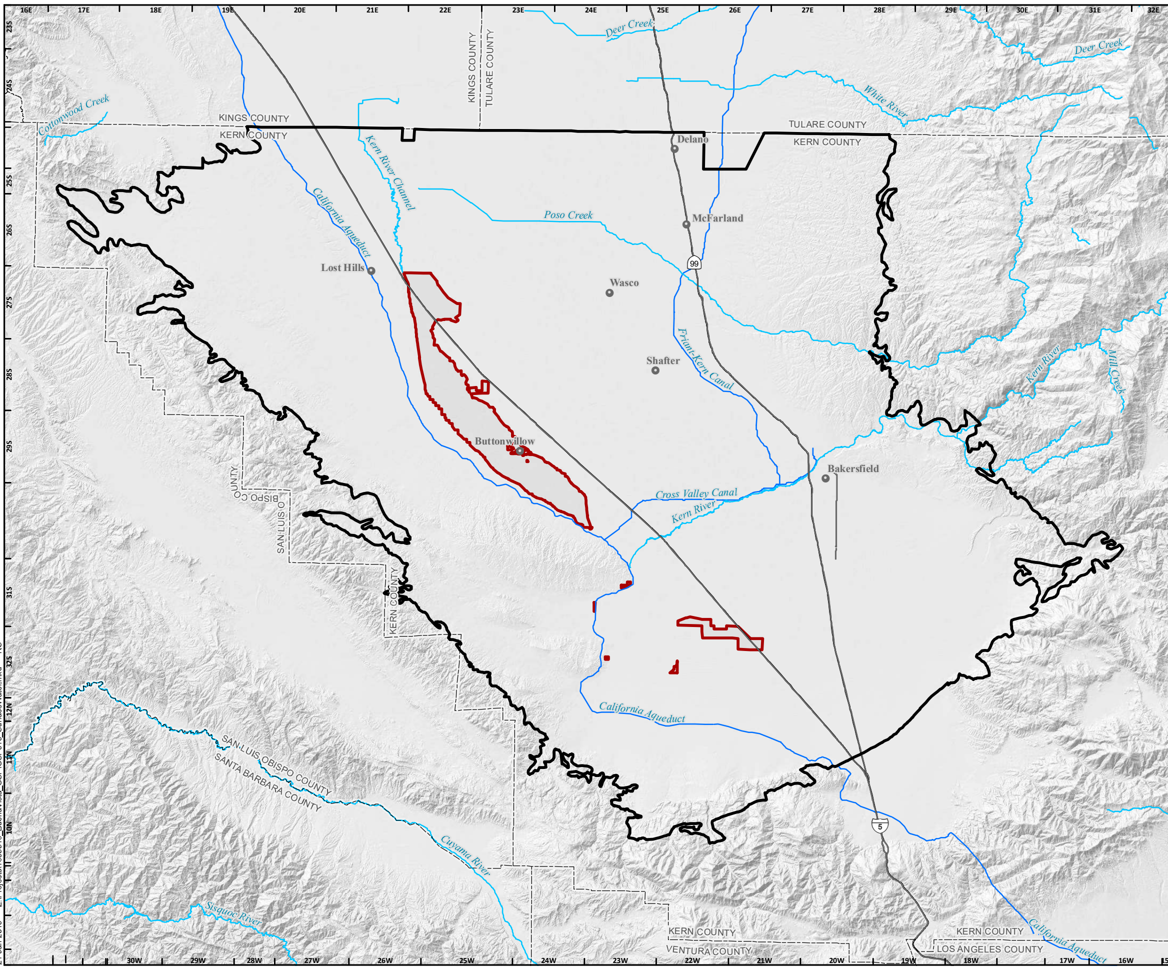
SEPTEMBER 2019 FIGURE 2-19

21-Jan-2019 Z:\Projects\1803518_BuenaVista_GSP\GSP018_Recharge.mxd RS



SURFACE WATER FEATURES

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- River, Creek or Ephemeral Stream
- Major Canal

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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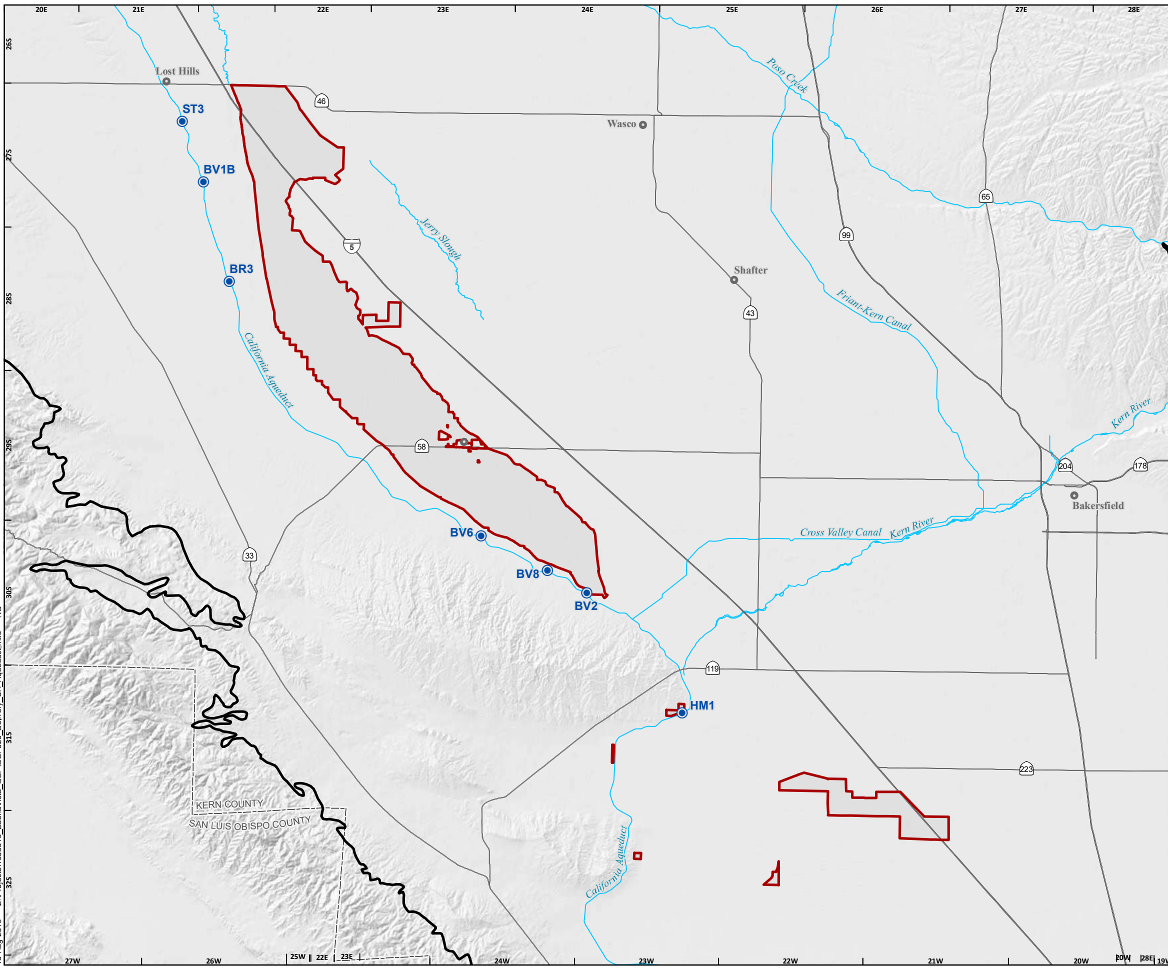
FIGURE 2-20



CALIFORNIA AQUEDUCT AND LOCATION OF TURNOUTS SERVING BUENA VISTA GSA

California Aqueduct Turnout

GSA Boundaries

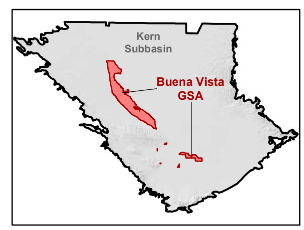
Buena Vista GSA

Kern Subbasin Boundary

All Other Features

Highway

Waterway



0 2 4 8

Miles

N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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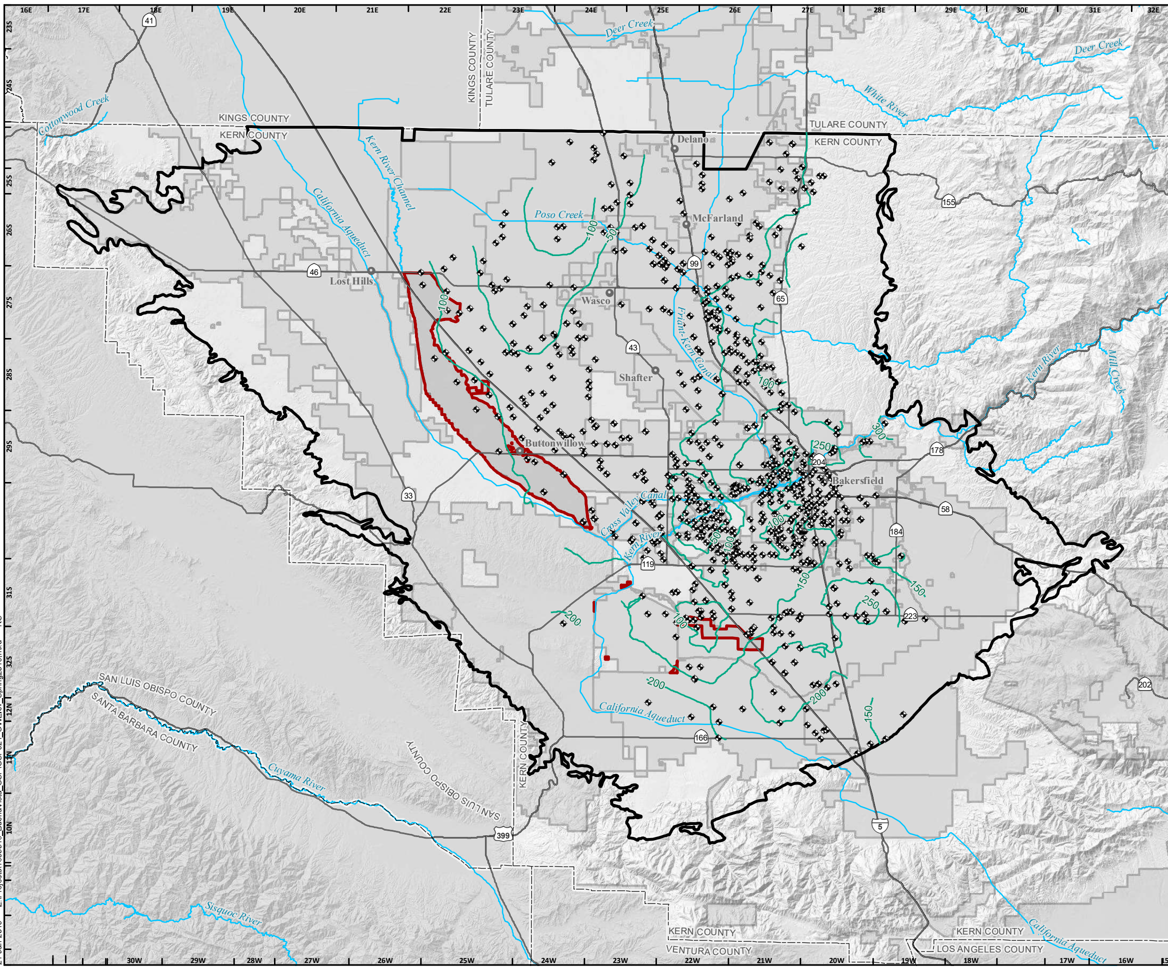
FIGURE 2-21

15-Aug-2019 Z:\Projects\1803518_BuenaVista_GSP\GSP020_Delivery_CA_Aqueduct.mxd RS



GROUNDWATER ELEVATIONS SPRING 2015

- Well Location
- Groundwater Elevation Contour (ft MSL)

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary
- Water Agency

All Other Features

- Highway
- Waterway

0 4 8 16
Miles

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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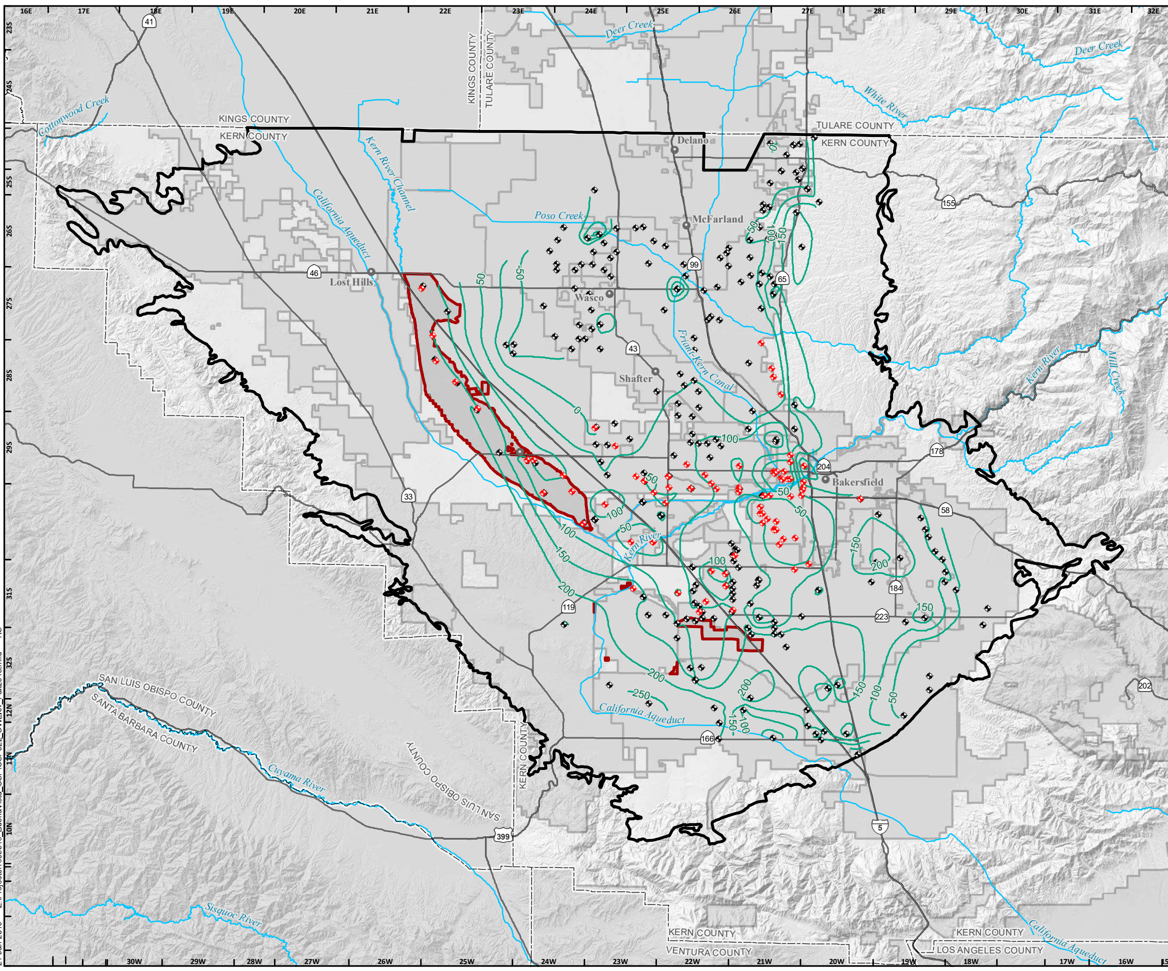
FIGURE 2-24

21-Jan-2019 Z:\Projects\1803518_BuenaVista_GSP\GSP021_GWElev_Spring2015.mxd RS



GROUNDWATER ELEVATIONS FALL 2015

CASGEM Well
KCWA Well
Groundwater Elevation Contour (ft MSL)

GSA Boundaries

Buena Vista GSA
Kern Subbasin Boundary
Water Agency

All Other Features

Highway
Waterway

0 4 8 16
Miles

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Kern County, California

Buena Vista GSA

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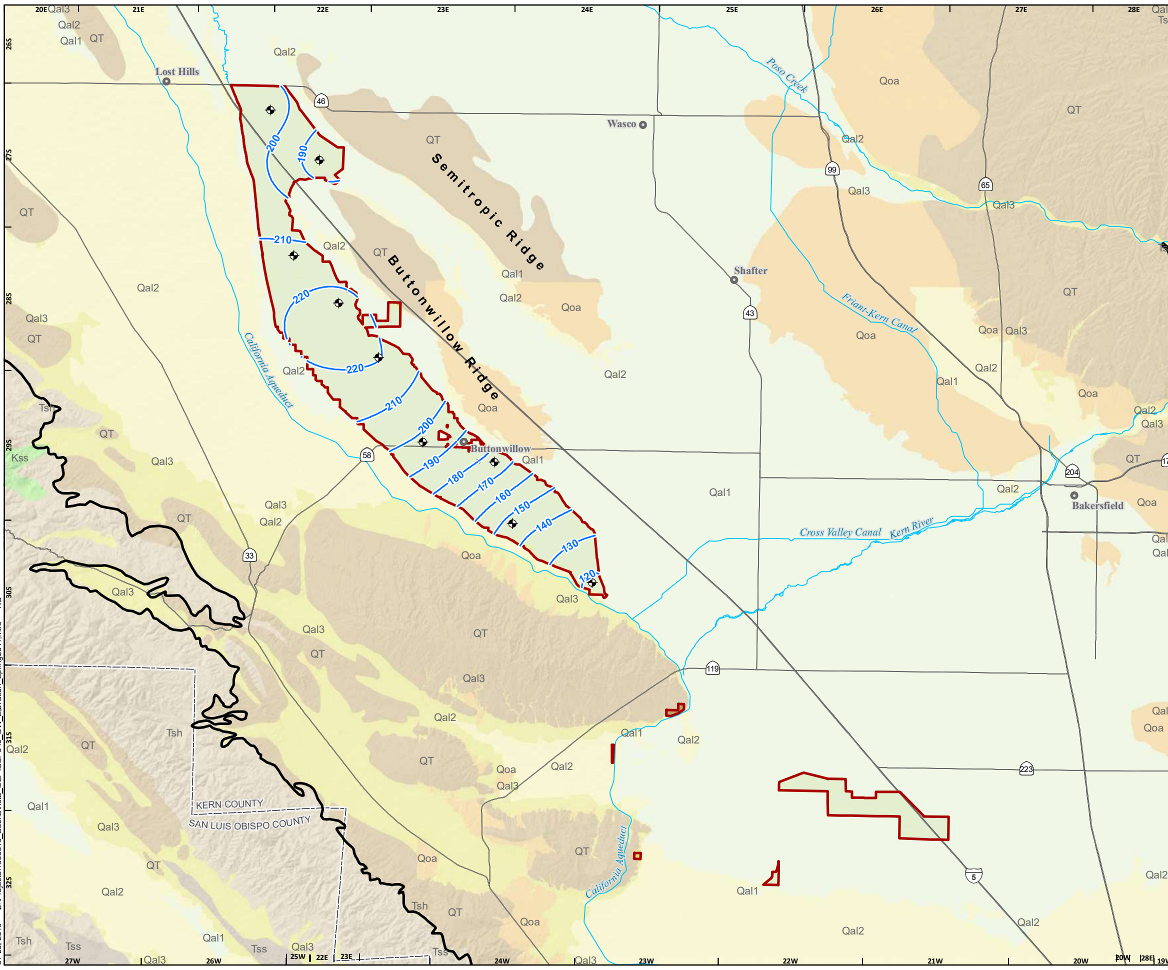
FIGURE 2-25

GROUNDWATER ELEVATION SPRING 2011



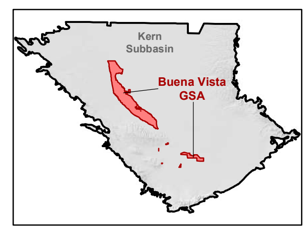
- District Monitoring Well
- Groundwater Elevation Contour (Spring 2011)

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2 4 8
Miles

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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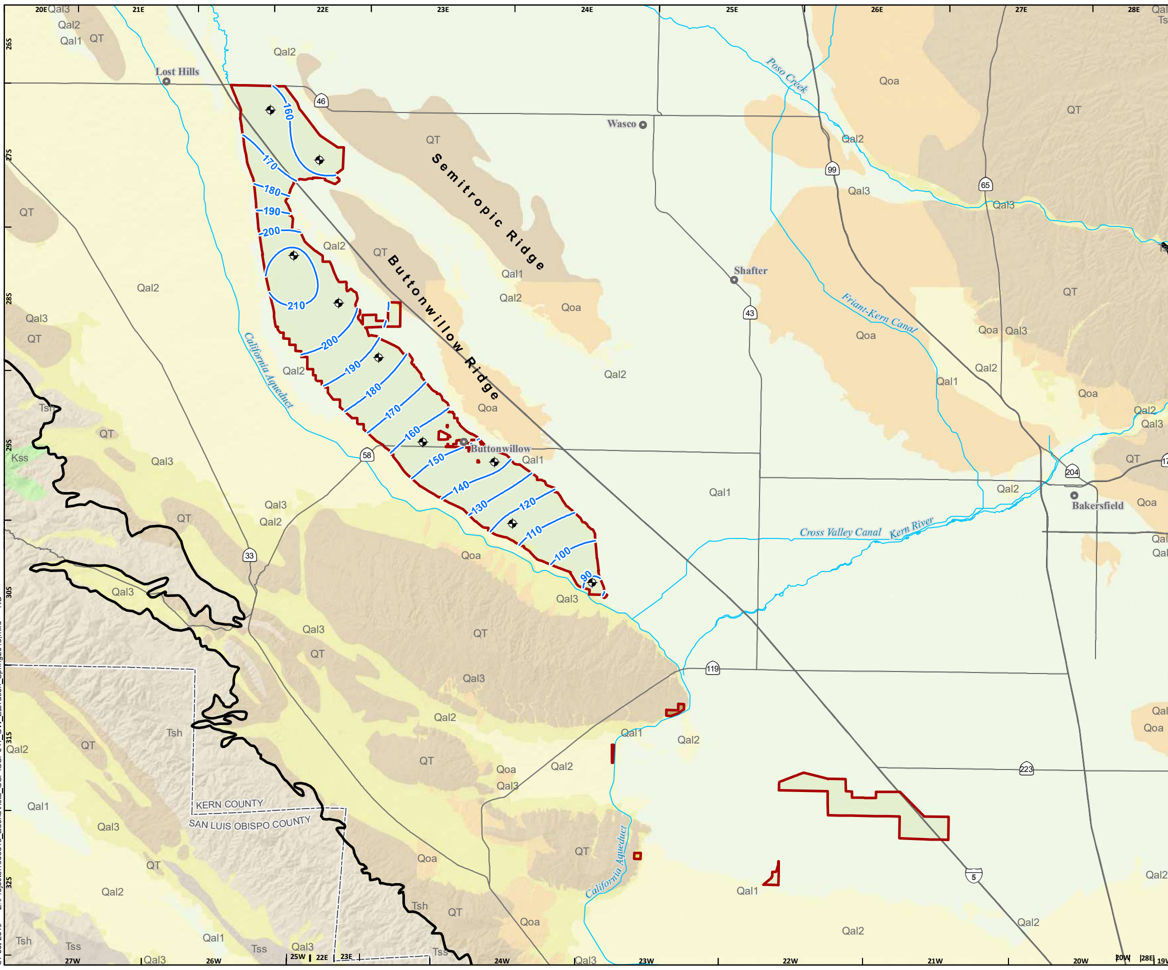
FIGURE 2-27A



GROUNDWATER ELEVATION SPRING 2015

- District Monitoring Well
- Groundwater Elevation Contour (Spring 2015)

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway

0 2 4 8 Miles

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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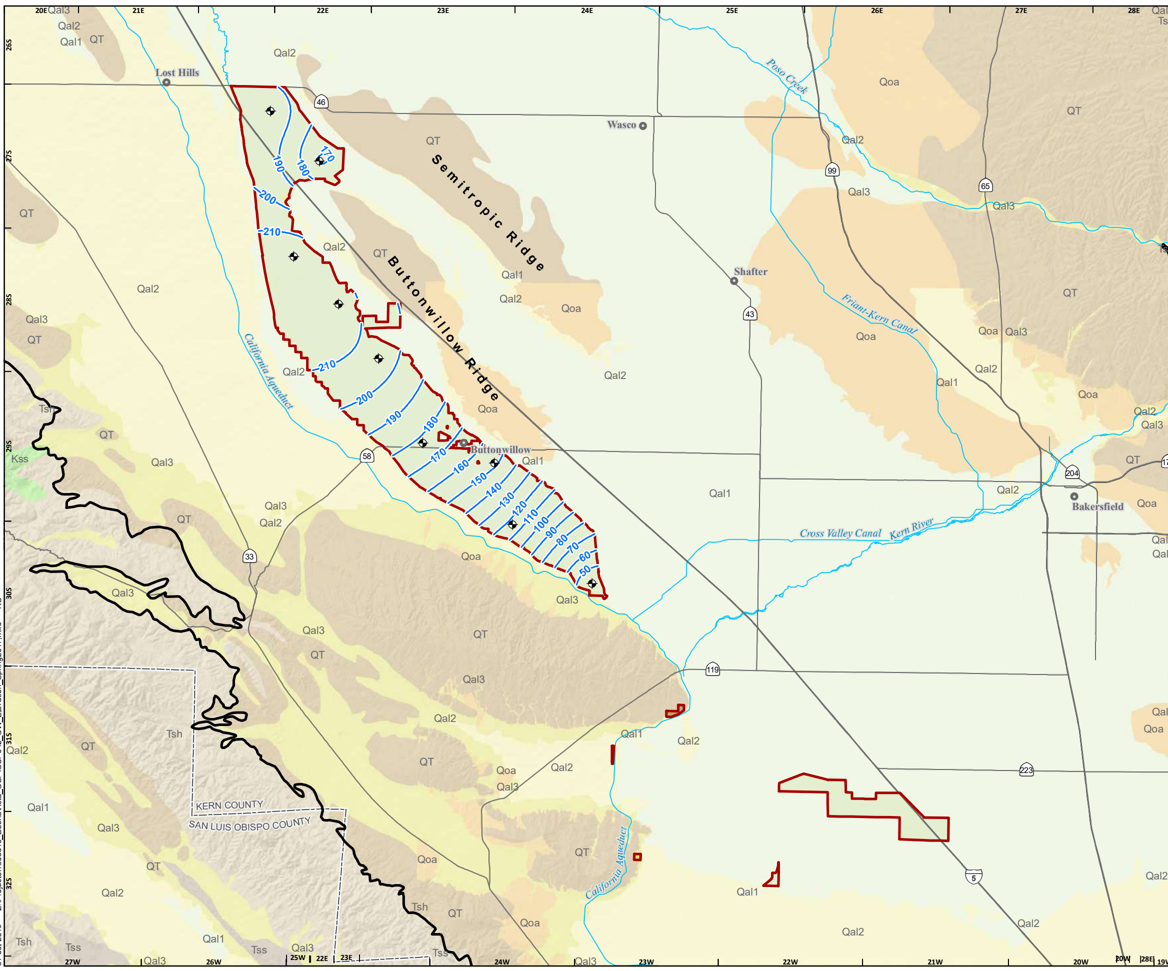
31-Jul-2019 Z:\Projects\1803518_BuenaVista_GSP\GSP041_GW_Elevation_Spring2015.mxd RS



