- Discharge to the stream system
- Groundwater production
- Subsurface outflow

- Change in groundwater storage

The estimated water budgets are provided below for the historical, current, and projected water budgets in AFY in the tables below.

Table 6-6. Average Annual Water Budget – American River (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Upstream Inflow	2,524,600	2,688,100	2,688,100	2,337,800
Tributary Inflows[1]	57,400	58,400	66,800	69,100
Groundwater Discharge	24,200	29,400	26,100	24,900
Surface Runoff	-	-	-	-
Direct Return Flow to Streams	15,800	17,800	17,800	17,800
Total Inflow	2,622,100	2,793,700	2,798,700	2,449,500
Outflows				
Infiltration to Groundwater	46,300	43,900	52,500	53,700
Surface Water Diversions	46,000	43,000	62,900	62,900
Outflow to Sacramento River	2,529,800	2,706,800	2,683,400	2,333,000
Total Outflow	2,622,100	2,793,700	2,798,700	2,449,500

Notes:

[1]Local Tributaries include Alder Creek, Buffalo Creek, and small watersheds for unmodeled streams. Alder Creek and Buffalo Creek are both within the South American Subbasin

Table 6-7. Average Annual Water Budget – Bear River (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Upstream Bear River Inflow	305,800	257,100	257,100	251,200
Tributary Inflows[1]	1,300	1,700	1,700	1,700
Groundwater Discharge	12,800	15,500	14,300	7,700
Surface Runoff	3,400	3,700	3,700	3,800
Direct Return Flow to Streams	12,900	15,400	15,200	15,600
Total Inflow	*336,200*	*293,400*	*292,000*	*280,000*
Outflows				
Infiltration to Groundwater	-	-	-	-
Surface Water Diversions[2]	-	-	-	-
Outflow to Feather River	336,200	293,400	292,000	280,000
Total Outflow	*336,200*	*293,400*	*292,000*	*280,000*

Notes:

[1]Local Tributaries include small watersheds for unmodelled streams

[2]Diversions incorporated within CoSANA from the Bear River occur upstream of the groundwater subbasin

Table 6-8. Average Annual Water Budget – Sacramento River (AFY)

Component	**Historical Condition Water Budget**	**Current Condition Water Budget**	**Projected Condition Water Budget**	**Projected Condition Water Budget with Climate Change**
Hydrologic Period	**WY 2009-2018**	**WY 1970 - 2019**	**WY 1970 - 2019**	**WY 1970 – 2019**
Inflows				
Upstream Feather River & Sacramento River Inflow	12,161,000	14,330,700	14,330,700	12,111,200
Tributary Inflows[1]	292,000	327,900	367,000	361,400
Groundwater Discharge	29,200	30,500	24,500	22,800
Surface Runoff	8,800	8,600	13,700	13,800
Direct Return Flow to Streams	28,900	32,800	34,800	35,100
Total Inflow	12,519,800	14,730,400	14,770,700	12,544,200
Outflows				
Infiltration to Groundwater	-	-	-	-
Surface Water Diversions	90,400	89,400	64,100	66,700
Outflow Downstream of American River Confluence	12,429,500	14,641,000	14,706,600	12,477,500
Total Outflow	12,519,800	14,730,400	14,770,700	12,544,200

Notes:

[1]Local Tributaries include Natomas East Drain and Natomas Cross Canal

Table 6-9. Average Annual Water Budget – Feather River (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Upstream Bear River Inflow	336,200	293,400	292,000	280,000
Upstream Feather River Inflow	4,563,200	5,860,300	5,860,300	4,679,600
Tributary Inflows	-	-	-	-
Groundwater Discharge	-	-	-	-
Surface Runoff	-	1	-	-
Direct Return Flow to Streams	-	-	-	-
Total Inflow	*4,899,400*	*6,153,700*	*6,152,300*	*4,959,600*
Outflows				
Infiltration to Groundwater	25,900	30,700	30,800	27,300
Surface Water Diversions	11,000	11,000	11,000	11,000
Outflow to Sacramento River	4,862,400	6,112,000	6,110,500	4,921,400
Total Outflow	*4,899,400*	*6,153,700*	*6,152,300*	*4,959,600*