GROUNDWATER ELEVATION SPRING 2017

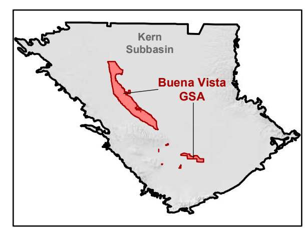
District Monitoring Well
Groundwater Elevation Contour (Spring 2017)

GSA Boundaries

Buena Vista GSA
Kern Subbasin Boundary

All Other Features

Highway
Waterway



0 2 4 8
Miles
N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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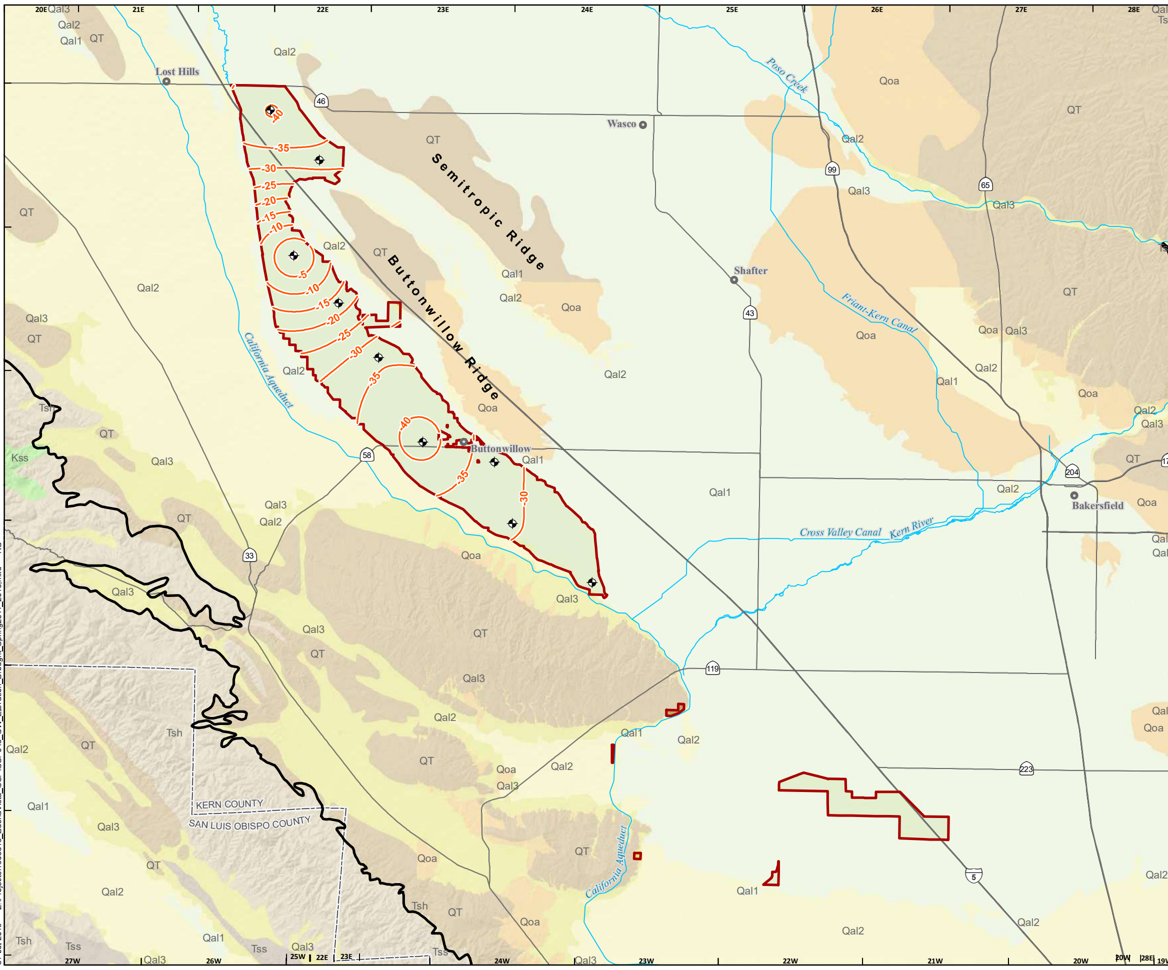
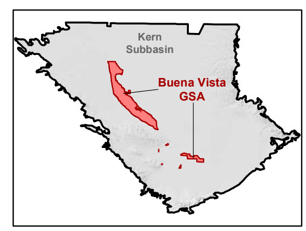
SEPTEMBER 2019 FIGURE 2-27C

31-Jul-2019 Z:\Projects\1803518_BuenaVista_GSP\GSP042_GW_Elevation_Spring2017.mxd RS

GROUNDWATER ELEVATION CHANGE DROUGHT: SPRING 2011 TO SPRING 2015





Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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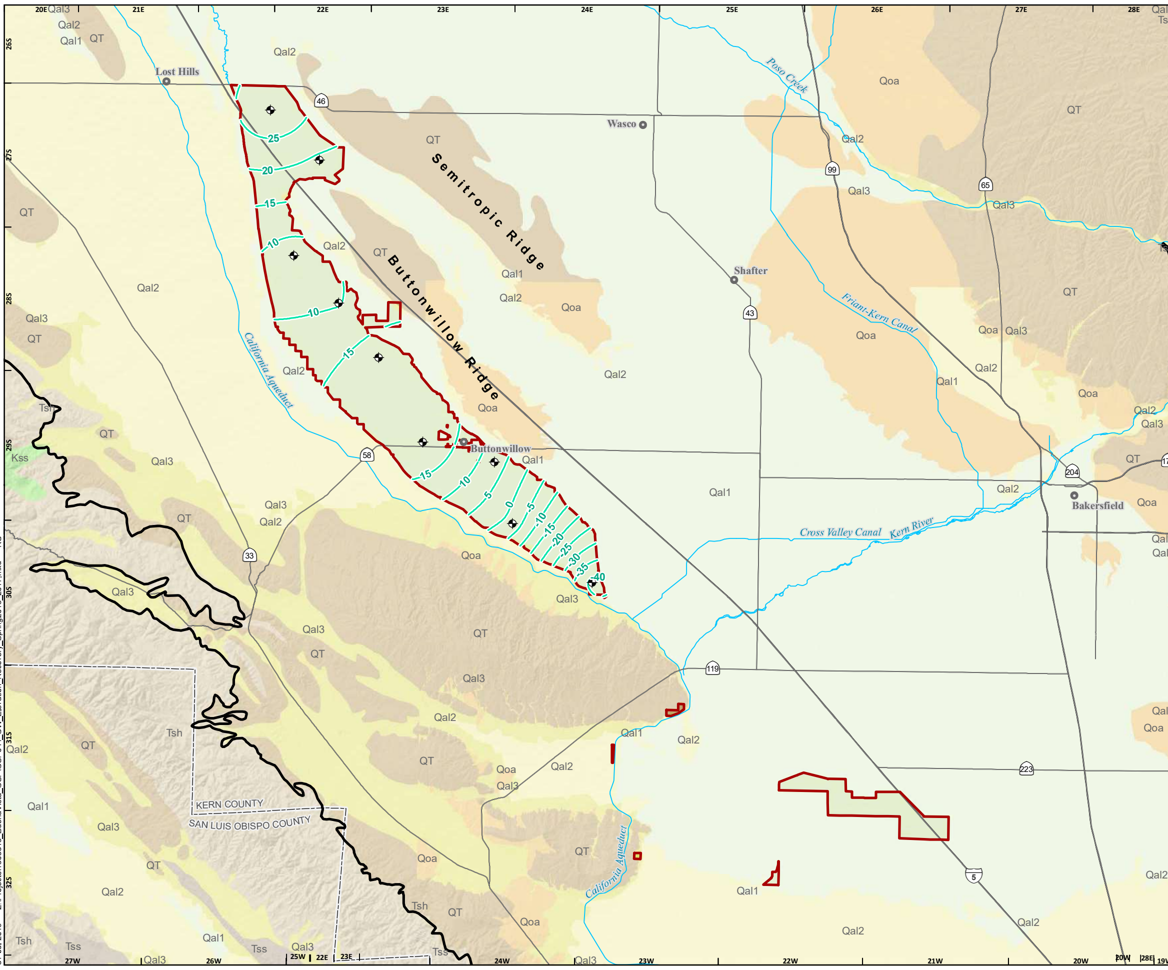
GROUNDWATER ELEVATION CHANGE DROUGHT RECOVERY: SPRING 2015 TO SPRING 2017



District Monitoring Well

Groundwater Elevation Contour - Drought Recovery (Spring 2015 - Spring 2017)

GSA Boundaries

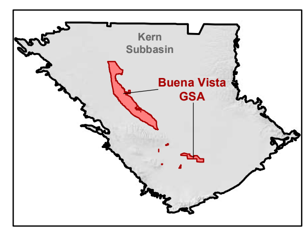
Buena Vista GSA

Kern Subbasin Boundary

All Other Features

Highway

Waterway



0 2 4 8
Miles
N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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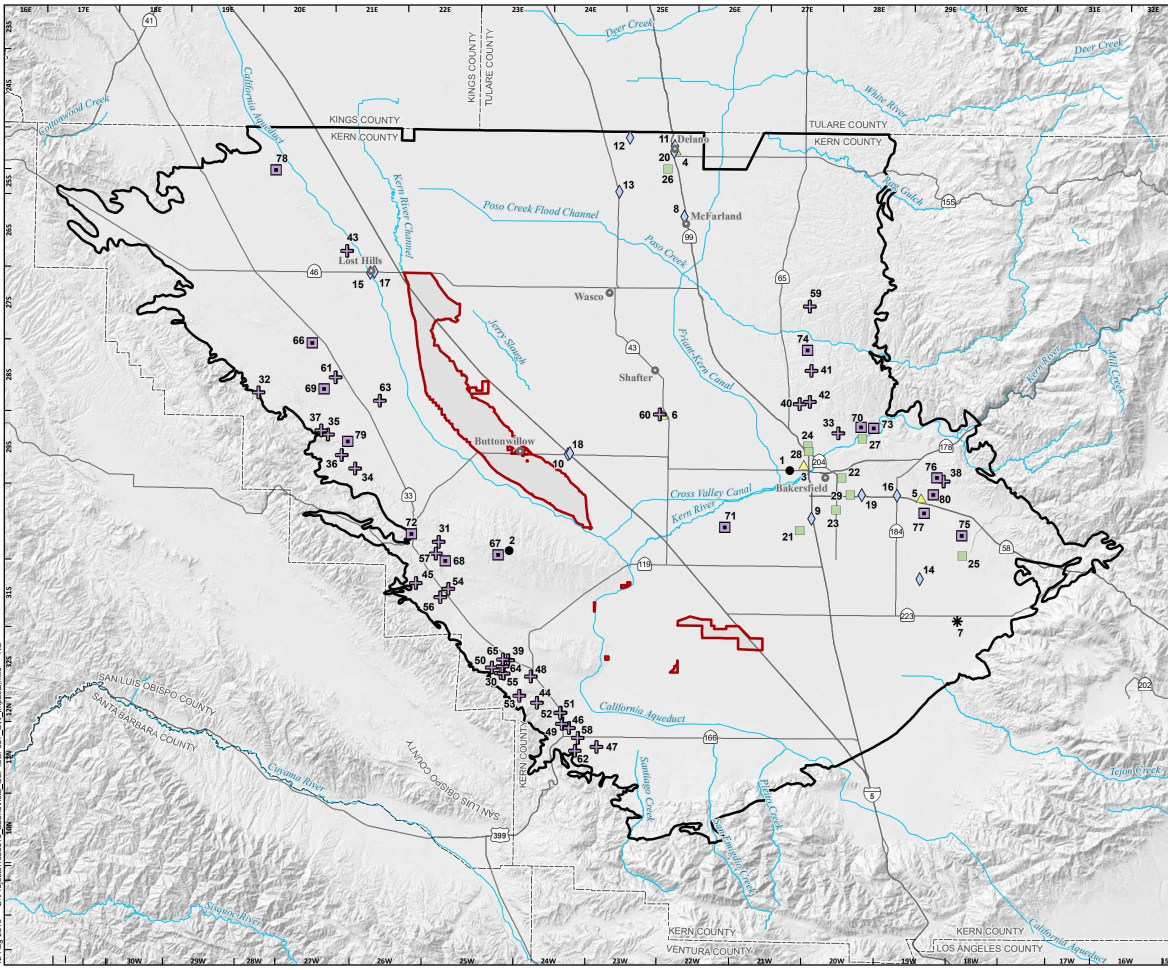
FIGURE 2-27E



SITES OF POTENTIAL GROUNDWATER IMPACTS

Site Types from Envirostor and Geotracker Database

(Map IDs cross-referenced with data table)

- Corrective Action (Current)
- Other Evaluation (Current or Inactive)
- Federal Superfund - Listed
- LUST Cleanup Site
- DTSC Site Cleanup Program (Active)
- Produced Water Ponds
- Underground Injection Control

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway

0 4 8 16
Miles

N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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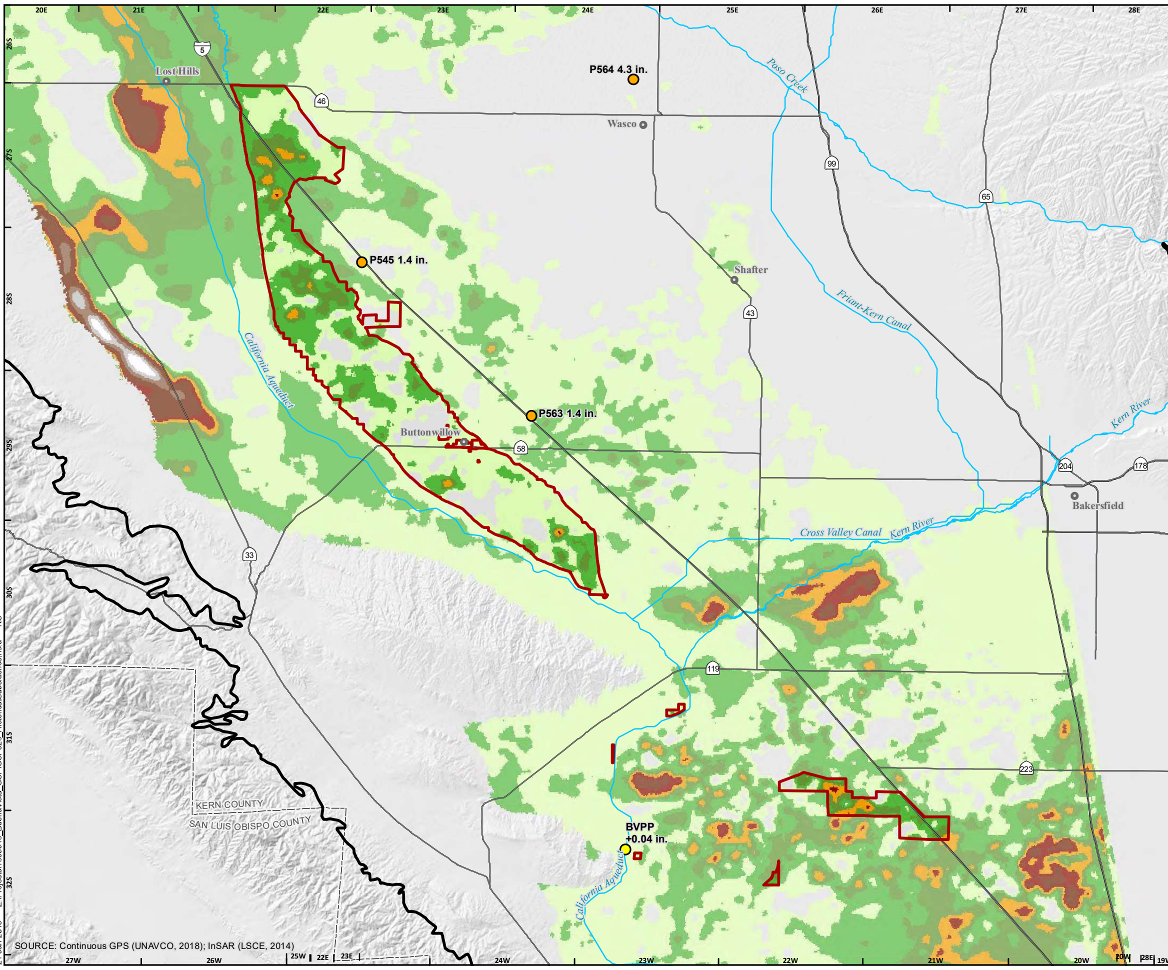
FIGURE 2-28

12-Aug-2019 Z:\Projects\1803518_BuenaVista_GSP\GSP027_GW_Impacts.mxd RS



HISTORICAL SUBSIDENCE

Subsidence Jan 2007 to Mar 2011

Continuous GPS

- Subsidence
- Uplift

Interferometric Synthetic Aperture (InSAR)

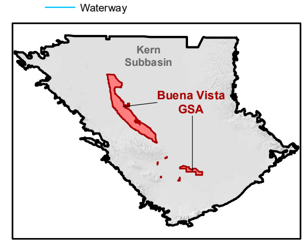
- 0
- 0-1 in
- 1-2 in
- 2-3 in
- 3-4 in
- 4-5 in
- 5-10 in
- 10-15 in
- 15-20 in
- 20-25 in

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2 4 8
Miles
N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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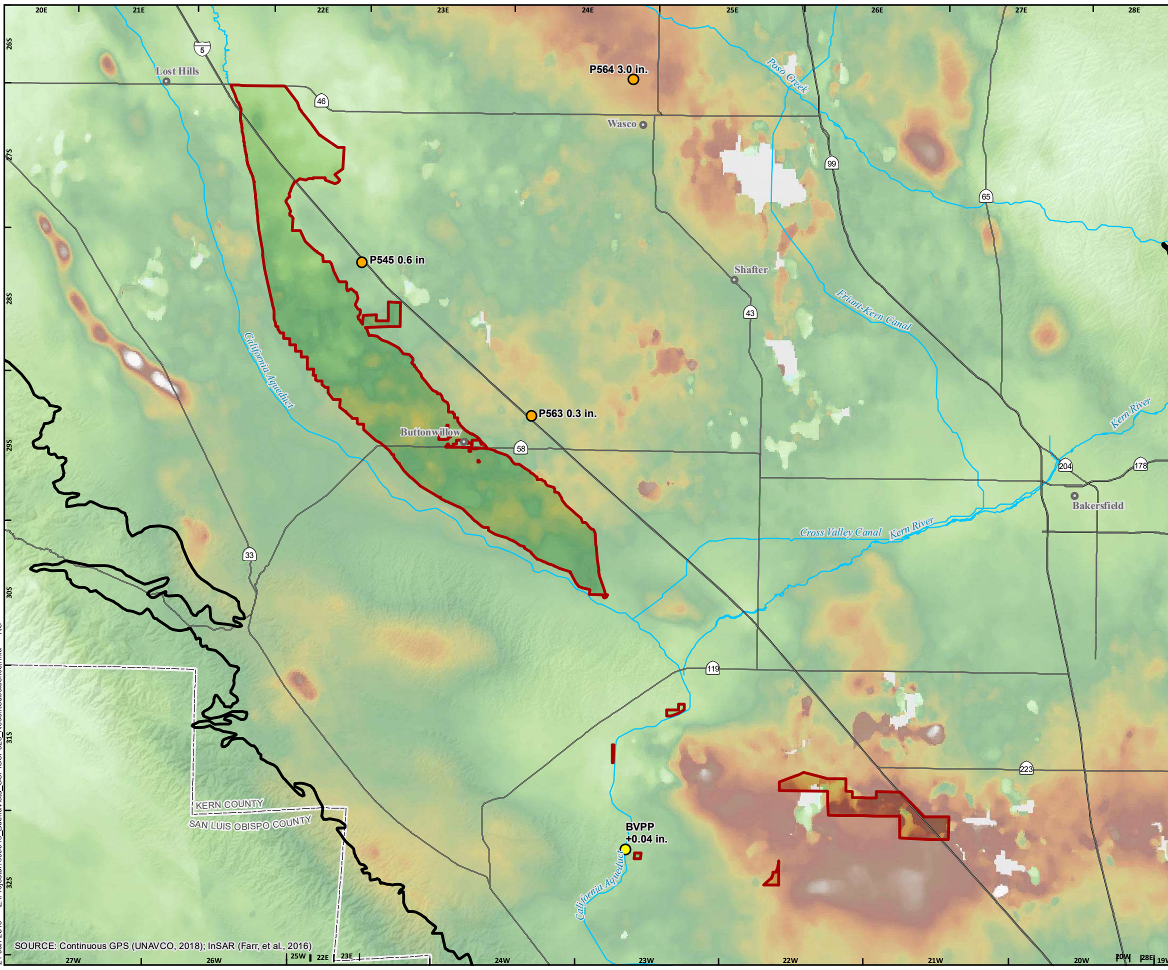
FIGURE 2-29



RECENT SUBSIDENCE (2015 TO 2016)

Subsidence May 2015 to September 2016

Continuous GPS

- Subsidence
- Uplift

Interferometric Synthetic Aperture (InSAR)

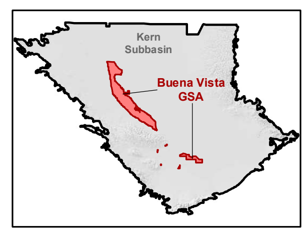
High : 10
9 in
8 in
7 in
6 in
5 in
4 in
3 in
2 in
1 in
Low : 0

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2 4 8
Miles

N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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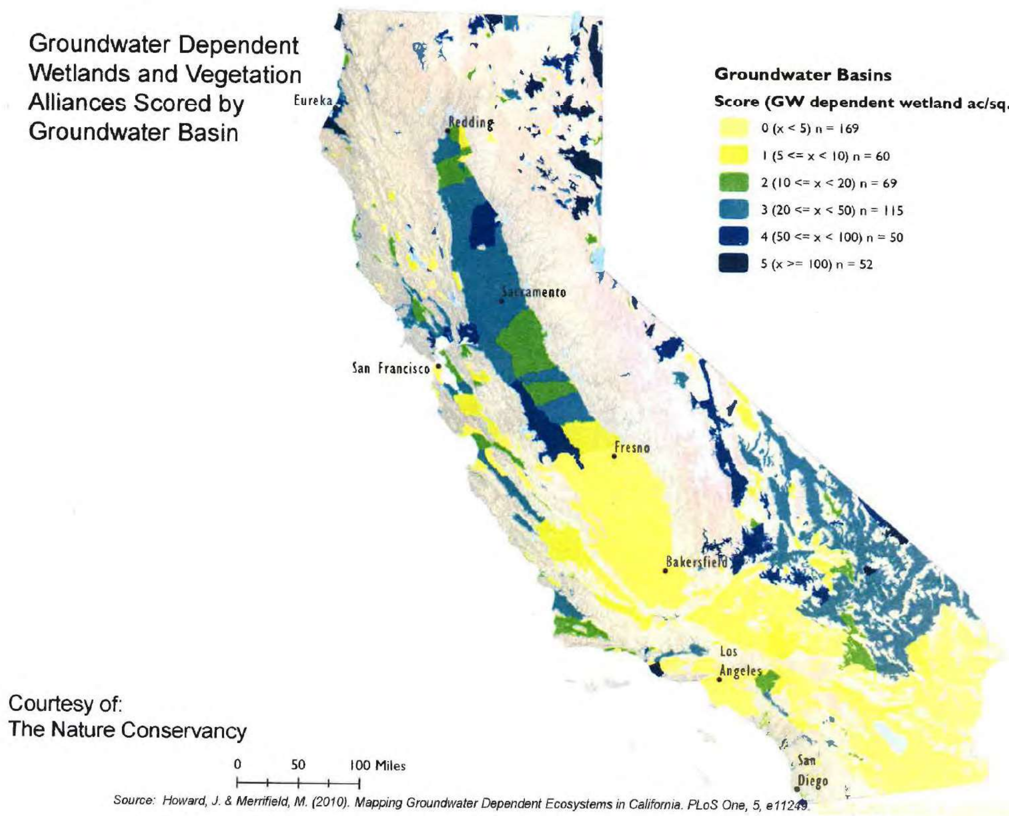
FIGURE 2-30



Source: Howard, J. & Merrifield, M. (2010). Mapping Groundwater Dependent Ecosystems in California. PLoS One, 5, e11249.