Table 6-10. Average Annual Water Budget – Composite of All Major Rivers (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Upstream Inflow[1]	14,681,100	17,013,200	17,014,700	14,447,500
Tributary Inflows[2]	350,700	388,000	435,500	432,200
Groundwater Discharge	66,200	75,400	64,800	55,300
Surface Runoff	12,200	12,200	17,400	17,600
Direct Return Flow to Streams	57,600	66,000	67,700	68,400
Total Inflow	15,167,800	17,554,800	17,600,200	15,021,000
Outflows				
Infiltration to Groundwater	72,200	74,600	83,300	80,900
Surface Water Diversions	147,400	143,400	138,000	140,600
Outflow from Sacramento and American Rivers	14,948,300	17,336,800	17,379,000	14,799,500
Total Outflow	15,167,800	17,554,800	17,600,200	15,021,000

Notes:

[1]Upstream inflows include Bear River, Feather River, Sacramento River, and American River flows into the North American Subbasin

[2]Local Tributaries include Racoon Creek, East Side Canal, Auburn Ravine, Pleasant Grove Creek, Pleasant Grove Creek Canal, Cross Canal. Natomas East Drain, Dry Creek, Magpie Creek, Arcade Creek, Buffalo Creek, and Alder Creek inflow into major rivers. Note that this list includes simulated tributaries within the South American Subbasin as well.

Table 6-11. Total Inflows to the Subbasin

Component	Historical Calibration (AFY)	Current Conditions (AFY)	Projected Conditions (AFY)	Projected Conditions with Climate Change (AFY)
Hydrologic Period	WY 2009 - 2018	50-Year Period	50-Year Period	50-Year Period
Auburn Ravine Upstream Flow	14,600	16,600	16,600	16,600
Pleasant Grove Creek Upstream Flow	22,100	25,200	25,200	25,200
Dry Creek Upstream Flow	29,600	33,500	33,500	34,000
Bear River Upstream Flow	305,800	257,100	257,100	251,200
Feather River Upstream Flow	4,563,200	5,860,300	5,860,300	4,679,600
Sacramento River Upstream Flow	7,287,600	8,207,700	8,209,200	7,178,800
American River Upstream Flows	2,524,600	2,688,100	2,688,100	2,337,800
Total Inflows	*14,747,500*	*17,088,400*	*17,090,000*	*14,523,300*
Outflow to Sacramento River	*14,948,300*	*17,336,800*	*17,379,000*	*14,799,500*

Table 6-12. Average Annual Water Budget – Land Surface System, North American Subbasin (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Precipitation	551,000	590,800	590,800	592,800
Total Surface Water Supply				
Municipal and Industrial	117,900	117,600	220,200	220,200
Agricultural	189,900	189,000	149,900	152,500
Total Groundwater Supply				
Municipal and Industrial	66,600	69,000	102,400	102,400
Agricultural	200,300	206,100	200,500	*220,400*
Ag Residential	20,600	20,600	14,600	14,600
Total Recycled Water Supply				
Remediated Municipal and Industrial	-	-	-	-
Recycled Water	-	-	-	-
Total Inflow	*1,146,300*	*1,193,000*	*1,278,400*	*1,302,900*
Outflows				
Evapotranspiration				
Municipal and Domestic	127,200	128,900	203,600	207,700
Agricultural	299,200	297,900	270,400	293,600
Refuge, Native, and Riparian	68,500	69,900	42,000	43,300
Runoff to the Stream System	297,000	328,400	356,300	358,400
Return Flow to the Stream System				
Agricultural	68,600	73,300	59,400	59,800
Municipal and Domestic	102,900	104,800	171,900	171,900
Deep Percolation				
Precipitation	53,100	55,700	42,600	39,900
Applied Surface Water				
Urban and Industrial	24,600	25,000	40,000	37,500
Agricultural	39,700	40,100	27,200	26,000
Applied Groundwater				
Urban and Industrial	13,900	14,600	18,600	17,500
Agricultural	41,900	43,700	36,400	37,600
Ag Residential	4,300	4,400	2,700	2,500
Applied Recycled Water				
Urban and Industrial	-	-	-	-
Applied Remediated Water				
Urban	-	-	-	-
Other Flows[1]	5,500	6,300	7,300	7,200
Total Outflow	*1,146,300*	*1,193,000*	*1,278,400*	*1,302,900*

Notes: [1] "Other Flows" is a closure term that captures the gains and losses due to land expansion and temporary seasonal storage in the root-zone.

Table 6-13. Average Annual Water Budget – Groundwater System, North American Subbasin (AFY)

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Hydrologic Period	WY 2009-2018	WY 1970 - 2019	WY 1970 - 2019	WY 1970 – 2019
Inflows				
Deep Percolation				
Precipitation	53,100	55,700	42,600	39,900
Applied Surface Water				
Urban and Industrial	24,600	25,000	40,000	37,500
Agricultural	39,700	40,100	27,200	26,000
Applied Groundwater				
Urban and Industrial	13,900	14,600	18,600	17,500
Agricultural	41,900	43,700	36,400	37,600
Ag Residential	4,300	4,400	2,700	2,500
Applied Recycled Water				
Urban and Industrial	-	-	-	-
Applied Remediated Water				
Urban	-	-	-	-
Infiltration from Streams				
American River	23,500	21,700	27,100	28,100
Bear River	3,300	2,700	3,000	5,000
Feather River	10,900	12,300	12,400	13,500
Sacramento River	3,700	6,100	7,600	8,400
Local Tributaries[1]	92,600	91,700	104,200	108,600
Groundwater Injection (from ASR and Remediation)	300	200	2,100	2,100
Other Recharge[2]	16,700	16,700	16,400	16,400
Subsurface Inflow				
South American Subbasin	21,800	16,600	18,300	18,400
Sutter Subbasin	1,400	1,400	1,400	2,100
Yolo Subbasin	10,200	9,000	10,800	11,800
Yuba Subbasin	6,500	6,700	6,800	7,600
Foothills	12,100	13,600	13,600	13,200
Outside B118 Subbasin	2,600	2,600	2,700	3,200
Total Inflow	*383,000*	*384,700*	*393,800*	*399,500*
Outflows				
Discharge to Streams				
American River	6,100	7,100	6,600	6,500
Bear River	9,500	10,000	9,100	6,400
Feather River	4,300	4,900	4,800	5,300
Sacramento River	16,300	20,300	15,800	16,200

Component	Historical Condition Water Budget	Current Condition Water Budget	Projected Condition Water Budget	Projected Condition Water Budget with Climate Change
Local Tributaries[1]	8,200	10,700	10,000	7,200
Groundwater Pumping				
Urban and Industrial	66,600	69,000	102,400	102,400
Ag Residential	20,600	20,600	14,600	14,600
Agricultural	200,300	206,100	200,500	220,400
Remediation	8,900	7,700	7,700	7,700
Subsurface Outflow				
South American Subbasin	7,700	9,700	13,000	13,200
Sutter Subbasin	1,400	2,000	2,000	1,400
Yolo Subbasin	400	500	400	400
Yuba Subbasin	100	100	100	100
Outside B118 Subbasin	900	1,400	1,300	1,100
Other Flows[3]	-	-	-	100
Total Outflow	*351,100*	*369,900*	*388,400*	*403,000*
Change in Groundwater Storage	*31,900*	*14,900*	*5,400*	*(3,500)*

Notes:

[1]Local Tributaries include Racoon Creek, East Side Canal, Auburn Ravine, Pleasant Grove Creek, Pleasant Grove Creek Canal, Cross Canal. Natomas East Drain, Dry Creek, Magpie Creek, and Arcade Creek.

[2]Other Recharge includes primarily unlined canals seepage.

[3] Other Flows is a closure term to help balance the model in the projected conditions with climate change scenario only.

6.5 Historical Water Budget

The historical water budget is a quantitative evaluation of the historical surface and groundwater supply covering the 10-year period from WY 2009 to 2018. This period was selected as the most recent, modeled, representative hydrologic period to represent recent historical conditions in the subbasin and as a subset of the CoSANA model calibration period of WY 1995 to 2018. The goal of the historical water budget analysis is to characterize the supply and demand, while summarizing the hydrologic flow within the Subbasin, including the movement of all primary sources of water such as rainfall, irrigation, streamflow, and subsurface flows.

The existing stream and canal network supplies multiple water users and agencies in the NASb, including the City of Sacramento, Carmichael Water District (WD), Natomas MWC, and Pleasant Grove Verona MWC. In addition to these entities, South Sutter WD, City of Roseville, City of Lincoln, San Juan WD, Orange Vale WC, Citrus Heights WD, California American WC, Sacramento Suburban WD, Fair Oaks WD, and Placer County WA supplied areas receive surface water that originates outside of the model boundaries.