SOURCE:

120 60 0 120
Miles

North of the Kern River Area
Basin Setting

Kern County, California

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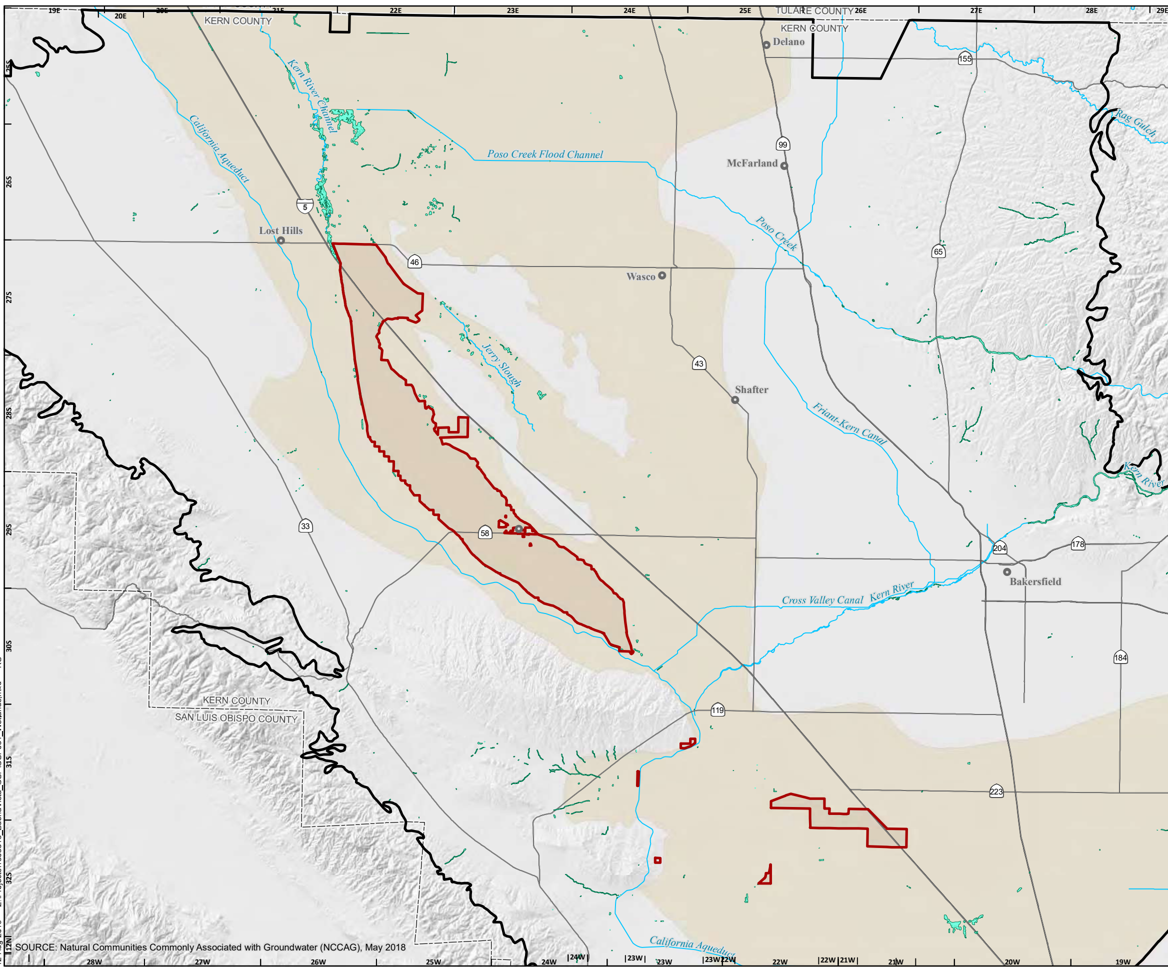
GROUNDWATER DEPENDENT WETLANDS AND VEGETATION ALLIANCES SCORED BY GROUNDWATER BASIN

SEPTEMBER 2019

FIGURE 2-35

01Jun2018 Z:\Projects\1800999_Kern_Subbasin\Fig2_44_Wetlands_Vegetation.mxd RS

POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS: WETLANDS



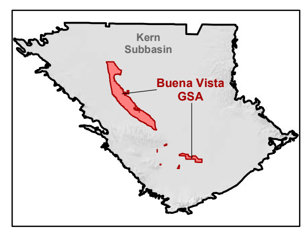
- Wetlands (NCCAG)
- USGS Extent of Corcoran Clay

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2.5 5 10
Miles
N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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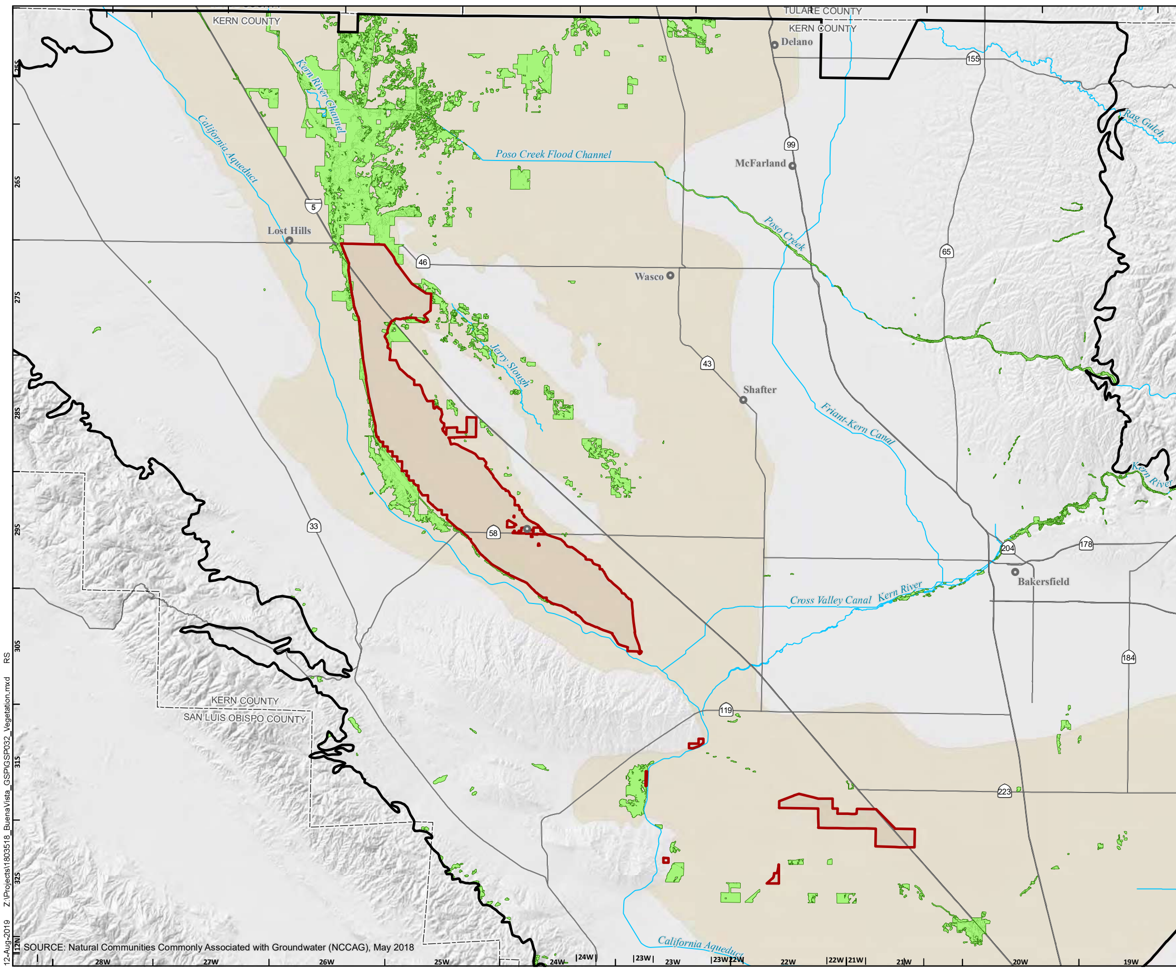
SEPTEMBER 2019 FIGURE 2-36



POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS: VEGETATION

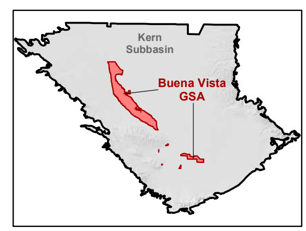
- Vegetation (NCCAG)
- USGS Extent of Corcoran Clay

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2.5 5 10
Miles
N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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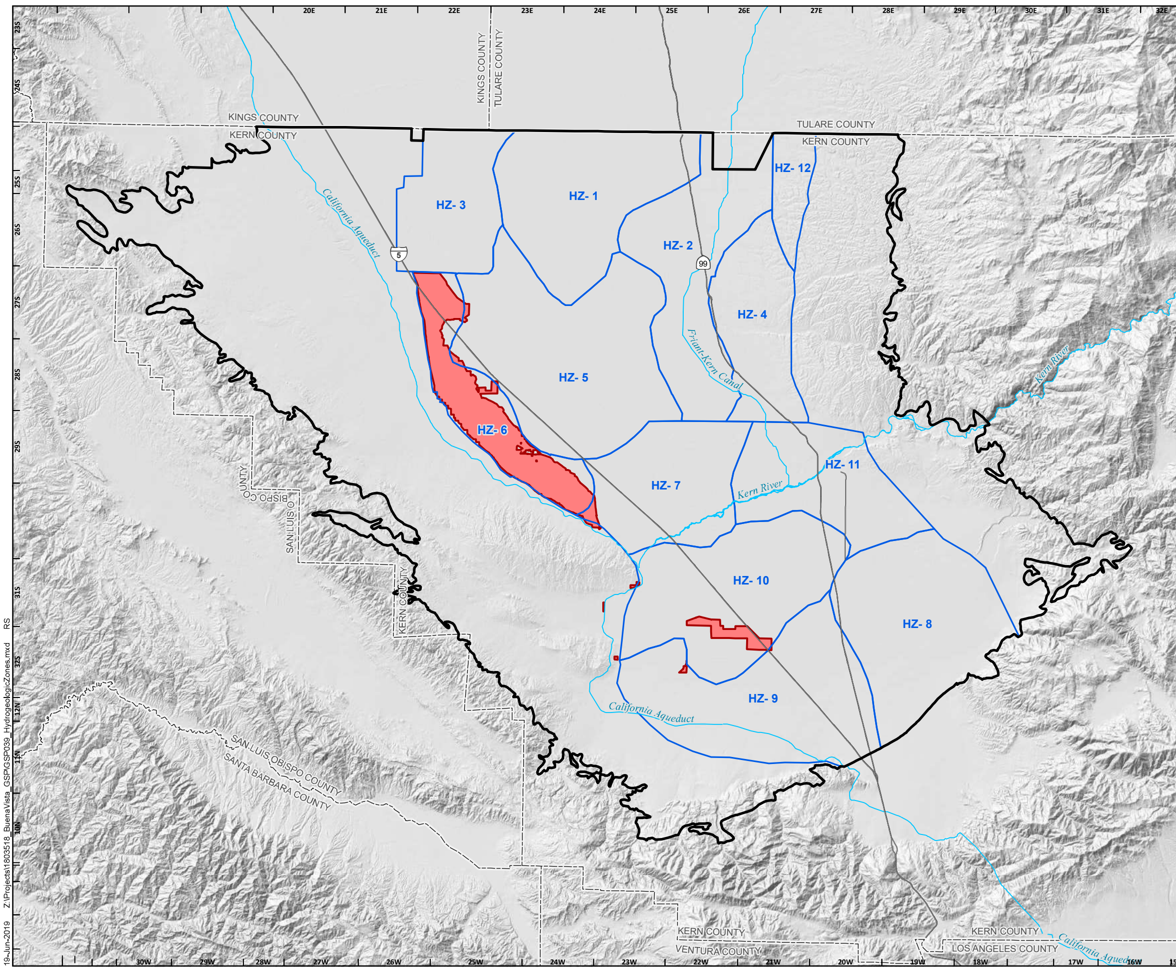
FIGURE 2-37



HYDROGEOLOGIC ZONES OF THE KERN COUNTY SUBBASIN

Hydrogeologic Zone

GSA Boundaries

Buena Vista GSA

Kern Subbasin Boundary

All Other Features

Highway

Waterway

0 4 8 16
Miles

N

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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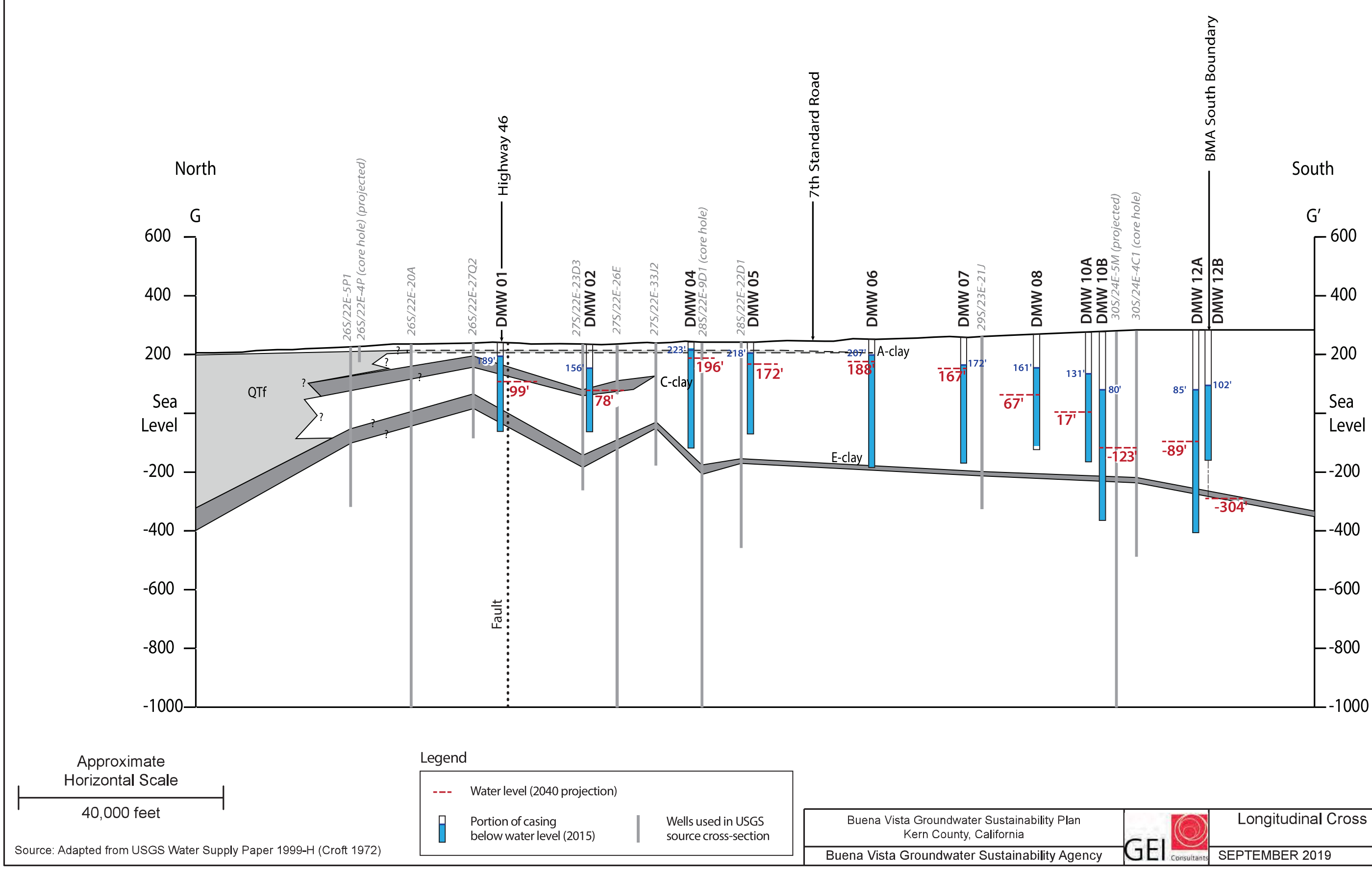
FIGURE 4-3



Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista Groundwater Sustainability Agency

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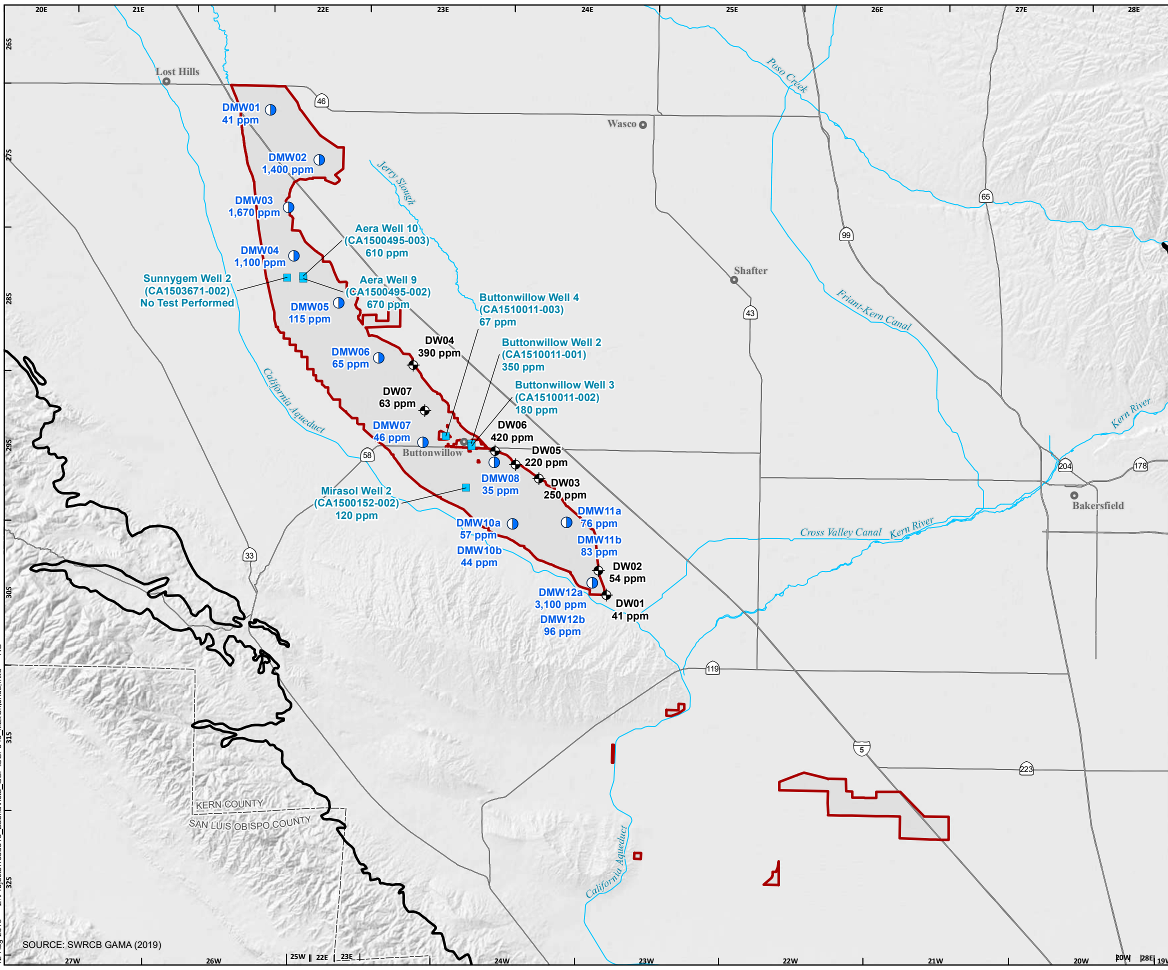
Longitudinal Cross Section of BMA

SEPTEMBER 2019

FIGURE 5.7

MAXIMUM CHLORIDE



Wells

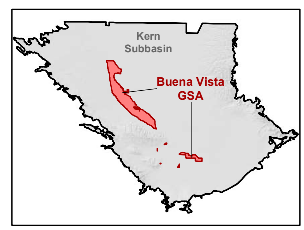
- District Extraction Well
- District Monitoring Well
- Public Water System Well

GSA Boundaries

- Buena Vista GSA
- Kern Subbasin Boundary

All Other Features

- Highway
- Waterway



0 2 4 8
Miles

Buena Vista Groundwater Sustainability Plan
Kern County, California

Buena Vista GSA

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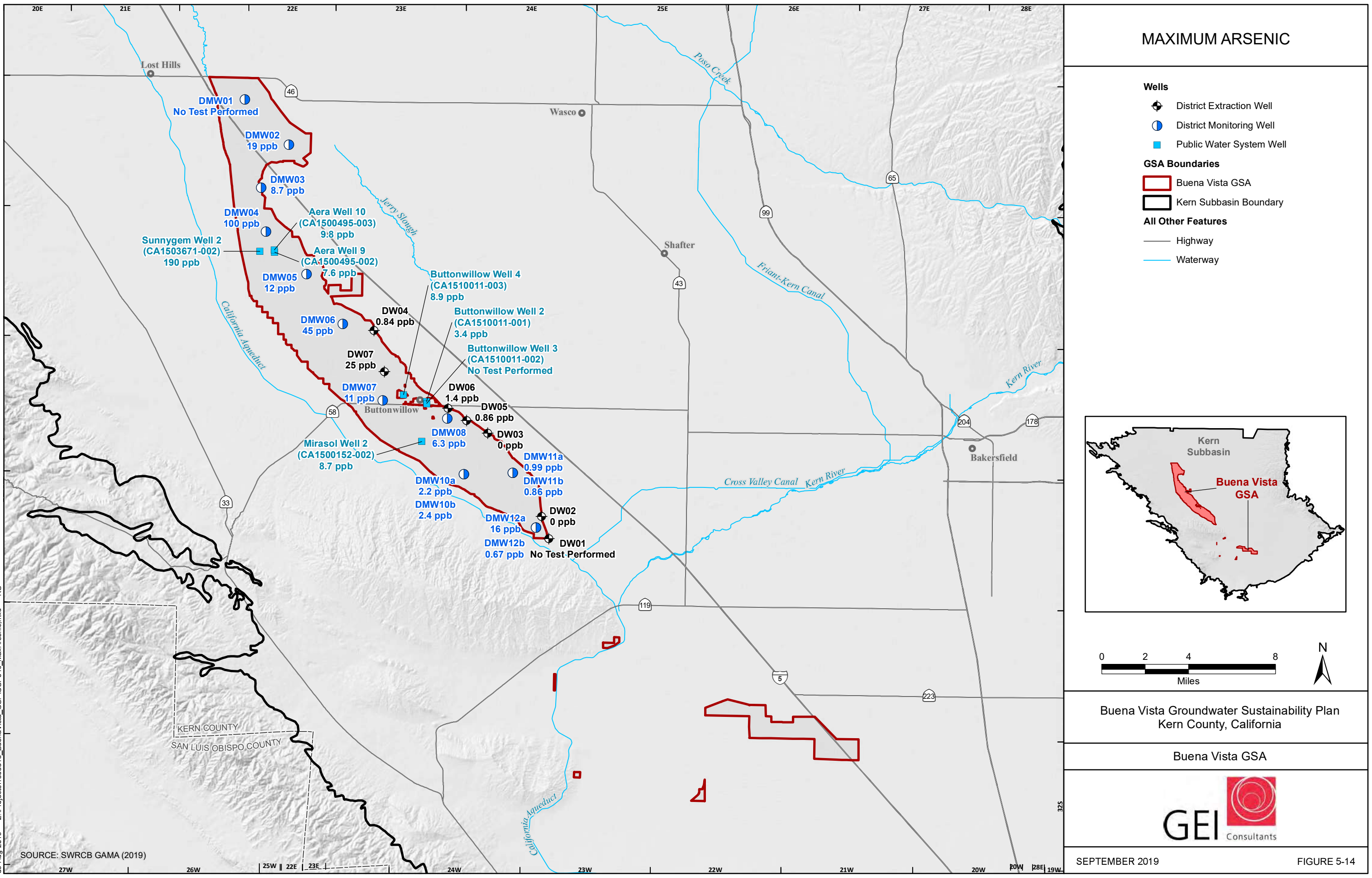
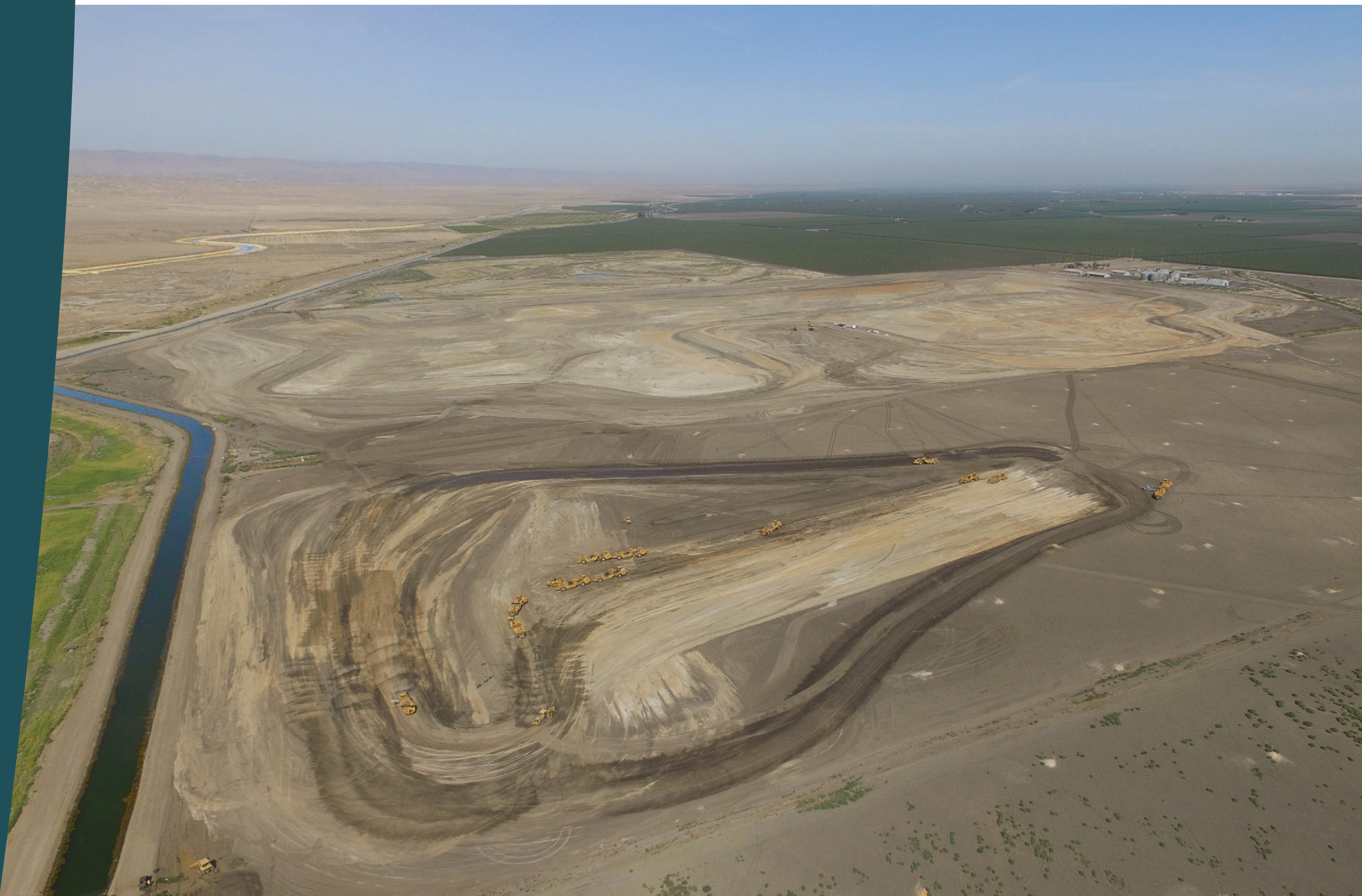


MAXIMUM ARSENIC
Wells
District Extraction Well
District Monitoring Well
Public Water System Well
GSA Boundaries
Buena Vista GSA
Kern Subbasin Boundary
All Other Features
Highway
Waterway
Kern Subbasin
Buena Vista GSA
0 2 4 8
Miles
N
DMW01 No Test Performed
DMW02 19 ppb
DMW03 8.7 ppb
DMW04 100 ppb
Aera Well 10 (CA1500495-003) 9.8 ppb
Sunnygem Well 2 (CA1503671-002) 190 ppb
Aera Well 9 (CA1500495-002) 7.6 ppb
DMW05 12 ppb
Buttonwillow Well 4 (CA1510011-003) 8.9 ppb
DW04 0.84 ppb
Buttonwillow Well 2 (CA1510011-001) 3.4 ppb
DMW06 45 ppb
DW07 25 ppb
Buttonwillow Well 3 (CA1510011-002) No Test Performed
DMW07 11 ppb
DW06 1.4 ppb
DW05 0.86 ppb
DMW08 6.3 ppb
DW03 0 ppb
Mirasol Well 2 (CA1500152-002) 8.7 ppb
DMW11a 0.99 ppb
DMW11b 0.86 ppb
DMW10a 2.2 ppb
DMW10b 2.4 ppb
DW02 0 ppb
DMW12a 16 ppb
DMW12b 0.67 ppb
DW01 No Test Performed
Lost Hills
Wasco
Shafter
Buttonwillow
Bakersfield
Poso Creek
Jerry Slough
Friant-Kern Canal
Kern River
California Aqueduct
Cross Valley Canal
KERN COUNTY
SAN LUIS OBISPO COUNTY
SOURCE: SWRCB GAMA (2019)
09-Aug-2019 Z:\Projects\1803518_BuenaVista_GSP\GSP046_MaxArsenic.mxd RS
Buena Vista Groundwater Sustainability Plan
Kern County, California
Buena Vista GSA
GEI Consultants
SEPTEMBER 2019
FIGURE 5-14

Appendix A

Kern County Subbasin Coordination Agreement



Kern County Subbasin Coordination Agreement

THIS COORDINATION AGREEMENT (the "Agreement") is made effective as of _______________ by and among the Groundwater Sustainability Agencies ("GSA") within the Kern County Subbasin that are developing a Groundwater Sustainability Plan ("GSP") (each a "Party" and collectively the "Parties"), each of which is identified in Appendix 1 and is made with reference to the following facts:

WHEREAS, on September 16, 2014, Governor Jerry Brown signed into law Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act ("SGMA"); and

WHEREAS, SGMA requires all groundwater basins designated as high or medium priority by the Department of Water Resources ("DWR") to manage groundwater in a sustainable manner; and

WHEREAS, the Kern County Subbasin (Basin Number 5-22. 14, DWR Bulletin 118) ("Basin") within the San Joaquin Valley Groundwater Basin, has been designated as a high-priority basin by DWR; and

WHEREAS, the Basin includes eleven (11) GSAs that are managing the Basin through five (5) different GSPs; and

WHEREAS, SGMA allows local agencies to engage in the sustainable management of groundwater, but requires GSAs intending to develop and implement multiple GSPs within a basin to enter into a coordination agreement;

WHEREAS, the Agreement does not prevent any Party from providing comments on a GSP, or otherwise coordinating among parties with regard to specific items in a GSP outside this Agreement, on issues including but not limited to specific border conditions between GSP's and/or the timing and/or effect of projects and management actions contained within another GSP; and

WHEREAS, nothing in this Agreement represents or should be construed as the determination of any claim or assertion of a groundwater right; specifically, the coordinated water budget information or data does not amount to an allocation, or otherwise represent a determination, validation, or denial of any claimed or asserted groundwater right.

THEREFORE, in consideration of the facts recited above and of the covenants, terms and conditions set forth herein, the Parties agree as follows:

SECTION 1 – PURPOSE

The purpose of this Agreement is to comply with SGMA coordination agreement requirements and ensure that the multiple GSPs within the Basin are developed and implemented utilizing the same methodologies and assumptions as required under SGMA and Title 23 of the California Code of Regulations, and that the elements of the GSPs are appropriately coordinated to support sustainable management.

The Parties intend that this Agreement be a description of how the multiple GSPs, developed by the individual GSAs, are implemented together to satisfy the requirements of SGMA. The Parties intend this Agreement to be incorporated as part of each individual GSP developed by the Parties.

SECTION 2 – GENERAL GUIDELINES

2.1 Responsibilities of the Parties

The Parties shall work collaboratively to comply with SGMA and this Agreement. Each Party to this Agreement is a GSA and acknowledges it is bound by the terms of the Agreement. This Agreement does not otherwise affect each Party's responsibility to implement the terms of their respective GSP. Rather, this Agreement is the mechanism through which the Parties will coordinate portions of the multiple GSPs to ensure such GSP coordination complies with SGMA.

2.2 No Adjudication or Alternative Plans in the Basin

As of the date of this Agreement, there are no portions of the Basin that have been adjudicated or have submitted for DWR approval an alternative to a GSP pursuant to Water Code Section 10733.6.

SECTION 3 – GOVERNANCE

3.1 Basin Coordination Committee

The Basin Coordination Committee (BCC) will oversee the activities described in section 3.1.5 of this Agreement. The Basin Coordination Committee will consist of one representative appointed from each GSP.

3.1.1 Each Basin Coordination Committee member's compensation for service on the Basin Coordination Committee, if any, is the responsibility of the appointing Party.

3.1.2 Each Basin Coordination Committee member shall serve at the pleasure of the appointing GSP and may be removed or substituted from the Basin Coordination Committee by the appointing GSP at any time.

3.1.3 The Basin Coordination Committee will meet periodically as it deems necessary to carry out the activities described in this Agreement

3.1.4 The Basin Coordination Committee may suggest subcommittees, workgroups, or otherwise request staff of the Parties to develop technical data, supporting information and/or recommendations.

3.1.5 The purposes of the Basin Coordination Committee are to (1) recommend to their respective GSAs the appointment of a Plan Manager who will act in accordance with this Agreement, and (2) provide a forum wherein the Parties may discuss basin coordination activities, which may include the development, planning, financing, environmental review, permitting, implementation, and long-term monitoring of the multiple GSPs in the Basin, pursuant to SMGA requirements ("Coordination Activities").

3.2 Plan Manager

The Plan Manager shall be appointed by unanimous agreement by the Parties for a term of one calendar year, and annually thereafter, and may be removed by unanimous agreement of the Parties with or without cause. The Plan Manager shall serve as the point of contact for DWR as specified in 23 CCR § 357.4, subd. (b)(1). The Plan Manager shall submit or assist with the submittal of all GSPs, plan amendments, supporting information, monitoring data and other pertinent information, Annual Reports, and periodic evaluations to DWR when required. The Plan Manager has no authority to take any action or represent the Basin Coordination Committee or a particular GSA without the specific direction and authority of the Basin Coordination Committee or the particular GSA, respectively. The Plan Manager is obligated to immediately disclose all communications he/she receives in his/her capacity as Plan Manager to the Basin Coordination Committee and the affected GSA, as appropriate under the circumstances.

SECTION 4 – EXCHANGE OF DATA AND INFORMATION

4.1 Procedure for Exchange of Information

4.1.1 The Parties may exchange information through collaboration and/or informal requests made at the Basin Coordination Committee level or through subcommittees suggested by the Basin Coordination Committee. However, to the extent it is necessary to make a written request for information to another Party, each Party shall designate a representative to respond to information requests and provide the name and contact information of the designee to the Basin Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine or other electronic means to the appropriate representative as named in this agreement.

4.1.2 Nothing in this Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Basin Coordination Committee.

4.2 Non-Disclosure of Confidential Information

Pursuant to Section 4.1 of this Agreement, a Party may provide one or more of the other Parties with confidential information. To ensure the protection of such confidential information and in consideration of the agreement to exchange said information, appropriate arrangements may be made to restrict or prevent further disclosure.

SECTION 5 – METHODOLOGIES & ASSUMPTIONS

Pursuant to California Water Code section 10727.6 and 23 CCR, § 357.4, the Parties will meet and agree upon the methodologies used in their respective GSPs with respect to utilizing the same data and methodologies for the following assumptions: 1) groundwater elevation data; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) change in groundwater storage; 6) water budget; and 7) sustainable yield, and that such methodologies and assumptions will continue to be used in the future development and implementation of such GSPs, except to the extent modified by the Parties in the future. Information regarding the agreed upon Basin methodologies and assumptions shall be attached as Appendix 2 to this Agreement when approved by all Parties.

SECTION 6 – MONITORING NETWORK

6.1 The Parties shall develop a monitoring network and monitoring network objectives for the Basin in accordance 23 CCR, §§ 354.32 – 354.40. Each network shall facilitate the collection of data in order to characterize groundwater and related surface water conditions in the Basin and evaluate changing conditions that occur from implementation of the individual GSPs. The individual GSPs shall include monitoring objectives, protocols, and data reporting requirements as necessary under SGMA and SGMA Regulations.

6.2 The monitoring network(s) will demonstrate short-term, seasonal, and long-term trends in groundwater and related surface water conditions. Each Party's GSP will describe the monitoring network's objectives for the Basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface water conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of GSP implementation. The Parties shall implement the monitoring network objectives to accomplish the following: a) demonstrate progress toward achieving measurable objectives described in the GSPs; b) monitor impacts to the beneficial uses or users of groundwater; c) monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds; and d) quantify annual changes in water budget components. Information regarding the agreed upon Basin monitoring network shall be attached as Appendix 3 to this Agreement when approved by all Parties.

6.3 The Parties shall design a monitoring network that will achieve the following for the enumerated sustainability indicators:

6.3.1 Chronic Lowering of Groundwater Levels:

The network shall collect information sufficient to demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods: a) density of monitoring wells to collect measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer; and b) take static groundwater elevation measurements, at least two times a year, representing seasonal low and high conditions.

6.3.2 Change in Groundwater Storage:

The network will provide sufficient data for the GSAs to estimate the change in annual groundwater in storage.

6.3.3 Degraded Water Quality:

The network will collect sufficient spatial and temporal data from each GSA to determine groundwater quality trends for water quality indicators, as determined by the GSA, to address known water quality issues.

6.3.4 Land Subsidence:

The network will identify the location, rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or any other appropriate method.

6.3.5 Seawater Intrusion/Depletion of Interconnected Surface Water:

The network will not be designed to monitor Seawater Intrusion and/or Depletion of Interconnected Surface Water because these issues are not applicable to the Basin.

6.4 The Parties shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors: a) the amount of current and projected groundwater use; b) aquifer characteristics, including confined or unconfined aquifer conditions or other physical characteristics that affect groundwater flow; c) impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal; d) whether individual GSAs have adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.

6.5 Parties may designate a subset of monitoring sites as representative of conditions in the Basin or a portion of the Basin.

6.6 The Parties shall identify data gaps where the Basin does not contain sufficient monitoring sites, where the frequency of monitoring is insufficient, or sites are unreliable. If such gaps are identified, the Parties shall describe the reason for the gap and describe actions that may be taken to remedy such gaps.

6.7 The Parties shall share information necessary to create a Basin map displaying the location and type of each monitoring site within the Basin, and a report in tabular format, including information regarding the monitoring site type, frequency of measurement, and purpose for which the monitoring site is being used.

SECTION 7 – COORDINATED WATER BUDGET

7.1 In accordance with 23 CCR, § 357.4 subd. (b) the Parties shall prepare a coordinated water budget for the Basin as described in this sub-section, as required by 23 CCR, § 354.18. The water budget will provide an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the Basin, including historical, current, and projected water budget conditions, and the change in the volume of water stored. Information regarding the agreed upon coordinated water budget shall be attached as Appendix 4 to this Agreement when approved by all Parties.

7.2 Each Party for its respective GSP shall endeavor to provide the information required by 23 CCR, § 356.2 to the Basin Coordination Committee by March 1 for the preceding calendar year.

7.3 The Parties shall use the projected water budgets to estimate future baseline conditions of supply, demand, and aquifer response to their GSP implementation, and to identify the uncertainties of these projected water budget components. The Parties shall use the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon for the projected water budget.

7.3.1 To the extent available, use 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.

7.3.2 Projected water demand shall utilize the most recent reliable land use, population growth, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.

7.3.3 Projected surface water supply shall utilize the most recent reliable water supply information as the baseline condition for estimating future surface water supply. The projected surface supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply as identified in the historical water budget and the projected changes in local land use planning, population growth, and climate.

SECTION 8 – COORDINATED DATA MANAGEMENT SYSTEM

The Parties will develop and will maintain a data management system that is capable of storing and reporting information relevant to the development and/or implementation of the GSPs and monitoring network of the Basin as required by SGMA and the SGMA Regulations. Information regarding the agreed upon coordinated data management system shall be attached as Appendix 5 to this Agreement when approved by all Parties.

SECTION 9 – ADOPTION AND USE OF THE COORDINATION AGREEMENT

9.1 Cooperative Implementation of GSPs

The Parties intend that their individual GSPs will be implemented together in order to satisfy the requirements of SGMA. The collective GSPs in a coordinated manner will utilize the groundwater models, a description of the physical setting and characteristics of the separate aquifer systems within the Basin, the methodologies and assumptions as specified in Water Code section 10727.6, a description of the undesirable results, the minimum thresholds, the measurable objectives, and monitoring protocols that together provide a description of the sustainable yield of the Basin(s) as a whole, and how it will be sustainably managed.

9.2 GSP and Coordination Agreement Submission

The Parties shall submit their respective GSPs to DWR through the Plan Manager in accordance with SGMA and SGMA Regulations. The Parties intend that this Agreement suffice to fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy Water Code sections 10727.2, 10727.4 and 10727.6 for the entire Basin.

9.3 In Event Entire Basin Not Covered by GSP

In the event it appears that the entire Basin may not be covered by one or more GSPs as of January 31, 2020, each Party may take such action as deemed necessary or appropriate by such Party with respect to filing its GSP and/or other documents with DWR.

9.4 Duration of Coordination Agreement

This Coordination Agreement shall be reopened for amendment at the at the submission of the next round of GSP's covering the Kern Subbasin (no later than 5 years from January 31, 2020). Unless amended at that time, the Coordination Agreement shall be automatically renewed every 5 years. The parties may agree to unanimously amend this Coordination Agreement at any time.

SECTION 10 – Modification and Termination of the Agreement

10.1 Modification

This Agreement shall be reviewed as part of each five year assessment and may be supplemented, amended, or modified only by the written agreement of all the Parties. No supplement, amendment, or modification of this Agreement shall be binding unless it is in writing and signed by all Parties.

10.2 Withdrawal, Termination, Adding Parties

10.2.1 A Party may unilaterally withdraw from this Agreement without causing or requiring termination of this Agreement, effective upon 30 days' notice to the other Parties.

10.2.2 A new GSA or group of GSA's may be added as a Party to this Agreement if such entity or entities is submitting a GSP within the Basin.

10.2.3 This Agreement may be rescinded by unanimous written consent of all the Parties. Nothing in this Agreement shall prevent the Parties from entering into another coordination agreement.

SECTION 11 – Dispute Resolution

11.1 Procedures for Resolving Conflicts

In the event that any dispute arises among the Parties relating to the rights and obligations arising from this Agreement, the aggrieved Party or Parties shall provide written notice to the other Parties of the dispute. Within thirty (30) days after such written notice, the Parties shall attempt in good faith to resolve the dispute through informal means. If the Parties cannot agree upon a resolution of the dispute within thirty (30) days from the providing of written notice specified above, the dispute will be elevated to the BCC for consideration, along with the notice of dispute and any other relevant supporting documentation produced and shared by the disputing parties pursuant to their informal meet and confer process. The BCC may issue a recommendation concerning resolution of the dispute. If the Parties cannot agree upon a resolution of the dispute following the input of the BCC, the disputing Parties will meet and confer to determine if other alternative dispute resolution methods are agreeable, including voluntary non-binding mediation, which may include the Department of Water Resources dispute resolution process, arbitration, or appointment of a panel of technical experts prior to commencement of any legal action. The cost of alternative dispute resolution shall be paid in equal proportion among the Parties to the dispute, otherwise the Parties shall bear their own costs. Upon completion of alternative dispute resolution, if any, and if the controversy has not been resolved, any Party may exercise any and all rights to bring a legal action relating to the dispute.

11.2 Litigation

In the event a dispute or claim is not resolved by a mutually agreeable settlement through informal negotiation or voluntary mediation, the aggrieved Party may file suit in a County Superior Court with jurisdiction to provide a binding decision on the matter.

[signature] - PRESIDENT — 1-10-20

Henry Miller Water District — Date
Print Name, Position

[signature] — 12-18-19

Kern Groundwater Authority — Date
Jason Selvidge, Vice Chair

[signature] - John Vidovich — 20 January 2020

Buena Vista Water Storage District — Date
Print Name, Position

[signature] — 1-15-20

Kern River Groundwater Sustainability Agency — Date
Print Name, Position

Olcese Water District Groundwater Sustainability Agency — Date
Print Name, Position

In the event that any dispute arises among the Parties relating to the rights and obligations arising from this Agreement, the aggrieved Party or Parties shall provide written notice to the other Parties of the dispute. Within thirty (30) days after such written notice, the Parties shall attempt in good faith to resolve the dispute through informal means. If the Parties cannot agree upon a resolution of the dispute within thirty (30) days from the providing of written notice specified above, the dispute will be elevated to the BCC for consideration, along with the notice of dispute and any other relevant supporting documentation produced and shared by the disputing parties pursuant to their informal meet and confer process. The BCC may issue a recommendation concerning resolution of the dispute. If the Parties cannot agree upon a resolution of the dispute following the input of the BCC, the disputing Parties will meet and confer to determine if other alternative dispute resolution methods are agreeable, including voluntary non-binding mediation, which may include the Department of Water Resources dispute resolution process, arbitration, or appointment of a panel of technical experts prior to commencement of any legal action. The cost of alternative dispute resolution shall be paid in equal proportion among the Parties to the dispute, otherwise the Parties shall bear their own costs. Upon completion of alternative dispute resolution, if any, and if the controversy has not been resolved, any Party may exercise any and all rights to bring a legal action relating to the dispute.

11.2 Litigation

In the event a dispute or claim is not resolved by a mutually agreeable settlement through informal negotiation or voluntary mediation, the aggrieved Party may file suit in a County Superior Court with jurisdiction to provide a binding decision on the matter.

____________________ ____________

Henry Miller Water District — Date
Print Name, Position

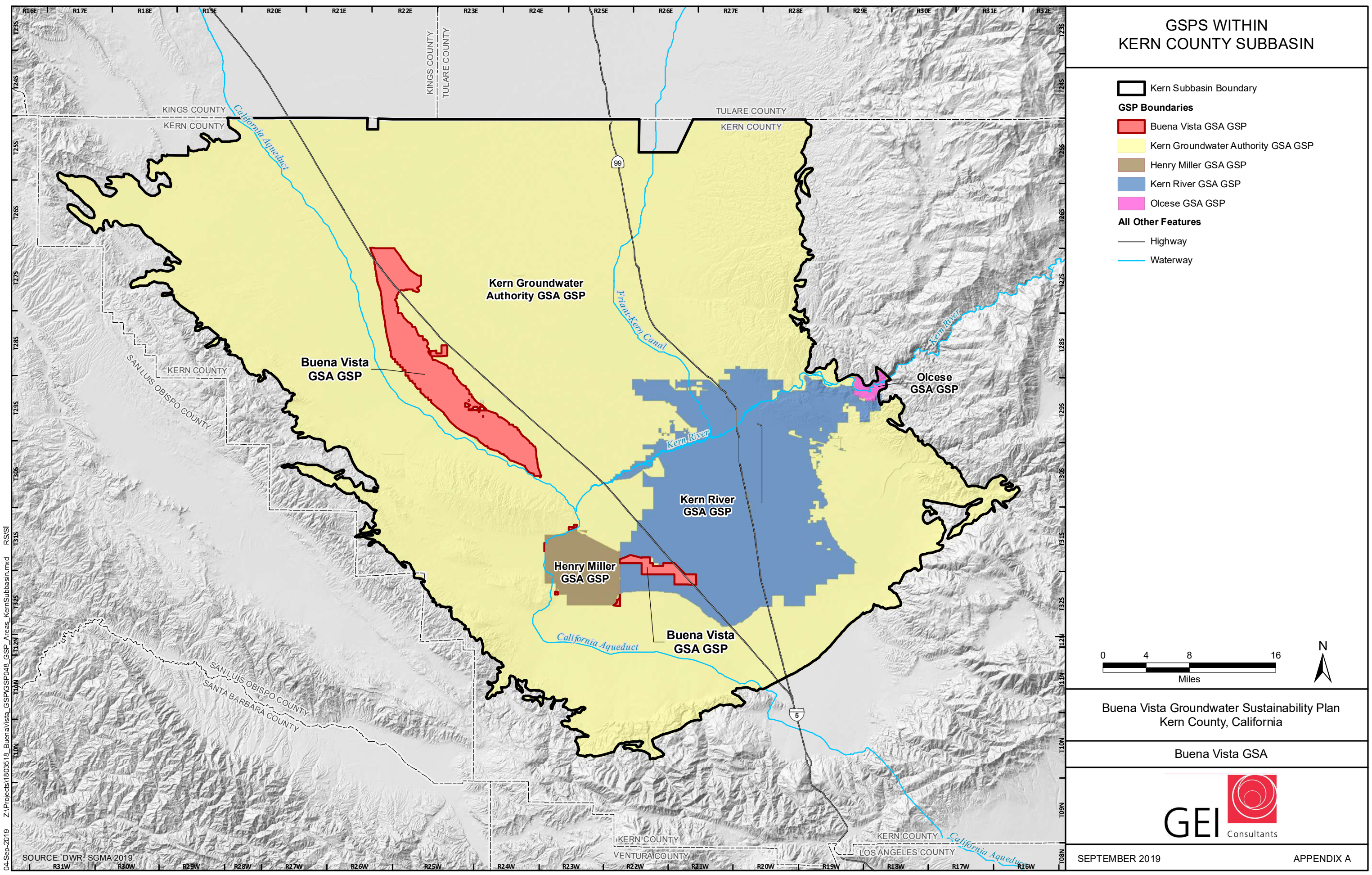
Kern Groundwater Authority — Date
Jason Selvidge, Vice Chair

Buena Vista Water Storage District — Date
Print Name, Position

Kern River Groundwater Sustainability Agency — Date
Print Name, Position

1/13/2020

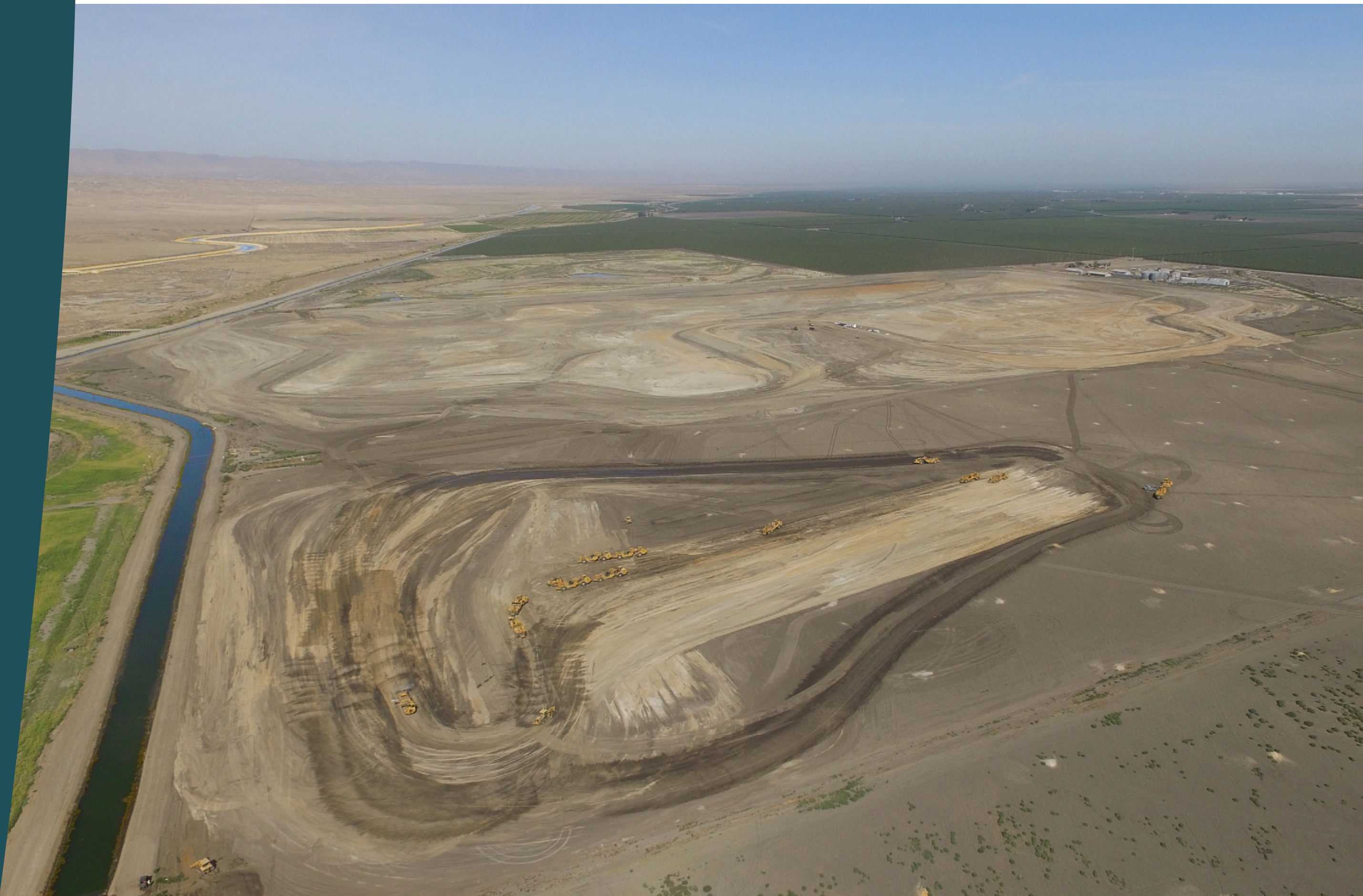
Olcese Water District Groundwater Sustainability Agency — Date
Print Name, Position
James L. Nickel, President



GSPS WITHIN
KERN COUNTY SUBBASIN
Kern Subbasin Boundary
GSP Boundaries
Buena Vista GSA GSP
Kern Groundwater Authority GSA GSP
Henry Miller GSA GSP
Kern River GSA GSP
Olcese GSA GSP
All Other Features
Highway
Waterway
Kern Groundwater Authority GSA GSP
Buena Vista GSA GSP
Kern River GSA GSP
Henry Miller GSA GSP
Olcese GSA GSP
Kern River
California Aqueduct
Friant-Kern Canal
KINGS COUNTY
KERN COUNTY
TULARE COUNTY
SAN LUIS OBISPO COUNTY
SANTA BARBARA COUNTY
VENTURA COUNTY
LOS ANGELES COUNTY
0 4 8 16
Miles
N
SOURCE: DWR SGMA 2019
Buena Vista Groundwater Sustainability Plan
Kern County, California
Buena Vista GSA
GEI Consultants
SEPTEMBER 2019
APPENDIX A

Appendix B

Comments and Responses on Public Review Draft GSP



December 4, 2019

Buena Vista Groundwater Sustainability Agency
525 North Main Street
Buttonwillow, CA 93206

Sent via email to administrator@bvh2o.com

Re: Comments on Draft Groundwater Sustainability Plan for Buena Vista Groundwater Sustainability Agency

To Buena Vista Groundwater Sustainability Agency,

Audubon California appreciates the opportunity to provide public comment on the draft Groundwater Sustainability Plan (GSP) for Buena Vista Groundwater Sustainability Agency (BVGSA).