When analyzing the stream and canal system, it is important to note potentially significant effects resulting from the natural interactions and managed operations of adjacent groundwater subbasins. Because the CoSANA model covers multiple subbasins, it is not always possible to distinguish between stream system inflows and outflows by subbasin. Because of this, the water budgets in **Tables 6-4 through Table 6-7** quantify budgets based on the major rivers and their associated tributaries. **Figure 6-3** below shows the composite inflows and outflows for portions of the American, Feather, Bear, and Sacramento Rivers that are adjacent to the NASb.

During the historical period, average annual surface water inflows of about 14,681,100 acre-feet (AF) enter the CoSANA model boundary via the American, Feather, Bear, and Sacramento Rivers. These flows are supplemented by tributary inflows (350,700 AFY), gain from groundwater (66,200 AFY), runoff (12,200 AFY), and direct return flows (57,600 AFY). These are offset by an equal quantity of stream outflows on these river reaches. Most of the streamflows flow out to the Sacramento and American Rivers (14,948,300 AFY). However, additional water exits the stream system as seepage to groundwater (72,200 AFY) and surface water diversions (147,400 AFY).

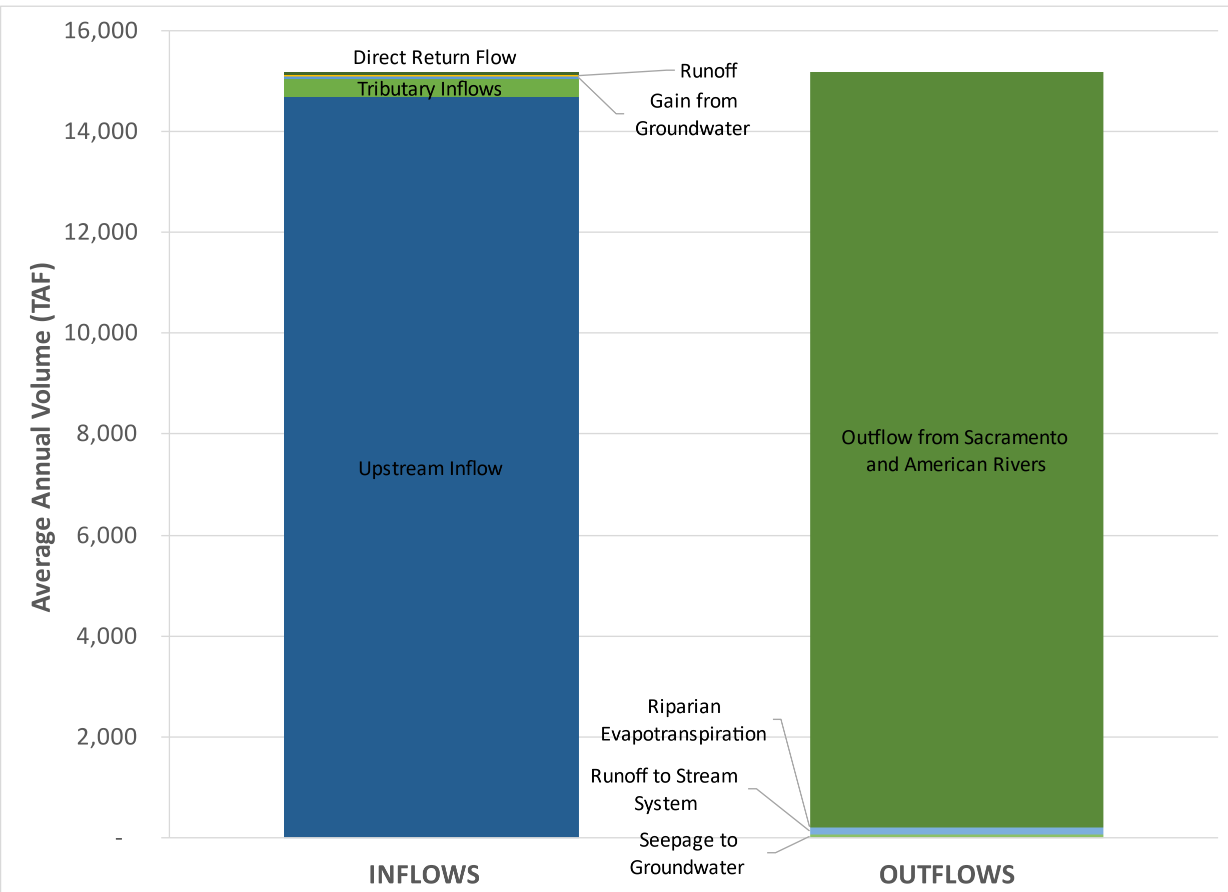


Figure 6-3. Historical Average Annual Water Budget – Stream and Canal Systems, North American Subbasin