Audubon California is a statewide nonprofit organization with a mission to protect birds and the places they need. Our organization has a long history of solutions-focused work in the Central Valley in collaboration with state and federal agencies, water districts, non-profits, and landowners. We are commenting on draft GSPs to provide technical information and to identify areas of opportunity to partner with landowners or GSAs to achieve groundwater and wildlife habitat benefits. Audubon is engaged in the Tulare Basin, including Kern County, as a member of the Central Valley Joint Venture and as a partner of the California Waterfowl Association (CWA), which has wetland and wildlife properties within Buena Vista GSA.

Audubon California is reviewing GSPs as a stakeholder for the environment with a particular focus on wetlands. Over 90 percent of historic wetlands in the Central Valley have been replaced with agriculture or urban development. The remaining wetlands are a critical component of the Pacific Flyway, supporting millions of migratory waterfowl, hundreds of thousands of shorebirds, and state listed species like the Tricolored Blackbird. Central Valley wetlands are part of California's commitment to national and international Pacific Flyway agreements and provide significant public trust benefits, including habitat for migratory birds, recharge of overdrafted aquifers, carbon sequestration, and recreation opportunities for birders, hunters, and disadvantaged communities.

Reflecting the critical importance of wetlands in Tulare Basin planning region that includes Buena Vista GSA, the Central Valley Joint Venture set a wetland restoration target of 11,000 acres to sustain waterfowl populations. The Central Valley Joint Venture, a collaboration of 19 public and private entities, including Audubon, sets science based bird population and habitat restoration objectives to support the goals of an international treaty between the United States, Canada, and Mexico, the North American Waterfowl Management Plan. The habitat restoration goals in the Tulare Basin planning region point to an already existing habitat deficit to supply the food energy needed for waterfowl populations. Any loss of managed wetlands will undermine Central Valley Joint Venture goals and only increase the existing habitat deficit.

Out of approximately 46,600 acres receiving water service from Buena Vista Water Storage District about 1,675 acres are managed wetlands that provide public trust benefits, including habitat for migratory waterfowl, shorebirds, and listed species like the Tricolored Blackbird. Disconnected from natural water sources as a consequence of surface water diversions and groundwater overpumping, wetland landowners must now utilize surface water deliveries or pump groundwater to provide flooded habitat. CWA aims to manage approximately 1,000 acres of wetlands each year, but this has rarely been accomplished due to limited access to water supplies and has become even less attainable due to lowering of groundwater levels making extraction unsustainable. The target of 1,000 acres of managed wetlands comprises just 2.1% of serviced acres in the District, extracting a small amount of groundwater for the outsized benefits they provide. Not only do these lands provide important habitat for waterbirds and wildlife, they provide multiple benefits to the basin such as recharge and water filtration.

Overall Comment

In reviewing this draft GSP, we see BVGSA is working hard to minimize the impacts to it growers in the service area. It is essential these efforts also include the managed wetlands. As beneficial users of water resources these habitats provide essential food and habitat resources to migratory birds and other wildlife. To ensure these wetlands continue to provide critical habitat it is vital they receive similar treatment to cropped lands. Because the focus of consumptive use, or evapotranspiration (ET), modeling efforts and proposed supply projects by the BVGSA have been on agriculture as the primary land use, we request that ET of managed wetlands be identified as a data gap and any proposed supply projects consider benefits that can be accessible to managed wetlands.

While demand reduction is an important management strategy for the District to reach groundwater sustainability, the target of 1,000 acres of managed wetlands require a tiny fraction of the overall water demands of the 46,000 acres of serviced land. Most importantly, managed wetlands provide habitat benefits of state and international significance. These wetlands need continued water supplies for duck clubs to survive in the District and to provide habitat for thousands of waterfowl and shorebirds, as well as state listed species like the Tricolored Blackbird.

Draft Groundwater Sustainability Plan Page-by-Page Comments

Additional page-by-page comments on the Buena Vista GSA draft GSP are detailed below. We welcome any follow up questions and look forward to seeing the issues raised below addressed in the final GSP submission in January 2020.

P 1. 1.1.1 Executive Summary, Introduction. The area of interest within Buena Vista GSA service area was historically more diverse than swamplands. Swamplands are defined by having predominately woody vegetation and trees. Historically, though there were trees in this part of the basin, it predominately consisted of grasses, reeds, and sedges, making it more characteristic of a marshland or wetland. Wetland would be a more appropriate description of the historic habitat complexity of this area.

P 1. 1.1.1 Executive Summary, Introduction. It is unclear what the land use is of non-agricultural acres that "receive water service" from BVGSA. Managed habitat, including wetlands, is a unique and important beneficial user of both surface and groundwater in the GSA and should be identified here as a receiver of water service.

P 4. Water Resources and Demand Budget, paragraph 3. The "native yield" reported here at 0.15 acre-feet per acre (AF/ac), is lower than the adjacent Semitropic Water Storage District's "native yield" of 0.5

AF/ac. Based on the proximity to the adjacent water storage district it is unclear why there is such a large difference in native yield. Additional details on how this was determined are needed. Additionally, do the values reported here reflect annual consumptive use (ET) of these sources or the 'pumped' volumes with some level of return flow?

P 5. Water Resources and Demand Budget, Bullets 1 and 3. #1) In the Introduction, 46,600 acres was stated as the number of acres serviced by the water storage district. Here it says, 43,643 acres. Please clarify which acreage is the correct number that receives service from Buena Vista Water Storage District. Furthermore, what is the acreage of managed habitat within or in addition to this serviced acreage? Bullet point #3 raises the question as to whether the projected irrigation demand per-acre value of 3.75 AF/ac (and thus the total demand) reflects consumptive demand (ET) or applied water demand. Additionally, the comparison to the current consumptive demand of 4.33 AF/ac for almonds is higher than what has been defined elsewhere as the "consumptive demand" for almonds (e.g. the ET of applied water or even the ET). Please provide additional information for clarity.

P 6. Table 1.1. 2020, 2030 and 2070 Resources vs. Demands. The water demand presented here seems to define demand as ET (see prior comment). The increase to reflect a continued trend toward high demand almonds seems counter intuitive to reaching water supply resilience and groundwater sustainability under SGMA. Additionally, the 2020 budget shows there is sufficient water to irrigate 46,000 acres, and identifies a "Balance" of over 80,000 AF. This would suggest that there is ample supply to provide water for important managed habitats in the service area. We would like to work with BVGSA to understand how managed habitats can access this water to provide critical habitat for the benefit of birds and wildlife, as well as provide potential groundwater recharge opportunities for the District.

P 15. 1.8.1 Description of Beneficial Uses and Users. Managed wetlands need to be included as beneficial users of water in the Buena Vista GSA service area. These lands rely on both surface water and groundwater to meet their needs. Groundwater dependent ecosystems more broadly should be identified as beneficial users of groundwater.

P 35. 2.2.4.7 Primary Use of the Principal Aquifer System – Introduction. Buena Vista Water Storage District (BVWSD) has a conveyance agreement with the Bureau of Reclamation for delivery of surface water from the State Water Project to Kern National Wildlife Refuge. In other areas of the Central Valley loss or recharge through seepage during conveyance can be over 25%. What is the loss of water that is being wheeled to Kern National Wildlife Refuge, and how is this being tracked? As the refuge works toward obtaining Full Level 4 supplies, more seepage (recharge) may occur and should be credited to the refuge.

P 37. Paragraph 1. The sentence "deep percolation has always played a minor role in groundwater recharge due to the GSAs restrictive surface soils" seems contrary to claims elsewhere noting the value of recharge from surface water on agricultural lands (see Section 2.2.4.7, for instance). It should be included that recharge does occur on managed habitat when flooded for waterbird habitat. Properties owned and operated by California Waterfowl Association may be suitable for recharge while also providing habitat benefit to waterbirds and wildlife.

P 37. Municipal, Domestic and Industrial Water Use. There are important managed habitat lands in Buena Vista GSA. As noted above, managed wetlands are beneficial users of both surface and groundwater. There needs to be a section here discussing managed habitat lands and their water source, use, and public benefit.

P 41. 2.2.7.4 Delineation of Recharge, Potential Recharge, and Discharge Areas. Direct and in-lieu recharge in the BVGSA service area can also occur on lands that are flooded to manage wetland habitat. This should be further evaluated on existing lands that manage habitat and new opportunities should be explored on other lands where there may be potential to provide multiple benefits via groundwater recharge and creation of wildlife habitat.

P 45-46. Figure 2-22 and Figure 2-23. Does the accounting of historical deliveries from California Aqueduct Turnouts as well as historical surface water deliveries recognize the additional diversion and delivery of State Water Project water, via exchange with Central Valley Project supplies, provided for the Kern NWR? Please provide details and clarification.

P 66. 2.3.9 Identify Groundwater Dependent Ecosystems – Introduction. The GSP should differentiate GDEs from managed habitat areas that purposefully apply surface or groundwater to the land to create important seasonal habitat for waterbirds. Managed wetlands often rely on pumped groundwater to provision habitat. In other sections of this draft GSP the district points out that there are many areas with shallow groundwater. Additional evaluation of these locations for the presence of GDEs is warranted. Lastly, seasonal fluctuations of groundwater depth caused by pumping as well as natural events can affect plants' ability to access groundwater. Therefore depth to groundwater as a proxy for determining presence of GDEs needs to be measured across multiple water years and inter-seasonally.

P 169. 6.2.2. Environmental Use. This is the first mention in the draft GSP of "environmental" or managed habitat being an important water user. This inclusion should be reflected throughout the GSP for consistency and to ensure environmental use is adequately addressed across the entire GSP. Additionally, please clarify what is meant by "environmental water use is largely consumptive, however, a greater proportion of environmental use is evaporation from free water surfaces."

P 170. 6.4 Total Water Use. It is important to continue highlighting environmental use as a beneficial user. As mentioned in the previous comment, the inclusion here should be reflected throughout the GSP for consistency and to ensure environmental use is appropriately addressed across the entire GSP.

P 176. 6.6.1.1 Surface Water Inflows. A bullet point should be added to include inflow from the State Water Project deliveries into the Buttonwillow Management Area that is then conveyed through Goose Lake Canal to Kern National Wildlife Area. There is seepage and outflow from this water source that stays in the GSA, so it should be identified here.

P 176. Table 6-3. A line should be added that reflects the imported surface water from the State Water Project that is then delivered to Kern National Wildlife Refuge.

P 178. 6.6.1.2 Groundwater Inflows. This section identifies that groundwater inflows come from "canal seepage" during conveyance. This will be important when evaluating the seepage that occurs when water is being conveyed through BVWSD canals to the Kern National Wildlife Refuge.

P 180. 6.6.2.1 Surface Water Outflow. Our above comments noted the need to recognize and describe inflows from the State Water Project to the Buttonwillow Management Area for conveyance through Goose Lake Canal to the Kern National Wildlife Refuge. Since the water conveyed through BVWSD to supply Kern NWR is identified in this section as an "outflow" it also needs to be an "inflow", separate from Buena Vista Water Storage District's State Water Project deliveries from Kern County Water Authority.

P 182. 6.6.2.3 Evapotranspiration. This section appropriately lists environmental users, in addition to agricultural users, as having consumptive use of surface water and groundwater. This section should note that the term “environmental”, per earlier in this section, includes managed habitat and duck clubs.

P 190. Canal Seepage. How is seepage for the Kern National Wildlife Refuge deliveries included in these values? Kern National Wildlife Refuge received over 8,000 AF in 2014 and 2015. This volume was reported at the Kern National Wildlife Refuge boundary, thus was more water turned off the California Aqueduct and into Buena Vista Water Storage District’s delivery canals? Please provide additional information to reconcile these differences.

P 196. Table 6-10. Water Budget Summary Results with Corresponding Water Year Type. For surface water inflows from the California Aqueduct, how much of this includes water for Kern National Wildlife Refuge, or how much needs to be included in a separate line? As noted below under “Outflows” for the Goose Lake Canal, inflows equals outflows, which is inconsistent with the Refuge Water Supply Program’s conveyance agreement that charges a significant seepage component in order to deliver the ‘out.’ Thus, the ‘in’ must be greater than the ‘out’ and should be a separate line item. This 15,000 – 20,000 AF of water reaching Kern NWR represents about 15% of Buena Vista Water Storage District’s budget. This is significant and needs to be appropriately accounted for. Additionally, under the section Infiltration from Surface Water Systems [Canal Seepage], it is unclear if the “Outlet Canal” would also include seepage from the Kern National Wildlife Refuge diversion off the California Aqueduct, and into or through the Buena Vista Water Storage District. Since the Kern National Wildlife Refuge supply is water imported on behalf of the Bureau of Reclamation, it should NOT be included as water credited to the District for groundwater extraction (see later in table).

P 215. 6.11.1.4 Demand and Surface Water Outflow. According to the historic water budget, during critical years, there is significant negative impact on groundwater storage. According to the budget discussion, critical years occur about as frequently as wet years, yet about twice the number of wet years are needed to occur for every critical year to meet overall water needs. How can an increase in irrigation demand to 150,000 AF/yr in 2030 and 175,000AF/yr by 2070 be supported? (See bullet points 2 and 3). Table 1.1 (page 6) shows a surplus with this increased demand caused by a shift to more nut crops. That does not seem to equate with the water budget. Also, see Table 6.18. Please provide additional evidence to support these claims.

P 215 6.11.1.5 Projects. The proposed recharge and temporary storage projects (i.e. Palms and Corn Camp Water Banking Projects) can also provide habitat benefits if designed with wildlife features. As other projects become further developed, managed habitat areas may also offer ideal opportunities for recharge or temporary storage of water, especially during high flow events that can negatively impact cultivated land. Managed habitat lands have existing water management infrastructure, providing an ideal location for early adoption of water projects at lower cost because water control structures are already in place.

Expanding the priorities of the GSAs’ proposed projects to include added benefits, such as habitat and wildlife value, can also lead to non-target benefits (e.g. increased water filtration or recreation opportunities). This may broaden cooperation among stakeholder groups and leverage more sources of funding to support projects. Audubon has been working on developing guidelines for implementing multiple-benefit water projects and is interested in helping Buena Vista GSA investigate these potential opportunities.

P 217. 6.11.1.7 Summary, paragraph 2. The projections that the BVGSA will be in surplus through 2070 does not align with the frequency of wet, normal, or dry conditions described in Table 6-9, Frequency Distribution of Water Year Types (page 195). Also, the component of seepage associated with Kern National Wildlife Refuge deliveries can exceed the projected surplus, especially by 2070. This raises questions about how that water is accounted for and claimed by Buena Vista Water Storage District to help it balance its own water needs. Please provide further information on this topic.

P 234. 7.2.5.1 Summary of Projects. What is the source of the shallow brackish water for the Brackish Groundwater Remediation Project? Is it related to canal seepage associated with deliveries to the Kern National Wildlife Refuge? Please provide additional information here.

Thank you for your consideration of Audubon California's comments. If you would like to discuss this matter further, please do not hesitate to contact me at (916) 737-5707 or via email at sarthur@audubon.org.

Sincerely,

Samantha Arthur
Working Lands Program Director
Audubon California

Responses to California Audubon Comments

The following text presents the comments from California Audubon with a response to each of the comments following in italics.

P1. 1.1.1 Executive Summary, Introduction. The area of interest within Buena Vista GSA service area was historically more diverse than swampland. Swamplands are defined by having predominately woody vegetation and trees. Historically, through there were trees in this part of the basin, it predominately consisted of grasses, reeds, and sedges, making it more characteristic of a marshland or wetland. Wetland would be a more appropriate description of the historic habitat complexity of this area.

The term swampland is used throughout the GSP because the lands that form the core of the Buena Vista GSA originally were part of much larger tracts within California's San Joaquin Valley identified in the middle of the nineteenth century by the U.S. Government as "swamp and overflowed lands". On December 22, 1870, Swamp Land District No. 121 was created which covered a region that included acreage in much of today's BVGSA. Because the BVGSA traces its ancestry to a district formed to reclaim "swamp land", this term has been retained when describing these lands.

P1. 1.1.1 Executive Summary, Introduction. It is unclear what the land use is of non-agricultural acres that "receive water service" from BVGSA. Managed habitat, including wetlands, is a unique and important beneficial user of both surface and groundwater in the GSA and should be identified here as a receiver of water service.

Conservation easements are the primary land use of non-agricultural areas that received water service from the BVWSD. Under the Conservation Easement Water Acquisition and Management Project (CEWAMP), Buena Vista is acquiring and managing water service rights in the "Northern Area Lands" (generally north of Lerdo Highway) that have transitioned away from full agricultural production and entered into conservation easements. Water intended for inclusion in the CEWAMP does not include water that has already been designated for use in habitat restoration by conservation easements.

P4. Water Resources and Demand Budget, paragraph 3. The "native yield" reported here at 0.15 acre-feet per acre (AF/ac), is lower than the adjacent Semitropic Water Storage District's "native yield" of 0.5 AF/ac. Based on the proximity to the adjacent water storage district it is unclear why there is such a large difference in native yield. Additional details on how this was determined are needed. Additionally, do the values reported here reflect annual consumptive use (ET) of these sources or the "pumped" volumes with some level of return flow?

The native yield of 0.15 acre-feet per acre per year is a standard for native yield agreed upon within the Kern County Subbasin for use in development of water budgets. As the name implies, "native yield" is intended to represent recharge to the Subbasin that results from historic "native" inflows and is independent of land use. Estimates of "native yield" do not rely on estimated demands such as consumptive use, and "native yield" is not influenced by groundwater pumping or return flow.

P5. Water Resources and Demand Budget, Bullets 1 and 3. #1) In the Introduction, 46,600 acres was stated as the number of acres serviced by the water storage district. Here it says, 43,643. Please clarify which acreage is the correct number that receives service from Buena Vista Water Storage District. Furthermore, what is the acreage of managed habitat within or in addition to this serviced acreage?

Bullet point #3 raises the question as to whether the projected irrigation demand per-acre value of 3.75 AF/ac (and thus the total demand) reflects consumptive demand or applied water demand. Additionally, the comparison to the current consumptive demand of 4.33 AF/ac for almonds is higher than what has been defined elsewhere as the “consumptive demand” for almonds (e.g. the ET of applied water or even the ET). Please provide additional information for clarity.

The correct area receiving water service 46,643 acres, the number reported in the 2016 District’s Engineer’s Assessment Report. Because the purpose of water budgets presented in this section is to quantify water leaving the service area through use, the values for irrigation demands all represent actual ET. This definition is used because deep percolation and tailwater, both components of applied water, have the potential to be retained within the territory of the GSA for future use. The value of 4.33 AF/ac for high yielding almonds grown in other areas of the San Joaquin Valley was cited to demonstrate that the projected increase in demand to 3.75 AF/ac is reasonable for mature plantings of tree crops.

P6. Table 1.1. 2020, 2040 and 2070 Resources vs. Demands. The water demand presented here seems to define demand as ET (see prior comment). The increase to reflect a continued trend toward high demand almonds seems counter intuitive to reaching water supply resilience and groundwater sustainability under SGMA. Additionally, the 2020 budget shows there is sufficient water to irrigate 46,000 acres and identifies a “Balance” of over 80,000 AF. This would suggest that there is ample supply to provide water for important managed habitats in the service area. We would like to work with the BVGSA to understand how managed habitats can access this water to provide critical habitat for the benefits of birds and wildlife, as well as provide potential groundwater recharge opportunities for the District.

Demand in this table is defined as ET to represent outflow from the GSA. The increase in demand captures the influences of climate change and on-going modifications to crops and farming practices that increase crop yield per acre while incrementally increasing consumptive demand. Therefore, while the increases in consumptive use per acre appear incongruous, the goal of the improvements in farming practices driving these increases is to reduce the volume of water required to produce a unit of output. The water resources identified in Table 1.1 include entitlements of BVWSD water that the District has committed to users outside of its service area. Therefore, this water is not available for use within the District until the expiration of agreements with these outside water agencies.

The District recognizes the potential value of developing water management projects that provide multiple benefits such as enhancement of wildlife habitat.

P15. 1.8.1 Description of Beneficial Uses and Users. Managed wetlands need to be included as beneficial users of water in the Buena Vista GSA service area. These lands rely on both surface water and groundwater to meet their needs. Groundwater dependent ecosystems more broadly should be identified as beneficial users of groundwater.

All wells within the GSA extract water for the following beneficial uses:

- *Agricultural Supply (AGR);*
- *Industrial Supply (IND), and*
- *Municipal and Domestic Supply (MUN).*

No wells within the GSA are dedicated to serving managed wetlands. The GSP includes an extensive section devoted to GDEs. While they are beneficial uses of groundwater, at this time, none have been identified within the boundaries of the BVGSA.

P 35. 2.2.4.7 Primary Use of the Principal Aquifer System – Introduction. Buena Vista Water Storage District has a conveyance agreement with the Bureau of Reclamation for delivery of surface water from the State Water Project to Kern National Wildlife Refuge. In other area of the Central Valley loss or recharge through seepage during conveyance can be over 25%. What is the loss of water that is being wheeled to Kern National Wildlife Refuge, and how is this being tracked? As the refuge works toward obtaining Full Level 4 supplies, more seepage (recharge) may occur and should be credited to the refuge.

State Water Project water delivered to the Kern National Wildlife Refuge under its conveyance agreement with the BVWSD is metered at the following three locations:

1. *As water enters the BV1-b Pipeline from the California Aqueduct;*
2. *As water leaves the BV1-b Pipeline and enters the District's Westside Canal, and*
3. *As water is delivered from the Goose Lake Canal to the Refuge.*

Under the agreement, losses that take place when water is conveyed belong to the Refuge, and the District is compensated for the volume of water delivered to the Refuge. Because the total volume of water lost is quantified through the metering of inflows to and deliveries from the conveyance system, the proportion of water lost in conveyance can be established on a seasonal basis. This proportion varies with the rate at which water is being conveyed (the percentage of water lost decreases as the flow rate in the canal increases).

The following table presents total annual losses for the 11-year period extending from 2009 through 2019. The table presents both the total volume of losses that have taken place during conveyance between the turnout to the BV-1 pipeline and the Refuge and the losses that have taken place within the boundaries of the BVGSA.

Year	*Total Losses (AF)*	*Losses Within BVGSA (AF)*
2009	*1,725*	*541*
2010	*1,635*	*512*
2011	*2,601*	*6902*
2012	*2,158*	*676*
2013	*3,3,92*	*1,063*
2014	*4,384*	*1,374*
2015	*3,249*	*1,018*
2016	*6,435*	*2,017*
2017	*6,591*	*2,066*
2018	*6,024*	*1,888*
2019	*4,711*	*1,477*
Annual Average	*3,864*	*1,211*

P37. Paragraph 1. The sentence "deep percolation has always played a minor role in groundwater recharge due to the GSAs restrictive surface soils" seem contrary to claims elsewhere noting the value of recharge from surface water on agricultural lands (see Section 2.2.4.7, for instance). It should be included that recharge does occur on managed habitat when flooded for waterbird habitat. Properties owned and operated by California Waterfowl Association may be suitable for recharge while also providing habitat benefit to waterbirds and wildlife.

Section 2.2.4.7 includes the language cited by Audubon that "deep percolation has always played a minor role in groundwater recharge due to the GSA's restrictive surface soils". The same section also states that, "the Community of Buttonwillow and individual domestic and industrial users rely entirely on groundwater, with groundwater elevations sustained by agricultural operations that recharge surface water diverted from the Kern River and the SWP." These two sentences are not contradictory as the agricultural operations noted in the second passage refer to seepage from unlined canals and other infrastructure and not to deep percolation of applied water.

P37. Municipal, Domestic and Industrial Water Use. There are important managed habitat lands in Buena Vista GSA. As noted above, managed wetlands are beneficial users of both surface and groundwater. There needs to be a section here discussing managed habitat lands and their water source, use, and public benefits.

As noted above, managed habitat lands within the BVGSA, such as lands enrolled in the CEWAMP program, receive their supplies from surface water sources and not from groundwater. Therefore, this use is not called out specifically in the GSP.

P41. 2.2.7.4 Delineation of Recharge, Potential Recharge, and Discharge Areas. Direct and in-lieu recharge in the BVGSA service area can also occur on lands that are flooded to manage wetland habitat. This should be further evaluated on existing lands that manage habitat and new opportunities should be explored on other lands where there may be potential to provide multiple benefits via groundwater recharge and creation of wildlife habitat.

Agreed. A clear example of this opportunity is the Palms Project where the scale and topography of the project may be well suited to development of environmental benefits.

P 45-46. Figure 2-22 and Figure 2.23. Does the accounting of historical deliveries from California Aqueduct Turnouts as well as historical surface water deliveries recognize the additional diversion and delivery of State Water Project Water, via exchange with the Central Valley Project supplies, provided for the Kern NWR? Please provide details and clarification.

As noted on the preceding response to the comment on P 35, State Water Project water delivered to the Kern National Wildlife Refuge under its conveyance agreement with the BVWSD is metered at the following three locations:

1. *As water enters the BV1-b Pipeline from the California Aqueduct;*
2. *As water leaves the BV1-b Pipeline and enters the District's Westside Canal, and*
3. *As water is delivered from the Goose Lake Canal to the Refuge.*

Under the agreement, losses that take place when water is conveyed belong to the Refuge and the Refuge compensates the District for the volume of water delivered. While the proportion of delivered water lost during conveyance varies with the rate at which water is being conveyed (the percentage of water lost decreases as the flow rate in the canal increases), therefore knowing the proportion lost at any point in time is not important since the total volume of water lost is accurately quantified by the metering of all inflows to and deliveries from the conveyance system.