The NASb land surface system water budget, shown below in **Figure 6-4**, includes approximately 1,146,300 AF of inflows each year, a combination of precipitation (551,000 AFY), surface water deliveries (307,800 AFY), and groundwater supplies (287,500 AFY). These inflows are balances with the outflows, which are comprised of evapotranspiration (494,900 AFY), surface runoff (297,000 AFY), return flow (171,500 AFY) to the stream and canal system, deep percolation (177,500 AFY), and other flows (5,500 AFY).

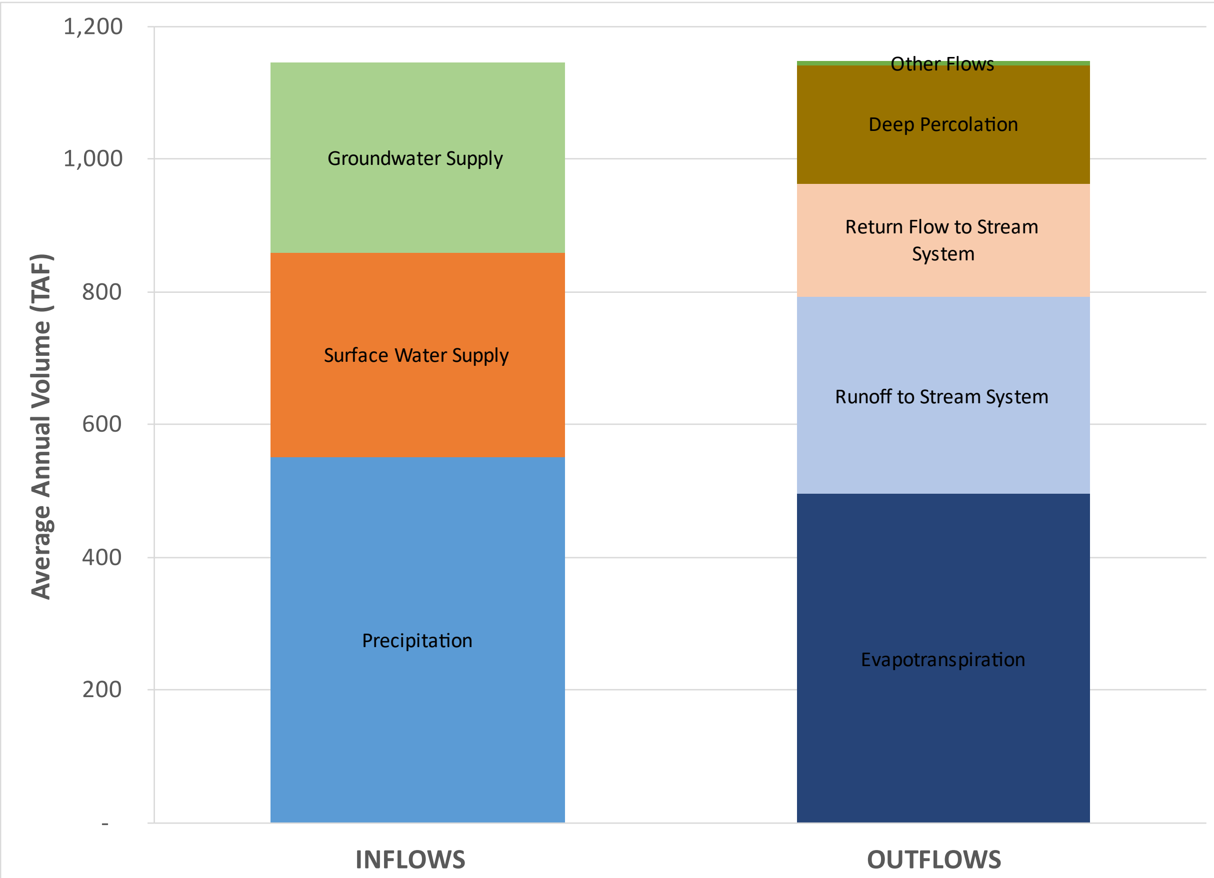


Figure 6-4. Historical Average Annual Water Budget – Land Surface System, North American Subbasin

The groundwater system of the NASb experiences approximately 383,000 AF of inflows each year, of which 177,500 AF is deep percolation. Additional inflows include infiltration from the stream system (134,000 AFY), injection of remediated water to the groundwater system (300 AFY), subsurface inflows (54,600 AFY) from the Sierra Nevada foothills and the neighboring subbasins (primarily Yolo and Yuba), and other recharge (16,700 AFY) which is primarily seepage from irrigation water canal system.

On average, the inflows exceed the groundwater outflows. The primary components of outflow from the groundwater system are groundwater pumping (296,400 AFY), followed by groundwater discharge to streams (44,400 AYF) and subsurface outflow to neighboring subbasins (10,400 AFY).

The NASb average historical groundwater budget has greater inflows than outflows, leading to an average annual increase in groundwater storage of approximately 31,900 AFY. **Figure 6-5** summarizes the average historical groundwater inflows and outflows in the NASb.

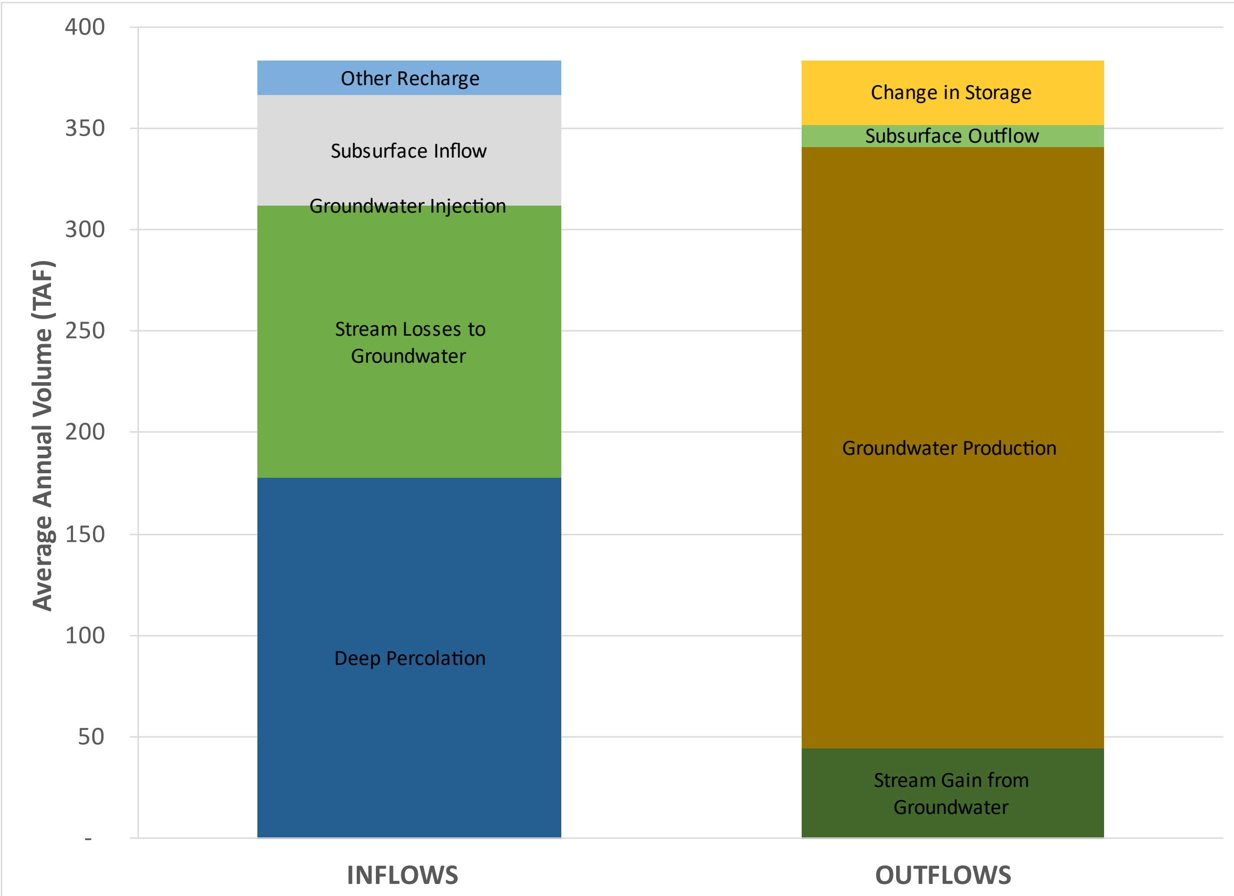


Figure 6-5. Historical Average Annual Water Budget – Groundwater System, North American Subbasin

Historical inflows and outflows change by water year type. In wet years, precipitation meets more of the water demand and greater recharge occurs from precipitation and streams. In dry years, more groundwater is pumped to meet the agricultural demand not met by precipitation and less recharge occurs from precipitation and streamflows. This contributes to an increase in groundwater storage in wet years and a decrease in dry years. Further, many urban water users practice conjunctive use, using more surface water in wet years and more groundwater in dry years to optimize these water supplies. While agricultural demand for applied water increases in dry years due to lack of precipitation, agricultural surface water supplies remain relatively consistent in most non-critical years. Note the agricultural surface water supply in this water budget is reflective of the volume available to the grower, and thus does not include operational spills, canal seepage, or evaporative losses. **Table 6-12** breaks down the average historical water supply and demand, by water year type, from the CoSANA simulated 29-year period of 1990 through 2018. Also shown are the average annual values for the 2009-2018 period.