P66 2.3.9 Identify Groundwater Dependent Ecosystems – Introduction. The GSP should differentiate GDEs from managed habitat areas that purposefully apply surface water or groundwater to the land to create important seasonal habitat for waterbirds. Managed wetlands often rely on pumped groundwater to provision habitat. In other sections of the draft GSP the district points out that there are many areas with shallow groundwater. Additional evaluation of these locations for the presence of GDEs is warranted. Lastly, seasonal fluctuations of groundwater depth caused by pumping as well as natural events can affect plants' ability to access groundwater. Therefore depth to groundwater as a proxy for determining presence of GDEs needs to be measured across multiple water years and inter-seasonally.

As described in the GSP and as indicated by the hydrographs included in the document, the only region of the BVGSA that experiences shallow groundwater is the northern portion of the Buttonwillow Management Area, an area where a shallow clay layer restricts vertical movement of water creating a perched condition. This land is intensively farmed and, as shown in Figure 2-38, is not characterized by vegetation that has been classified as supporting GDEs. While groundwater levels do fluctuate seasonally throughout the GSA, in most areas the fluctuations occur within a range that is beneath the rooting depths of wetland vegetation.

P 169. 6.2.2 Environmental Use. This is the first mention in the draft GSP of "environmental" or managed habitat being an important water user. This inclusion should be reflected throughout the GSP for consistency and to ensure environmental use is adequately addressed across the entire GSP. Additionally, please clarify what is meant by "environmental water use is largely consumptive. However, a greater proportion of environmental use is evaporation from free water surfaces."

Both agricultural and environmental consumptive use is expressed as actual evapotranspiration (ETa). In the case of agricultural consumptive use, the largest component is transpiration through plant tissues with only a small fraction of the ET being attributable to evaporation from the ground surface. By contrast, in the case of environmental land uses, a greater proportion of managed habitat includes wetlands or other free water surfaces. For this reason, a greater proportion of environmental consumptive use is evaporation from these surfaces.

The District anticipates that approximately 3,000 acres have been or will be encumbered by conservation easements within the boundaries of the BVGSA. Therefore, relative to other land uses, environmental uses occupy a small proportion of the BVGSA, and we believe are appropriately addressed in the GSP. As described the BVWSD's Agricultural Water Management Plan, the District does supply water to support habitat such as the KNWR and the Tule Elk Reserve. However, these areas do not lie within the boundaries of the BVGSA.

P 170. 6.4 Total Water Use. It is important to continue highlighting environmental use as a beneficial user. As mentioned in the previous comment, the inclusion here should be reflected throughout the GSP for consistency and to ensure environmental use is appropriately addressed across the entire GSP.

The BVGSA recognizes the beneficial nature of environmental users of groundwater. However, as noted above, we believe that given the proportion of lands within the GSA boundaries now occupied by environmental uses, these uses are addressed at an appropriate level in the GSP.

P 176. 6.6.1.1 Surface Water Inflows. A bullet point should be added to include inflow from the State Water Project deliveries into the Buttonwillow Management Area that is then conveyed through Goose Lake Canal to Kern National Wildlife Area. There is seepage and outflow from this water source that stays in the GSA, so it should be identified here.

The water budget is structured to present flow paths in a way that will support analysis of the groundwater conditions in the BVGSA. The flow path of interest to California Audubon is captured in the following bullet:

- *CVP Friant-Kern Unit, transfer or exchange water delivered via either the East Side Canal or CA Aqueduct turnouts.*

Disaggregating this information, as requested, would not improve the accuracy of the budget for the purpose of quantifying water movement into and through the BVGSA.

P 176. Table 6-3. A line should be added that reflects the imported surface water from the State Water Project that is then delivered to Kern National Wildlife Refuge.

As noted in the previous response, the purpose of the water budget presented in this GSP is to inform the GSA and reviewers on the volumes and timing of water moving into and out of the groundwater system underlying the GSA. Identifying individual sources of inflows and destinations for outflows adds to the complexity of the budget without contributing to the budget's accuracy or its ability to provide insights of importance for SGMA compliance.

P 178. 6.6.1.2 Groundwater Inflows. This section identifies that groundwater inflows come from "canal seepage" during conveyance. This will be important when evaluating the seepage that occurs when water is being conveyed through BVWSD canals to the Kern National Wildlife Refuge.

As described in earlier responses, the volume of water diverted from the California Aqueduct for delivery to the Kern National Wildlife Refuge is metered and the volume actually delivered to the Refuge is also metered. Therefore, the losses, primarily canal seepage, associated with conveyance of water between the California Aqueduct and the Refuge are known.

P 180. 6.6.2.1. Surface Water Outflow. Our above comments noted the need to recognize and describe inflows from the State Water Project to the Buttonwillow Management Area for conveyance through Goose Lake Canal to the Kern National Wildlife Refuge. Since the water conveyed through BVWSD to supply Kern NWR is identified in this section as an "outflow" it also needs to be an "inflow", separate from Buena Vista Water Storage District's State Water Project deliveries from Kern County Water Authority.

As described above, the purpose of the GSP's groundwater budget is to provide information on inflows to and outflows from the GSA and the impact these flows have on groundwater elevations, storage and quality. Because all outflow in the Goose Lake Canal is delivered to the KNWR, there is a one-to-one correspondence between the flow path and the destination.

P 182. 6.6.2.3 Evapotranspiration. This section appropriately lists environmental users, in addition to agricultural users, as having consumptive use of surface and groundwater. This section should note that the term "environmental", per earlier in this section, includes managed habitat and duck clubs.

The GSP has been modified to include the suggested change.

P 190. Canal Seepage. How is seepage for the Kern National Wildlife Refuge deliveries included in these values? Kern National Wildlife Refuge receive over 8,000 AF in 2014 and 2015. This volume was reported at the Kern National Wildlife Refuge boundary, thus was more water turned off the California Aqueduct and into Buena Vista Water Storage District's delivery canals? Please provide additional information to reconcile these differences.

As noted in the responses to comments on P 35 and p 46, State Water Project water delivered to the Kern National Wildlife Refuge under its conveyance agreement with the BVWSD is metered at the following three locations:

1. *As water enters the BV1-b Pipeline from the California Aqueduct;*
2. *As water leaves the BV1-b Pipeline and enters the District's Westside Canal, and*
3. *As water is delivered from the Goose Lake Canal to the Refuge.*

As suggested in this comment, more water is turned into the BV1-b Pipeline from the California Aqueduct than is delivered at the turnout from the Goose Lake Canal to the Refuge. Because flows at both locations are metered, these conveyance losses are quantified, and belong to the Refuge.

P 196. Table 6-10. Water Budget Summary Results with Corresponding Water Year Type. For surface water inflows from the California Aqueduct, how much of this includes water for Kern National Wildlife Refuge, or how much needs to be included in a separate line. As noted below under "Outflow" for the Goose Lake Canal, inflows equal outflows, which is inconsistent with the Refuge Water Supply Program's conveyance agreement that charges a significant separate component in order to deliver the 'out.' Thus, the 'in' must be greater than the 'out' and should be a separate line item. This 15,000 - 20,000 AF of water reaching Kern NWR represents about 15% of Buena Vista Water Storage District's budget. This is significant and must be appropriately accounted for. Additionally, under the section Infiltration from Surface Water Systems [Canal Seepage], it is unclear if the "Outlet Canal" would also include seepage from the Kern National Wildlife Refuge diversion off the California Aqueduct, and into or through the Buena Vista Water Storage District. Since the Kern National Wildlife Refuge supply is water diverted on behalf of the Bureau of Reclamation, it should NOT be included as water credited to the District for groundwater extraction (see later in table).

Water diverted at turnout BV-1 from the California Aqueduct for conveyance to the Kern National Wildlife Refuge is metered at the point of diversion, at the location where the BV-1 discharges to the Westside Canal and at the point where water is delivered to the Kern National Wildlife Refuge. Therefore, the infrastructure needed to convey water to the Refuge and to accurately account for the volumes of water diverted, delivered and lost during conveyance is used to determine the payment the

BVWSD receives for deliveries to the Refuge and the credits Reclamation receives for the quantity of water lost during conveyance. As noted elsewhere in these responses, the purpose of the water budgets presented in the GSP is not to account for deliveries of water to the KNWR but to provide information needed to understand how surface and groundwater are managed in the GSA to sustain groundwater levels, storage and quality.

All water conveyed through the facilities of the Buena Vista Water Storage District to the KNWR is diverted from the California Aqueduct at BV-1. The Outlet Canal is located at the extreme south of the Buttonwillow Management Area and conveys water diverted from the Kern River into the District. Kern River water entering the District via the Outlet Canal is not delivered to the Refuge and no seepage from the Outlet Canal should be credited to the Refuge.

Part 1: P215. 6.11.1.4 Demand and Surface Water Outflow. According to the historic water budget, during critical years, there is significant negative impact on groundwater storage. According to the budget discussion, critical years occur about as frequently as wet years, yet about twice the number of wet years are needed to occur for every critical year to meet overall water needs.

During the period of the historic water budget (1994-2015), wet years occurred 34.8% of the time and critical years occurred 26.1% of the time. These qualitative categories are determined based on numerical indices, which can be used to analyze individual wet and critical years and to assess the relative severity of a sequence of consecutive wet or critical years. The table below shows the range of water year indices used to categorize year types in the southern Central Valley.

San Joaquin Valley Water Year Hydrologic Classification	
Year Type:	***Water Year Index:***
Wet	*Equal to or greater than 3.8*
Above Normal	*Greater than 3.1 and less than 3.8*
Below Normal	*Greater than 2.5 and equal to or less than 3.1*
Dry	*Greater than 2.1 and equal to or less than 2.5*
Critical	*Equal to or less than 2.1*

It is correct that the GSP's historic water budget shows a significant decrease in groundwater storage during critical years. The change in storage is calculated based on groundwater elevations observed in District Monitoring Wells which were adversely impacted by the cumulative effects of consecutive dry/critical years.

The following information describes the severity of the recent critical years and why the reduction in groundwater storage observed during these years was uncharacteristically large:

- *During the 23 year period of the historic water budget, critical years occurred 40% more frequently than during the long-term record spanning 118 years. The latter 7 years of the GSP's water budget showed an even greater variance, with critical years occurred 130% more frequently than over the period of record.*
    - *Historical: 1901 – 2018 (118 yrs): 22 critical years (18.6%)*
    - *GSP: 1993 – 2015 (23 yrs): 6 critical years (26.1%)*
    - *Recent: 2009 – 2015 (7 yrs): 3 critical years (42.9%)*

- *Groundwater elevations in the southern portion of the BMA experienced noticeable declines during the final four years (2012 – 2015) of the GSP's historic water budget. This period covered one of the most severe droughts in the historical record with consecutive years of dry or critical conditions.*
    - *2014 had the lowest water year index (0.81) on record while 2015 had the 3rd lowest index (1.16). The cumulative result was a large drop in groundwater elevations, and therefore, a similarly large drop in the estimated volume of groundwater in storage.*
    - *The average index for the San Joaquin River during this 4-year period was 1.47, lower than any other period with 3 or more consecutive dry or critical years as shown in the table below. It should be noted that 2016 was also a "dry" year, but this index was omitted from the analysis to maintain consistency with the GSP's period of record.*

Consecutive Dry/ Critical Years (min = 3)		
Begin	End	Index_Avg
1929	1931	1.74
1959	1961	1.81
1987	1992	1.72
2012	2015	1.47

This analysis indicates that the decline in groundwater storage observed in the southern portion of the GSA during critical years included in the District's water budget overstates the typical impact of critical years on groundwater because of the severity of the critical years experienced during the final years of the budget period.

It is also important to recognize that Buena Vista's Palms Groundwater Recharge Project lies in the extreme south of the BVGSA and is being implemented to enable water diverted from the Kern River to be used to replenish groundwater in the area of the GSA where groundwater levels have been observed to be most vulnerable to drought.

<u>Part 2:</u> How can an increase in irrigation demand to 150,000 AF/yr in 2030 and 175,000 AF/year by 2070 be supported? (See bullet points 2 and 3). Table 1.1 (page 6) shows a surplus with this increased demand caused by a shift to more nut crops. That does not seem to equate with the water budget. Also, see Table 6.18. Please provide additional evidence to support these claims.

Demand for irrigation water is expected to increase as nut trees within BVGSA mature and cropping shifts to a higher proportion of permanent crops. The expected demand increases in 2030 and 2070 are supported by increased supplies expected to result from management actions implemented by the BVGSA. Examples of these actions include:

- *Phasing out transfer agreements and exchanges of BVWSD's Kern River water rights and use of this water to meet demands within the BVGSA.*
- *Increased groundwater recharge in wet or above normal water years with the completion of Palms and Corn Camp water banking projects. The recharged water will be available for use during years of limited surface water supplies.*
- *When water supplies are not sufficient to meet demands, deficit irrigation of nut crops will continue to be used by growers within BVGSA. The BVWSD also has an active land fallowing program to incentivize growers to fallow annual crops.*

P215. 6.11.1.4 Demand and Surface Water Outflow. According to the historic water budget, during critical years, there is significant negative impact on groundwater storage. According to the budget discussion, critical years occur about as frequently as wet years, yet about twice the number of wet years are needed to occur for every critical year to meet overall water needs. How can an increase in irrigation demand to 150,000 AF/yr in 2030 and 175,000 AF/year by 2070 be supported? (See bullet points 2 and 3). Table 1.1 (page 6) shows a surplus with this increase demand caused by a shift to more nut crops. That does not seem to equate with the water budget. Also, see Table 6.18. Please provide additional evidence to support these claims.

An important distinction between the water budget presented in Table 6-10 and that shown in Table 16-18 is that Table 6-10 presents a budget that conforms with the structure of DWR guidance for development of water budgets presented in GSPs by showing the historical movement of water into and out of the GSA and the resulting changes in groundwater storage. By contrast, Table 6-10 balances water resources available to the BVGSA versus present and future demands placed on these resources. The resources included in Table 6-10 include entitlements to Kern River water that Buena Vista now makes available to users outside of the BVGSA but that will be put to use within the GSA to meet the increasing demands. For example, Table 6-10 has annual deliveries though the East Side Canal (Kern River diversions) ranging from 97,427 AF/year to 20, 169 AF/year. These values are substantially below the BVWSD diversion rights shown in Table 6-18 of 149,000 AF/year in 2020 which are then reduced to 147,000 AF/year for the 2030 and 2070 projections.

P 215 6.11.1.1.5 Projects. The proposed recharge and temporary storage project (i.e. Palms and Corn Camp Water Banking Projects) can also provide habitat benefits if designed with wildlife features. As other projects become further developed, managed habitat areas may also offer ideal opportunities for recharge or temporary storage of water, especially during high flow events that can negatively impact cultivated land. Managed habitat lands have existing water management infrastructure, providing an ideal location for early adoption of water projects at lower cost because water control structures are already in place.

Expanding the priorities of the GSA's proposed projects to include added benefits, such as habitat and wildlife value, can also lead to non-target benefits (e.g., increased water filtration or recreation opportunities). This may broaden cooperation among stakeholder groups and leverage more sources of funding to support benefits. Audubon has been working on developing guidelines for implementing multiple-benefit water projects and is interested in helping Buena Vista GSA investigate these potential opportunities.

The BVGSA welcomes opportunities to implement new groundwater recharge facilities or to expand existing facilities to achieve multiple-benefits including support of wildlife habitat. As noted in the comment, increasing the range of benefits that may be attained by projects broadens cooperation among stakeholders and widens support for funding and implementation of these projects.

Because no natural water courses flow into the BVGSA, there is no risk of crop land being inundated by storm water. Therefore, the concept of diverting flood flows into wetlands to protect crops from flooding does not apply in the BVGSA.

P 217. 6.11.1.7 Summary, paragraph 2. The projections that the BVGSA will be in surplus through 2070 does not align with the frequency of wet, normal, or dry conditions described in Table 6-9. Frequency

Distribution of Water Year Types (page 195). Also, the component of seepage associated with Kern National Wildlife Refuge deliveries can exceed the projected surplus, especially by 2070. This raises questions about how that water is accounted for and claimed by Buena Vista Water Storage District to help it balance its own water needs. Please provide further information on this topic.

As shown in the table presented in the response to the comment on Page 35, both total measured losses associated with conveyance between the California Aqueduct and the KNWR and losses within the portion of the conveyance path that lies within the BVGSA are in line with the surplus projected for 2070. In addition, it is likely that improvements in the facilities used to distribute water throughout the District and the practices used to operate these facilities will improve the efficiency and effectiveness of water management.

P 234. 7.2.5.1 Summary of Projects. What is the source of the shallow brackish water for the Brackish Groundwater Remediation Project? Is it related to canal seepage associated with deliveries to the Kern National Wildlife Refuge? Please provide additional information here.

The primary source of the brackish, perched groundwater found in the area of the Brackish Groundwater Remediation Program (BGRP) is deep percolation of the applied irrigation water and seepage of tailwater discharges from surface drains. Shallow perched groundwater with elevated TDS concentrations has adversely impacted plant growth and crop yields in affected areas of the district.

The pathway taken by water diverted from the California Aqueduct at BV-1 for conveyance to the Kern National Wildlife Refuge lies to the north of the BGRP. Therefore, seepage of water diverted to supply the Refuge is unlikely to contribute to the conditions being addressed by the BGRP.

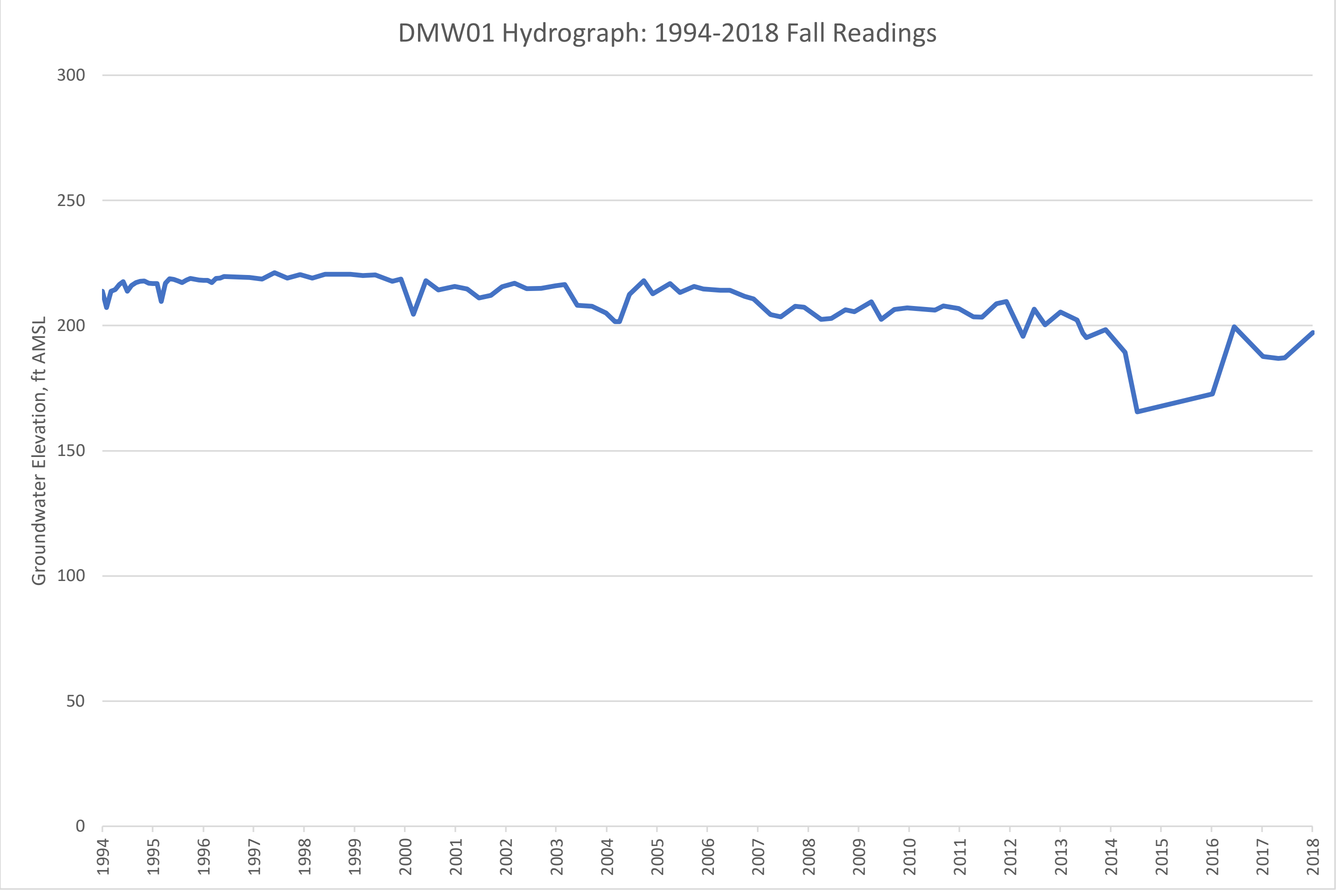
Appendix C

Groundwater Hydrographs

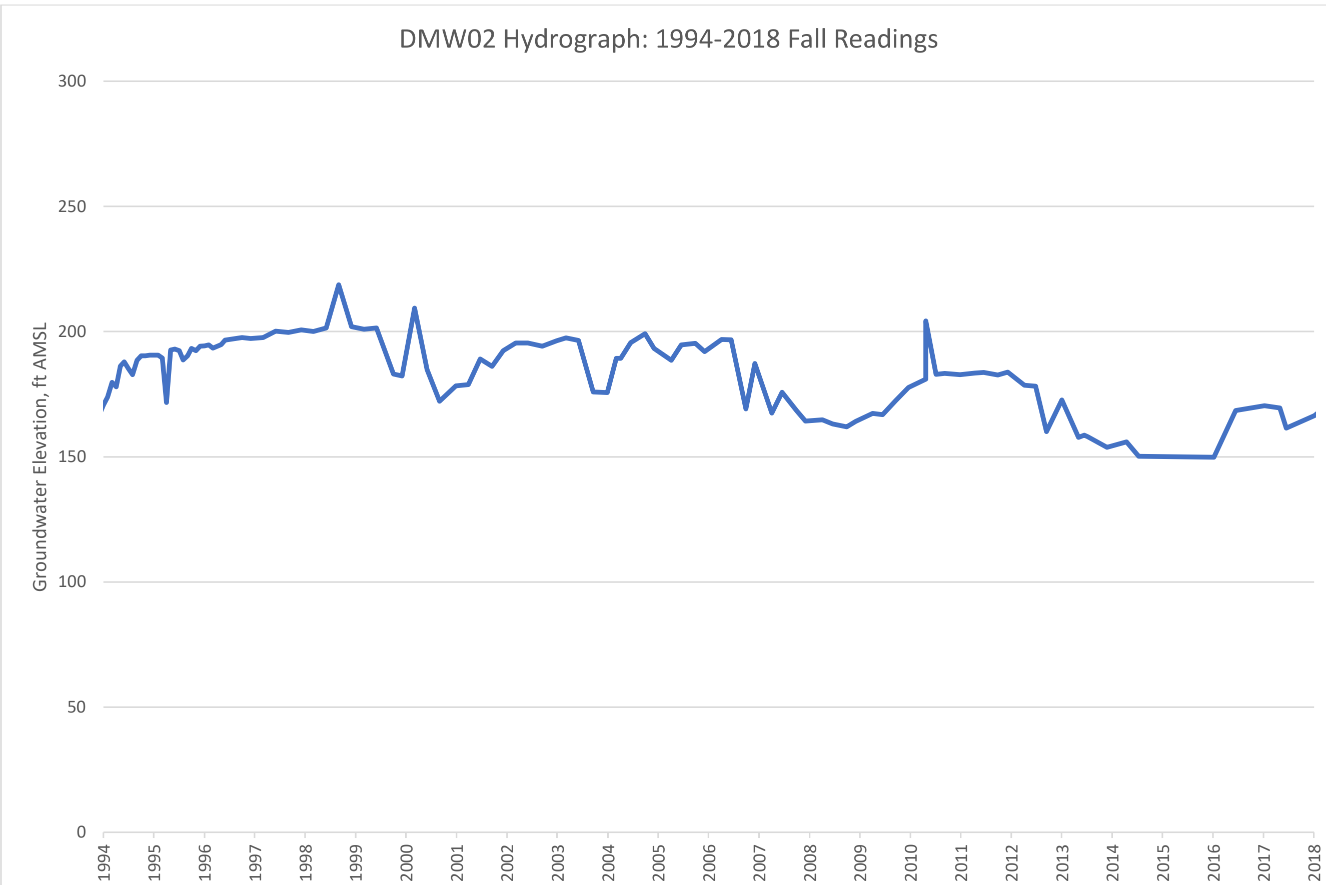
Hydrograph Key

Hydrographs included in this appendix are from district monitoring wells and piezometers referenced throughout the GSP. These wells and piezometers are central to the GSA's monitoring networks because of their distribution throughout the GSA, their long periods of record and the reliability of their data.