During the 2009-2018 historical period, the availability of surface water supplies were largely reliable. During the period, the only water right curtailment experienced by an urban water user was to a post-1914 water right permit held by Carmichael Water District on the lower American River. This occurred in parts of 2014 and 2015.

Table 6-14. Average Annual Values for Key Components of Water Budget by Year Type (AFY)

Component	Water Year Type (Sacramento River Index)					
	Wet	Above Normal	Below Normal	Dry	Critical	10-Year Average WY 2009-2018
Water Demand						
Ag Demand	417,300	413,800	434,300	449,600	436,000	410,800
Urban Demand	212,600	223,800	213,900	218,900	197,300	184,500
Total Demand	*633,400*	*659,100*	*653,900*	*672,800*	*637,400*	*602,800*
Water Supply						
Total Surface Water Supply						
Agricultural	215,500	233,900	211,300	213,100	181,900	189,900
Urban	116,500	126,400	126,600	133,800	110,700	117,900
Total Groundwater Supply						
Agricultural	181,200	177,300	202,400	215,900	233,500	200,300
Ag Residential	20,600	20,600	20,600	20,600	20,600	20,600
Urban	96,100	97,400	87,300	85,100	86,600	66,600
Remediation	3,500	3,500	5,700	4,300	4,100	7,500
Total Supply	*633,400*	*659,100*	*653,900*	*672,800*	*637,400*	*602,800*
Change in GW Storage	*102,300*	*29,300*	*12,600*	*(7,300)*	*(66,400)*	*31,800*

Note:
Information is presented here to show variability in historical conditions based on water year type. However, as these data are based on historical conditions, other differences are present beyond water year type that influence the values shown. For instance, the Above Normal year of 1991 will have different conditions and results than the Critical year of 2015 due to level of development, changes in management, nuances of the water year, and a variety of other factors. In some cases, these distinctions may be more significant than the impact of the water year type, resulting in some results and trends in this table that may seem nonintuitive.

6.6 Current Water Budget

The current water budget quantifies inflows to and outflows from the basin using 50-years of hydrology in conjunction with water supply, demand, and land use information reflecting the current level of development. Current level of development for most of the entities in the NASb is defined as the average demand and supply conditions during the most recent 10 years (approx. 2009-2018). The only exception is the supply mix for the current level of development for the City of Sacramento, which is defined per the city's Groundwater Master Plan. These conditions are incorporated in the Current Conditions Baseline simulation of the CoSANA model.