Local Well Name	State Well Number
DMW01	27S22E08A001M
DMW02	27S22E23D001M
DMW04	28S22E10D001M
DMW05	28S22E14R001M
DMW06	28S23E31B002M
DMW07	29S23E16R002M
DMW08	29S23E24H001M
DMW10A	30S24E06B003M
DMW10B	30S24E06B002M
DMW12A	30S24E14M002M
DMW12B	30S24E14M003M
PIEZ-015 (BV-8A)	27S22E15D001M
PIEZ-023 (BV-10D)	27S22E29J001M
PIEZ-034 (BV-21)	28S22E04N001M
PIEZ-035 (BV-22)	28S22E16D001M



DMW01 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
150
100
50
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018



DMW02 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
150
100
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1994
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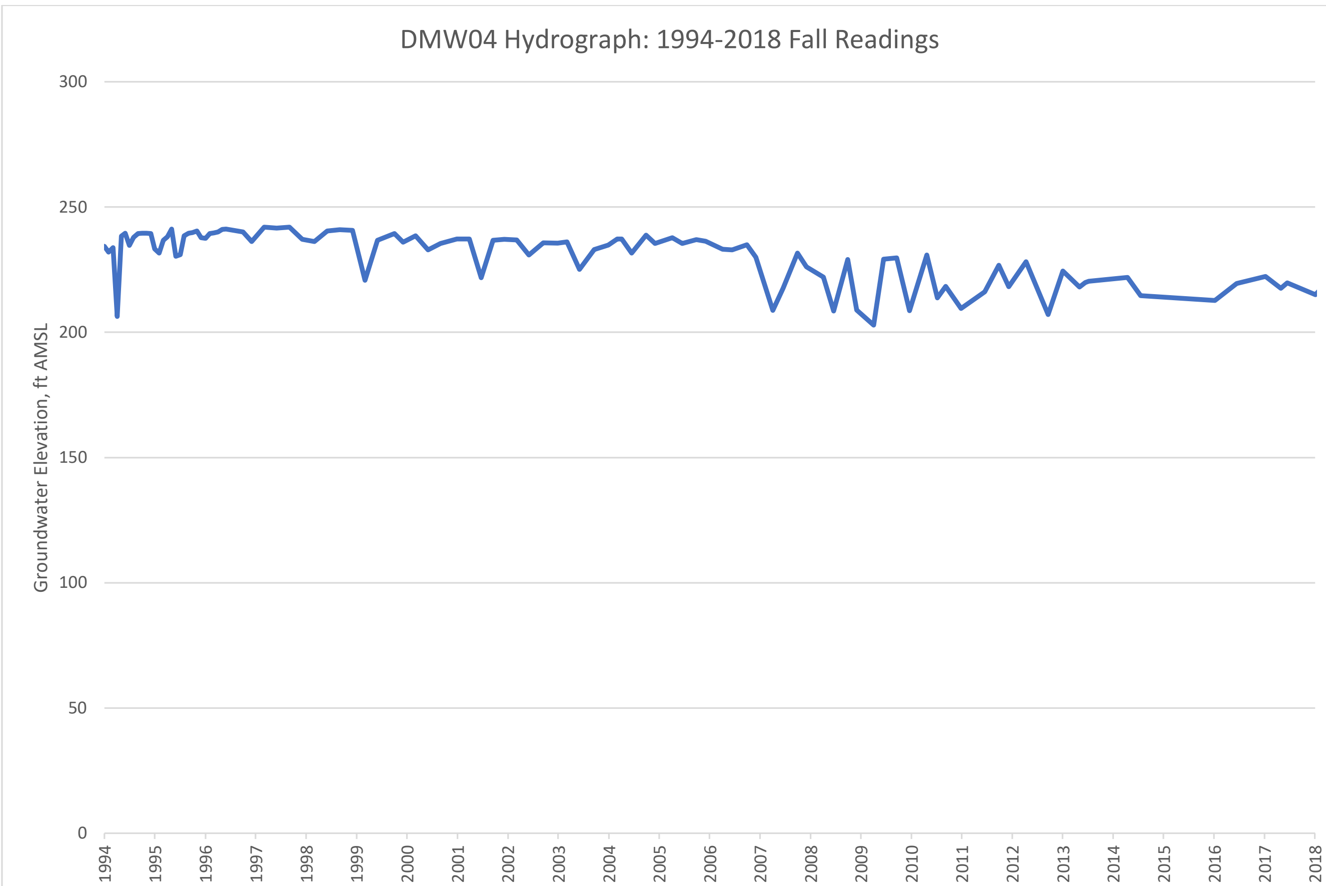

DMW04 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
150
100
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0
1994
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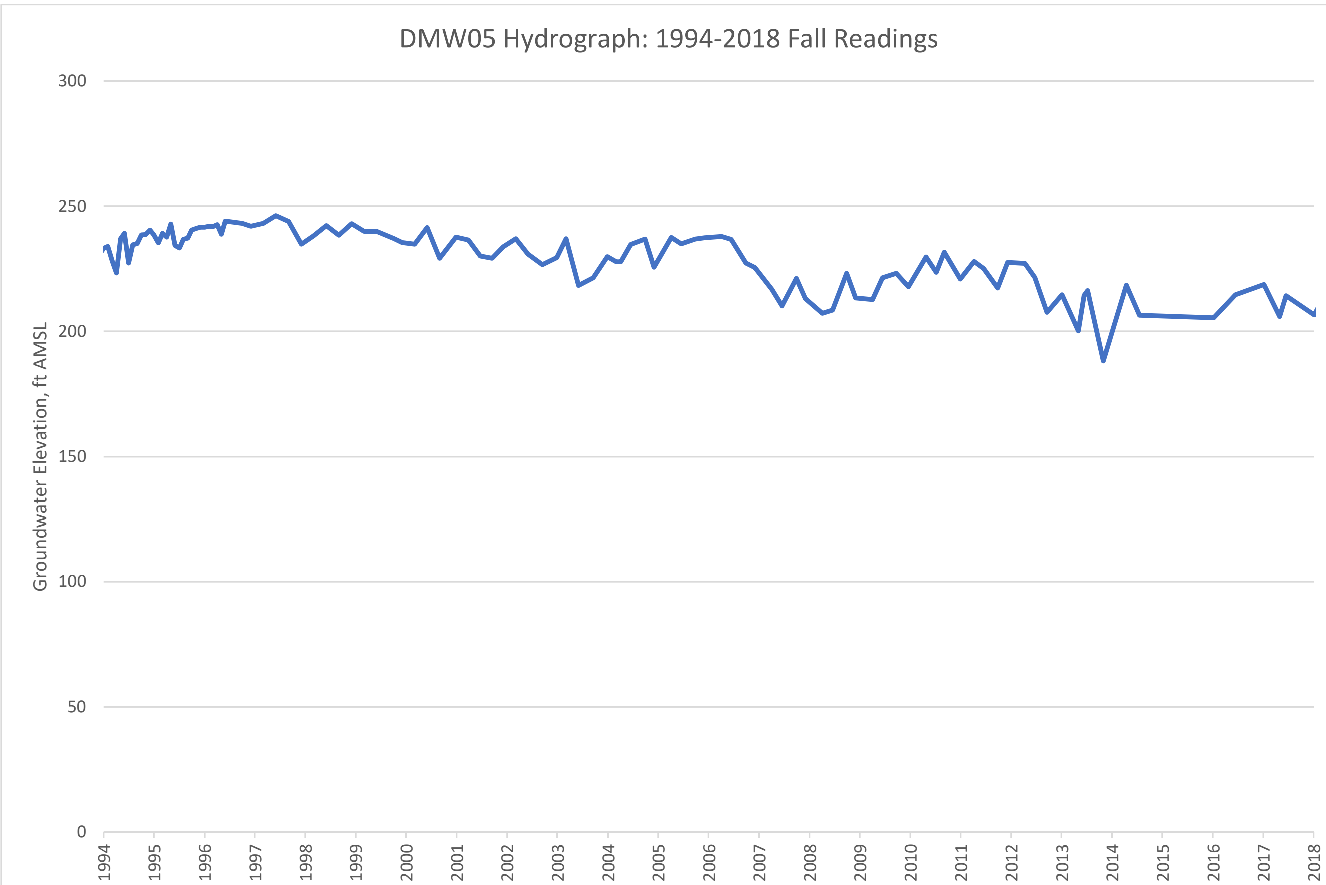

DMW05 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
150
100
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1994
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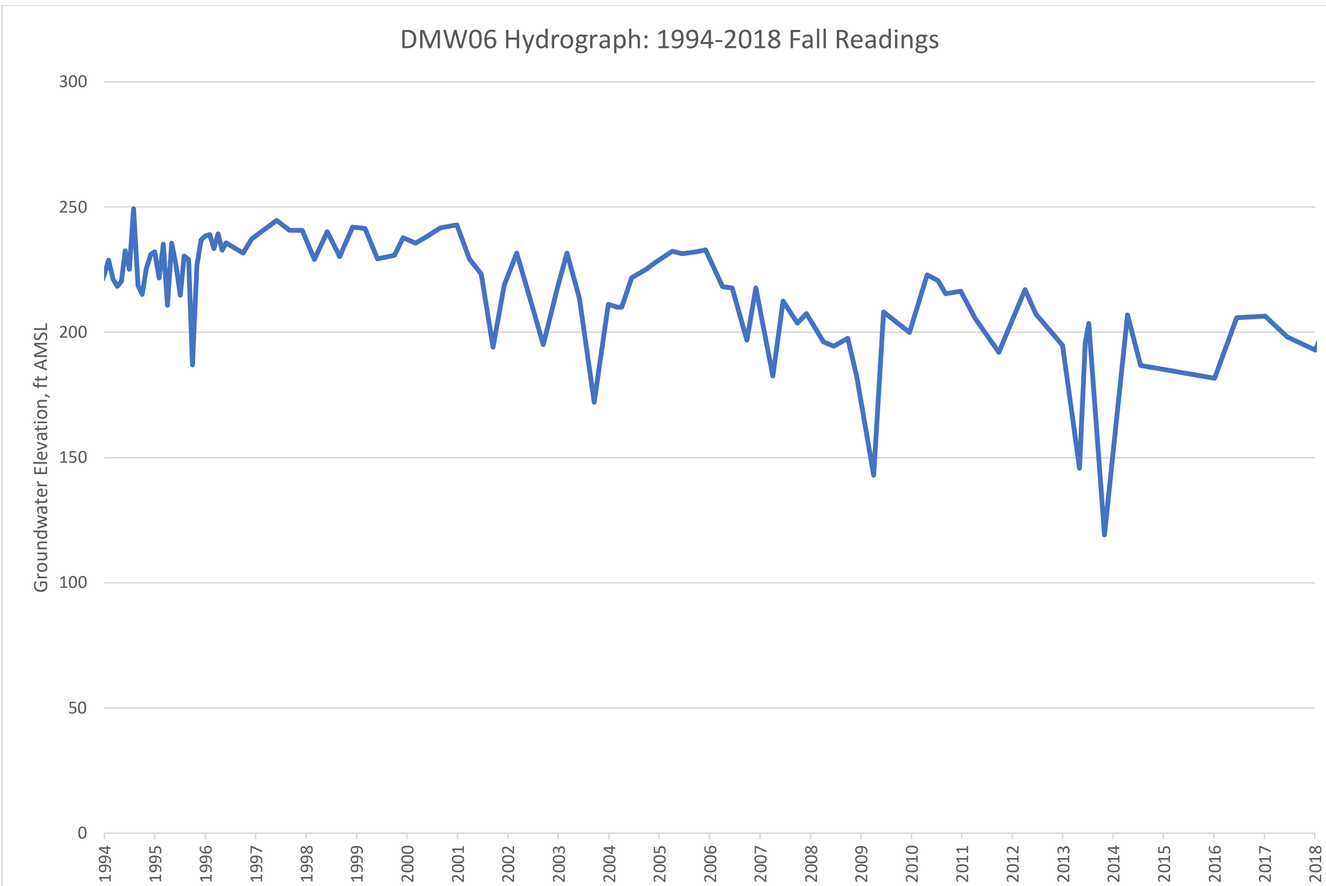

DMW06 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
150
100
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0
1994
1995
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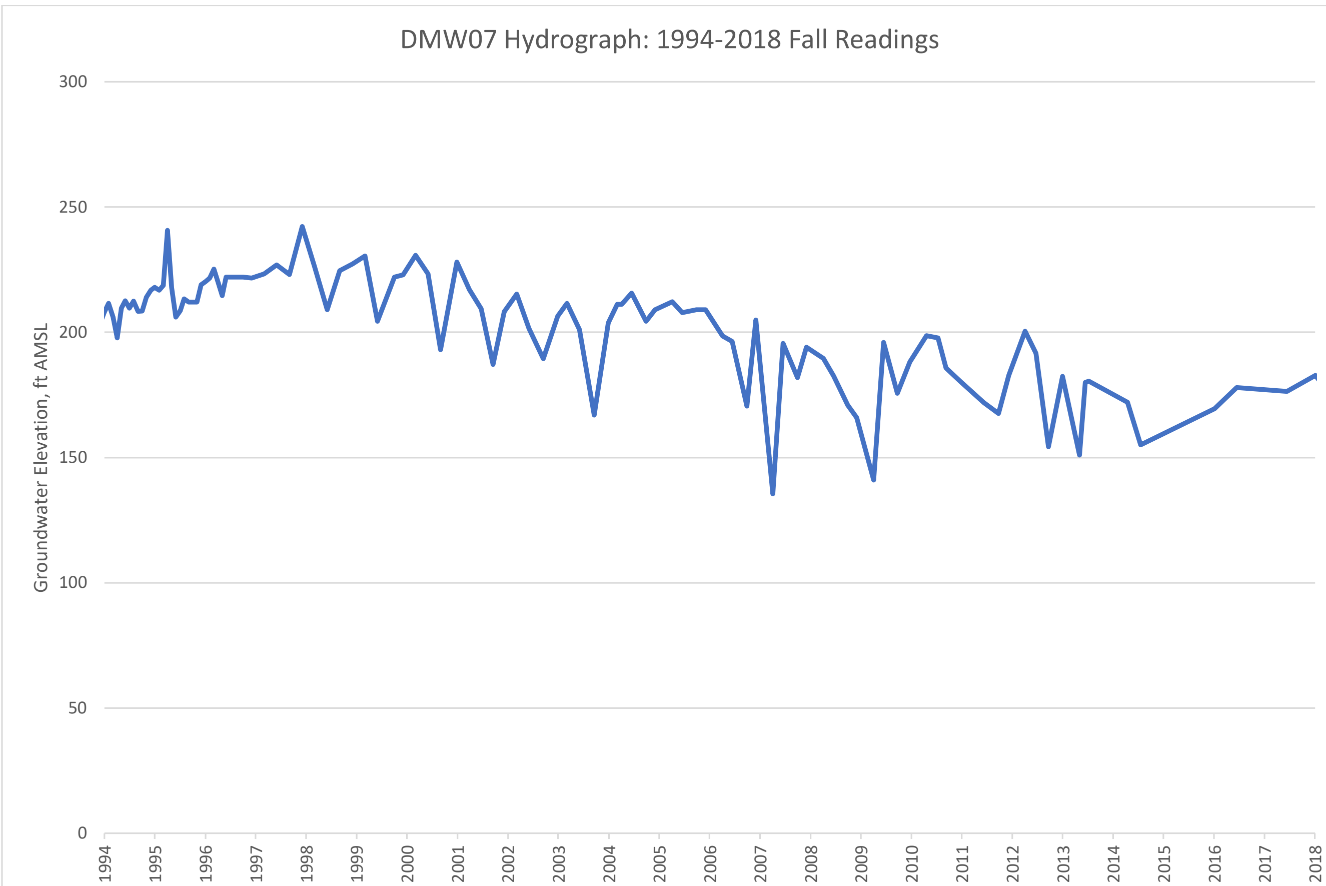

DMW07 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
150
100
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0
1994
1995
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1997
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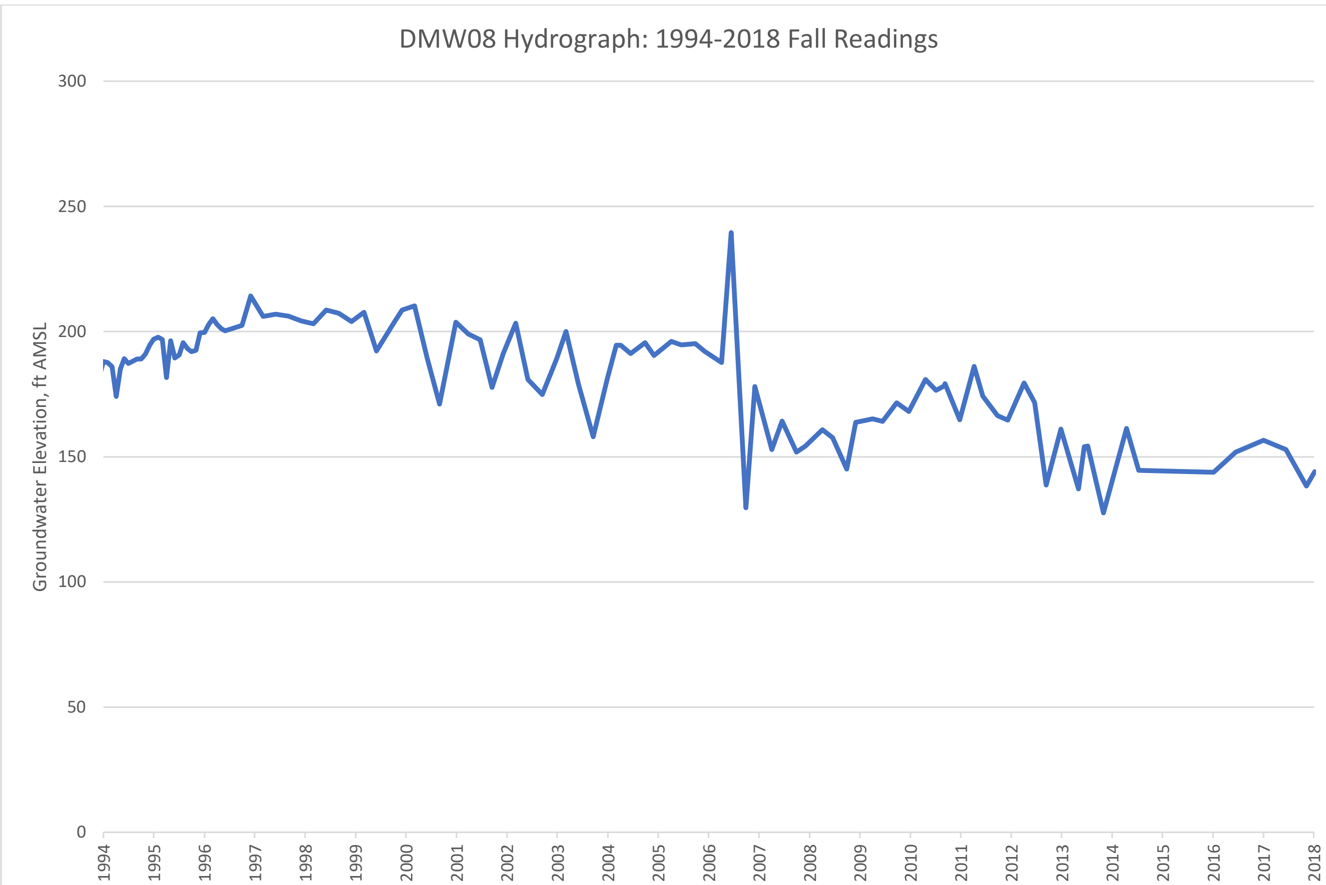

DMW08 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
150
100
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1994
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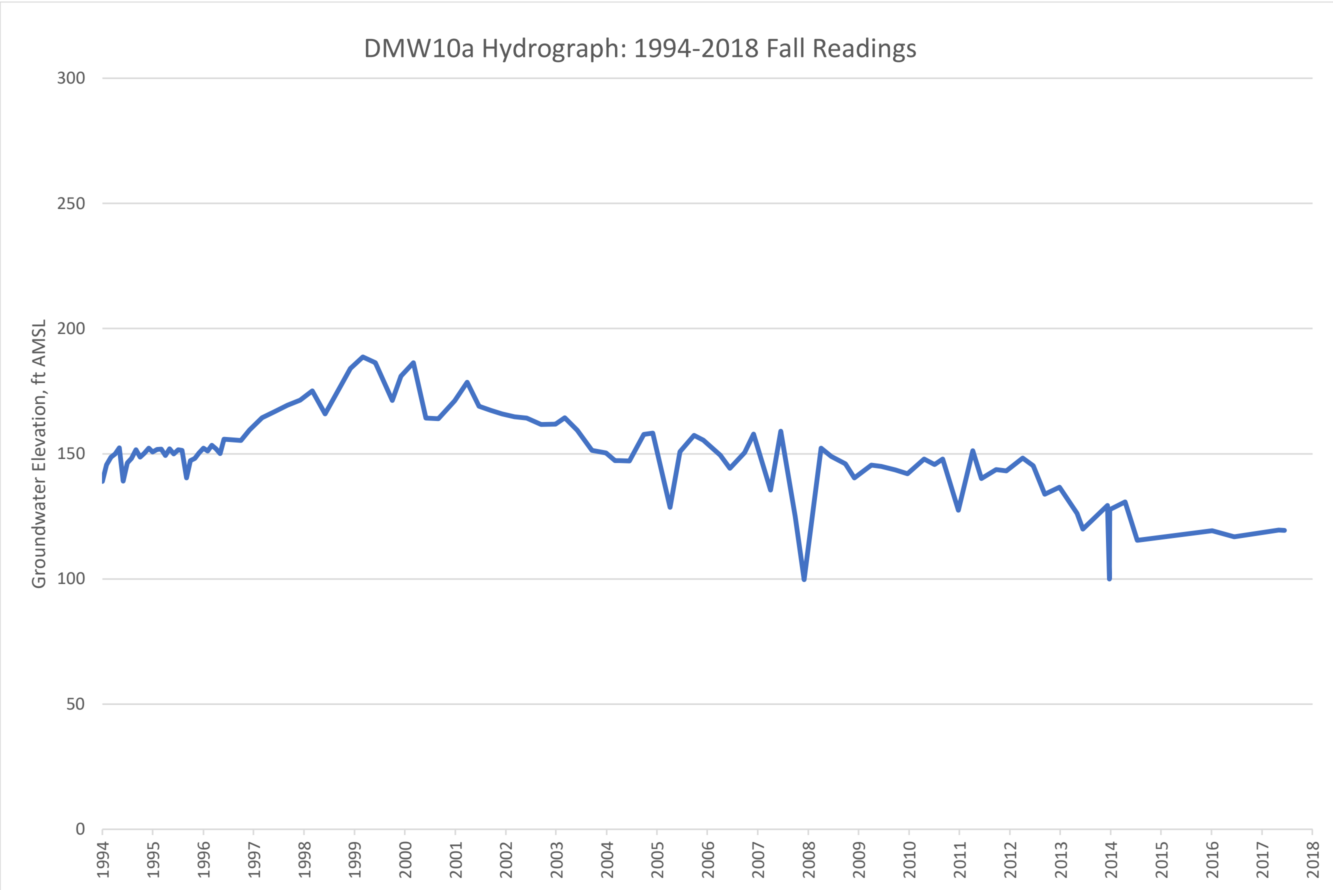

DMW10a Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
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100
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1994
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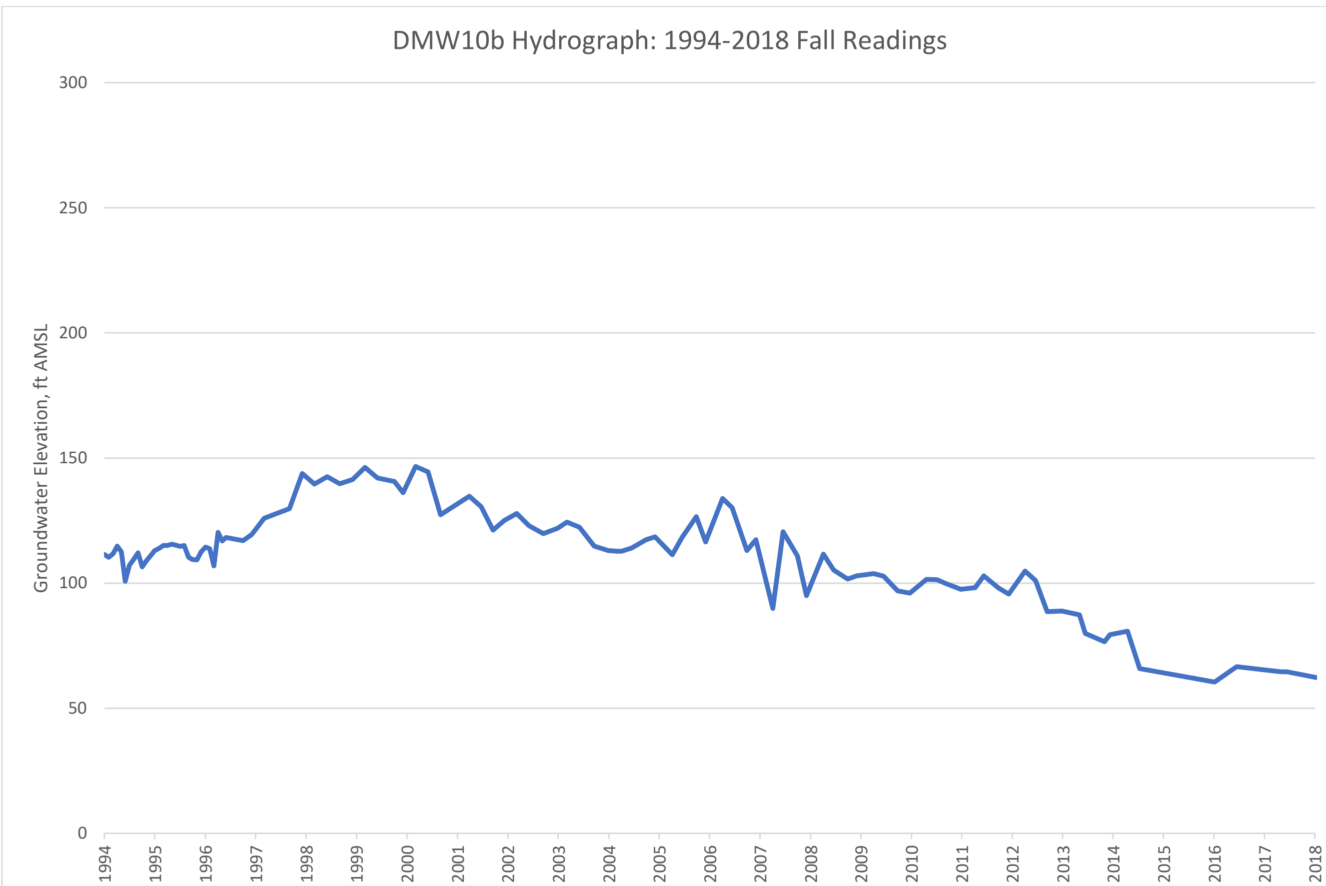
DMW10b Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
0
50
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300
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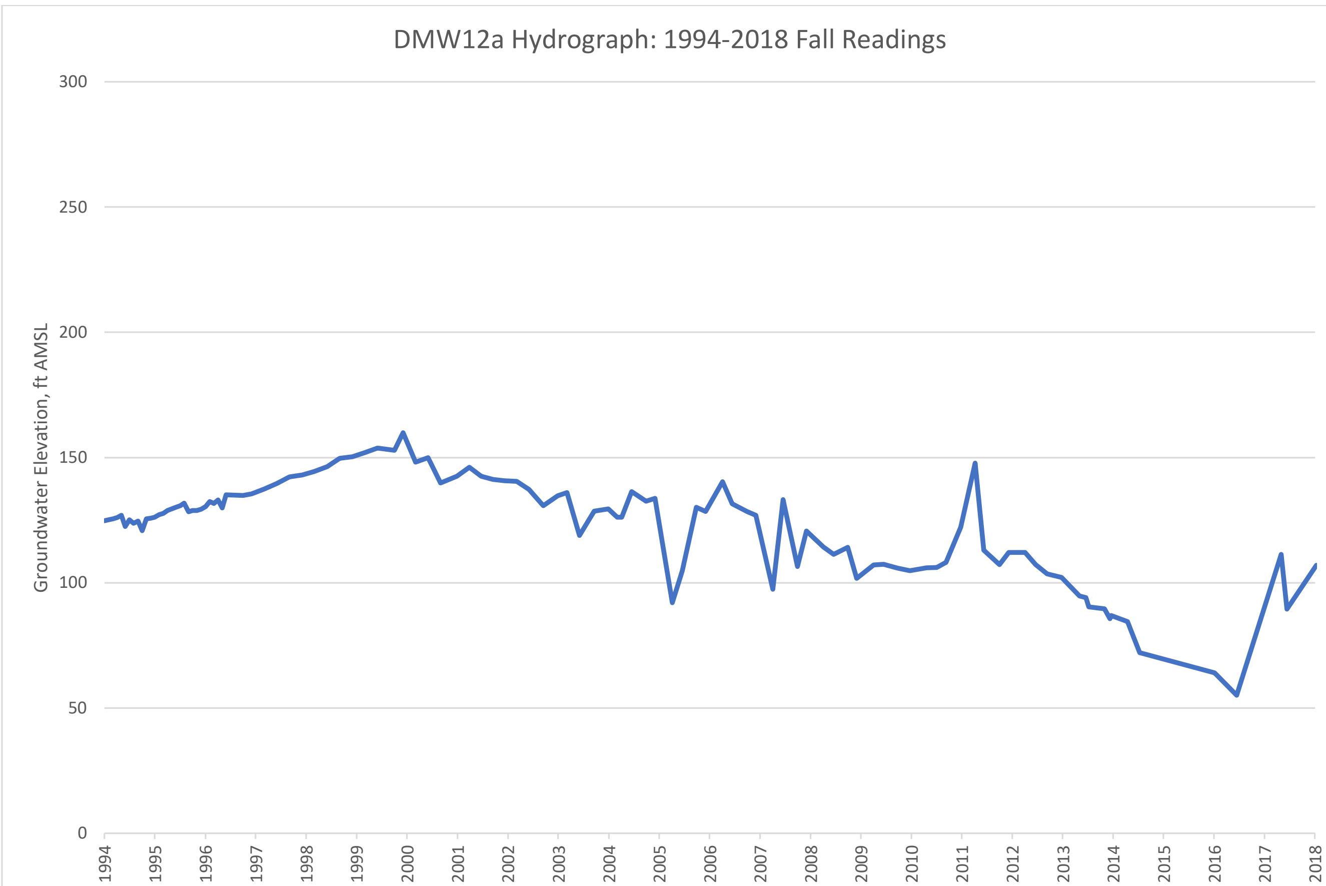
DMW12a Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
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100
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0
1994
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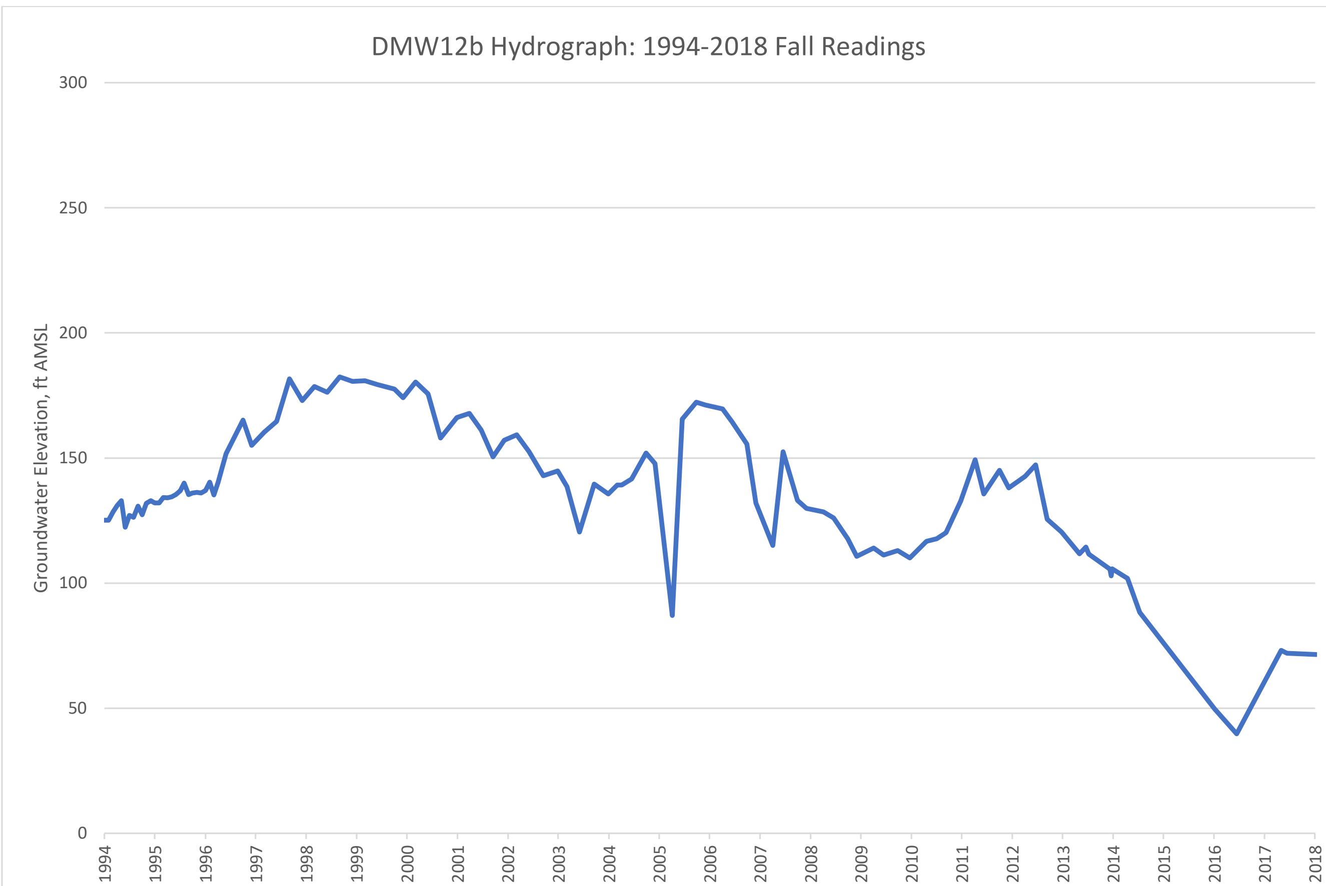

DMW12b Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
300
250
200
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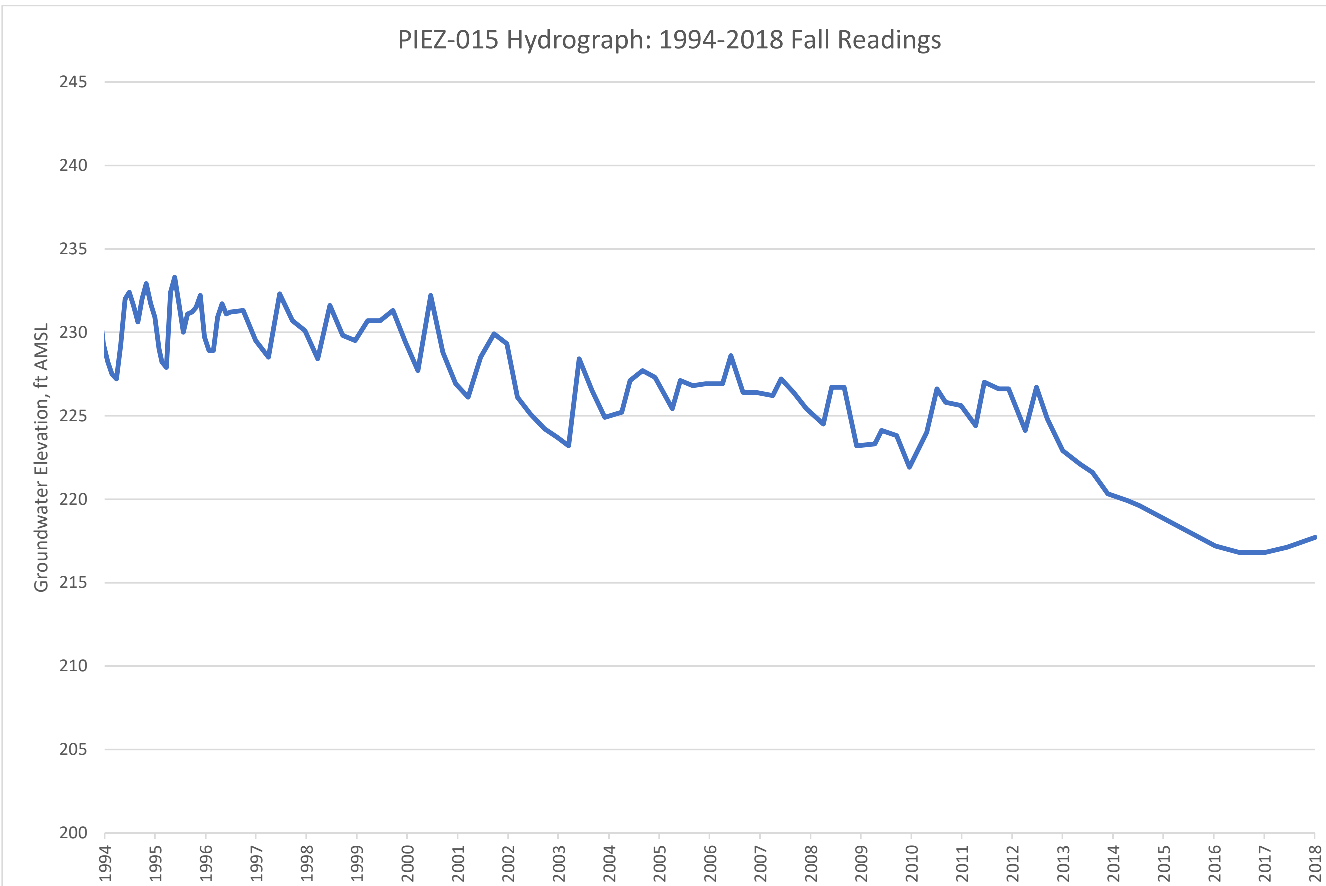

PIEZ-015 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
245
240
235
230
225
220
215
210
205
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1994
1995
1996
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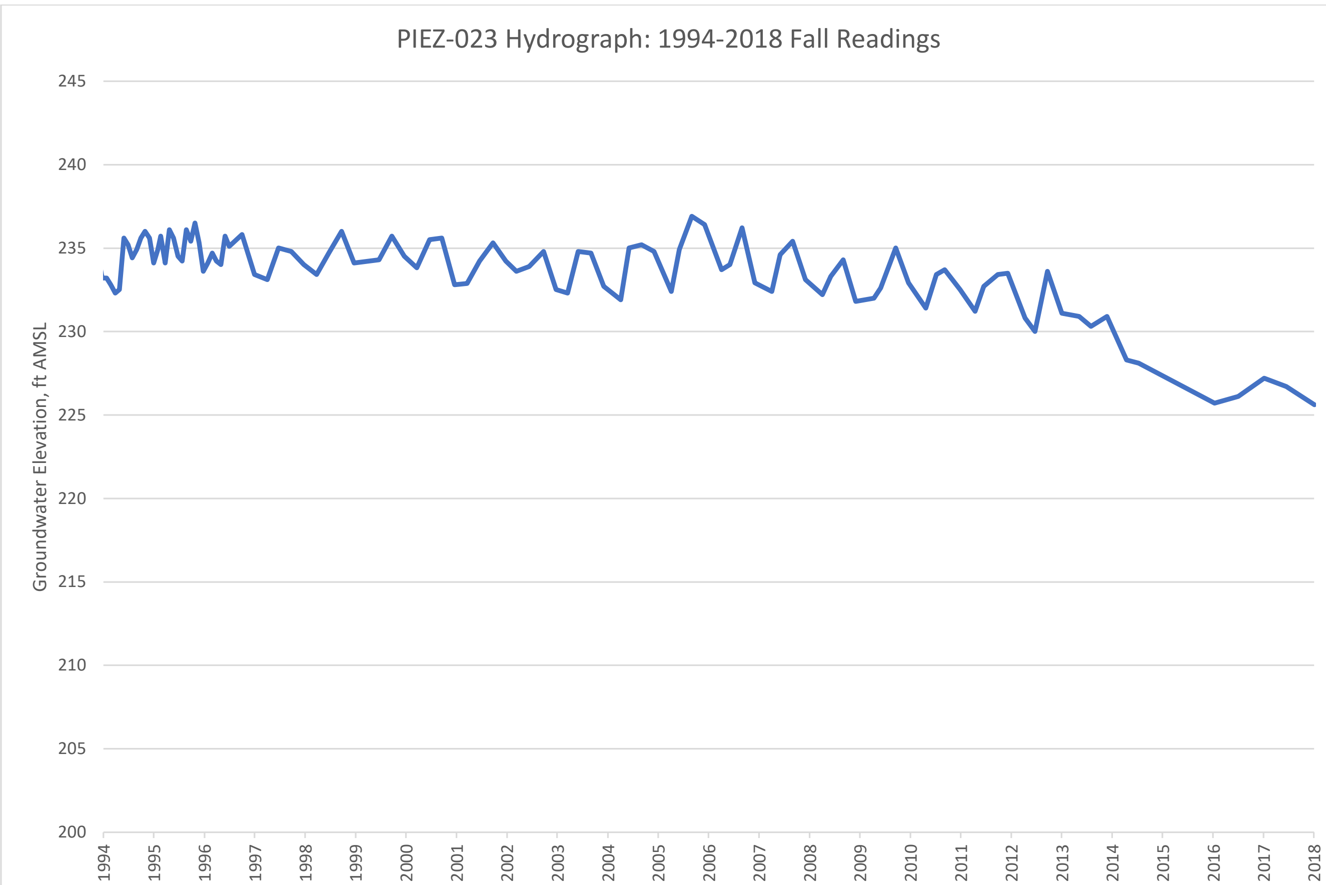

PIEZ-023 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
245
240
235
230
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220
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1994
1995
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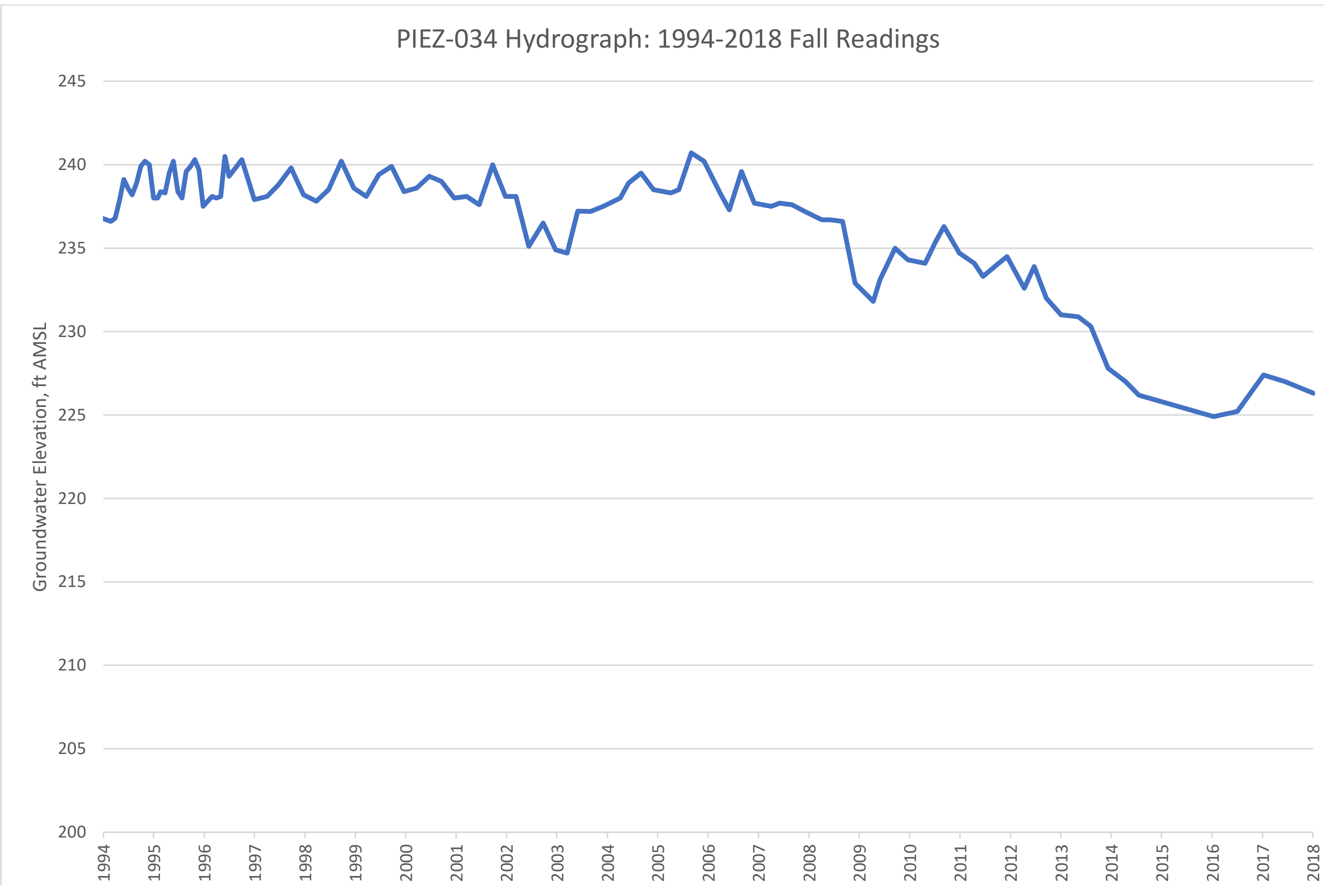

PIEZ-034 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
245
240
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1994
1995
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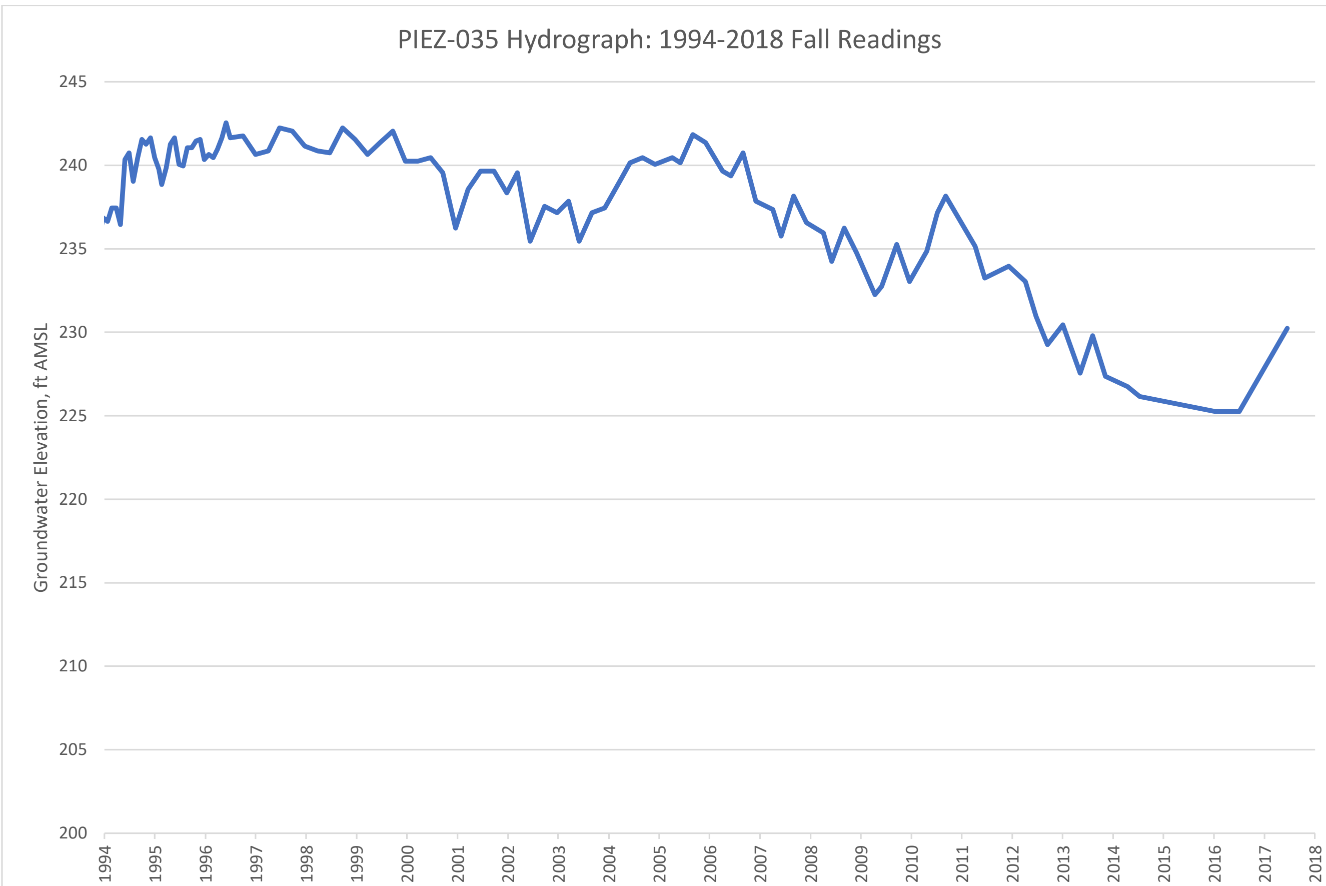

PIEZ-035 Hydrograph: 1994-2018 Fall Readings
Groundwater Elevation, ft AMSL
245
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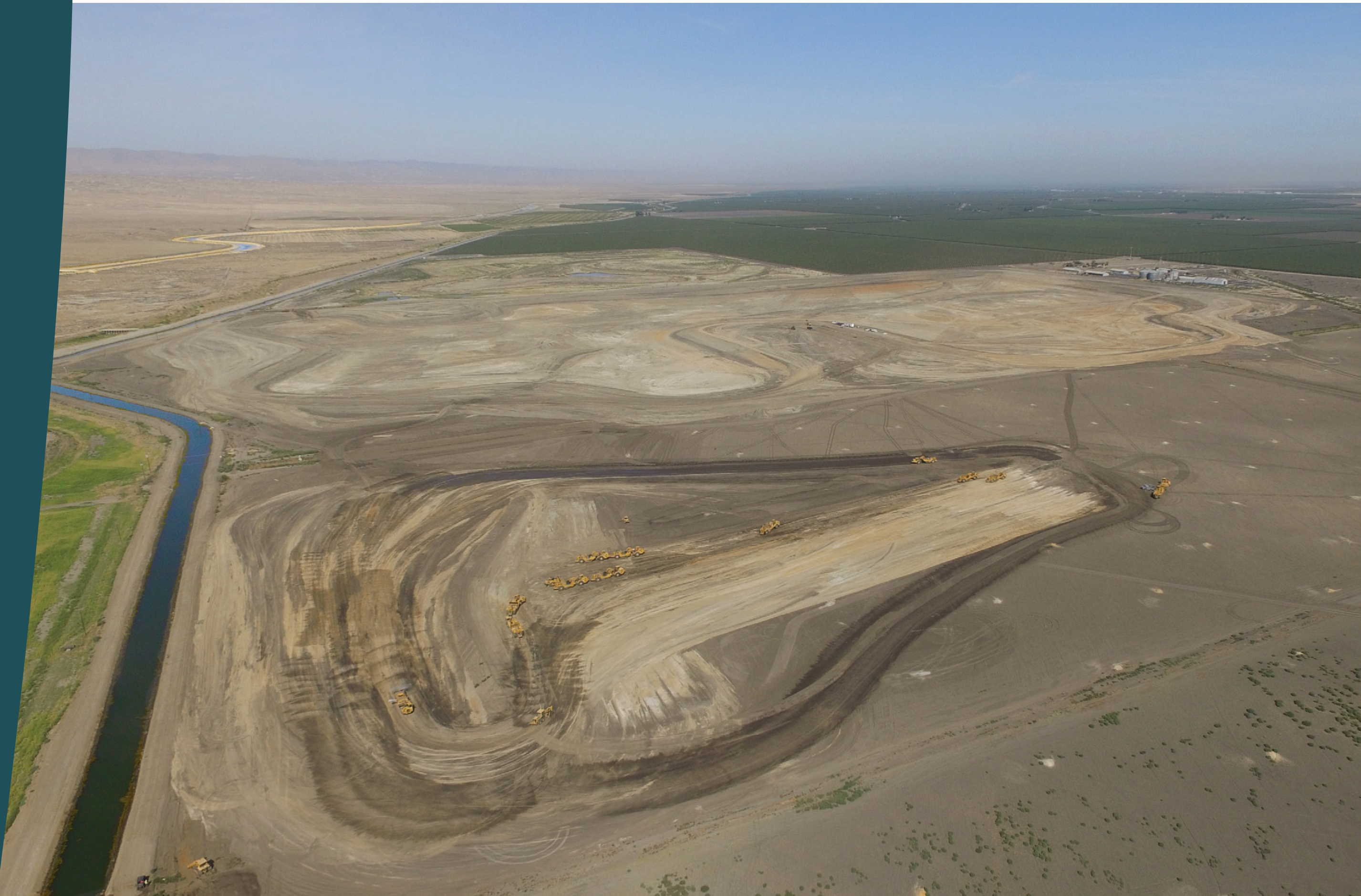
Appendix D

Draft Monitoring Protocol



Monitoring Protocol for Buena Vista GSA

Submitted to:
Buena Vista GSA

Date: August 2019

Table of Contents

1 Introduction

1.1 Regulations and Purpose of Monitoring Protocols

This document describes the protocols for the collection, recording, and storage of geologic and hydrologic data for the Buena Vista GSA, which is within the Kern County Subbasin. These monitoring protocols were initially developed for Buena Vista GSA but can be adapted for other agencies interested in applying a uniform protocol for geologic and hydrologic monitoring to support the implementation of Groundwater Sustainability Plans (GSPs) required by the Sustainable Groundwater Management Act (SGMA). The rationale of monitoring network design and site selection is discussed in Chapter 4 – Monitoring Network.

Pursuant to §352.2 and §10727.2 of the SGMA Emergency Regulations [1], shown below, monitoring protocols for data collection and management must be adopted to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence, and surface water flow and quality. The monitoring protocols described in this document are informed by existing monitoring protocols, when possible, and are intended to provide practical guidance for field personnel in the collection and management of data.

> *§ 352.2: Monitoring Protocols*
> *Each Plan shall include monitoring protocols adopted by the Agency for data collection and management, as follows:*
>
> *(a) Monitoring protocols shall be developed according to best management practices.*
> *(b) The Agency may rely on monitoring protocols included as part of the best management practices developed by the Department or may adopt similar monitoring protocols that will yield comparable data.*
> *(c) Monitoring protocols shall be reviewed at least every five years as part of the periodic evaluation of the Plan and modified as necessary.*
>
> *§ 10727.2 Required Plan Elements*
>
> *(f) Monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin. The monitoring protocols shall be designed to generate information that promotes efficient and effective groundwater management.*