In the Current Conditions Baseline, average annual surface water inflows of approximately 17,013,200 AFY enter the CoSANA model boundary via the American, Feather, Bear, and Sacramento Rivers. These flows are supplemented by tributary inflows (388,000 AFY), gain from groundwater (75,400 AFY), runoff (12,200 AFY), and direct return flows (66,000 AFY). These are offset by an equal quantity of stream outflows on these river reaches. Most of the streamflows flow out to the Sacramento and American Rivers (17,336,900 AFY). However, additional water exits the stream system as seepage to groundwater (74,600 AFY) and surface water diversions (143,400 AFY).

Figure 6-6 summarizes the average annual current conditions inflows and outflows in the NASb surface water network.

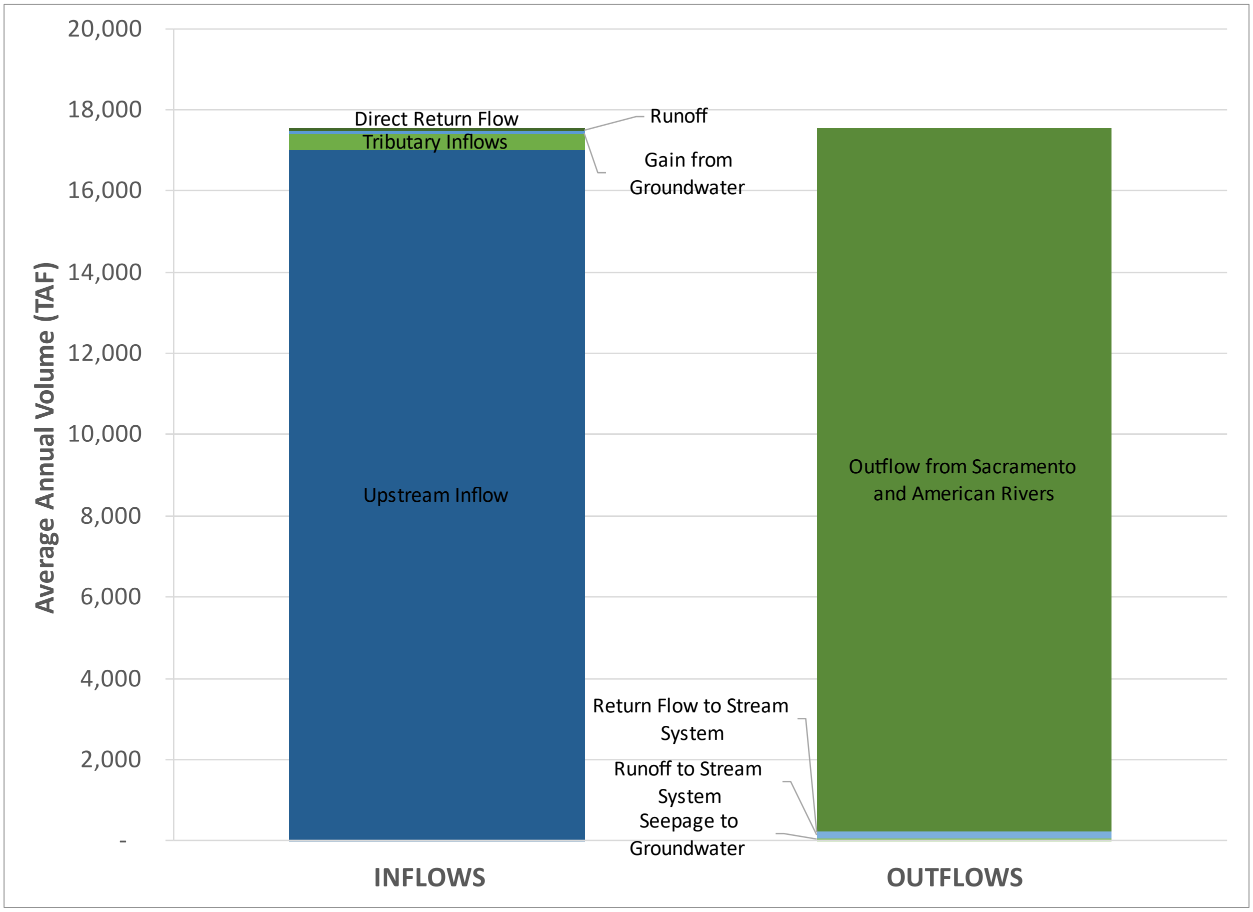


Figure 6-6. Average Annual Current Water Budget – Stream and Canal Systems, North American Subbasin

The current land surface water budget simulates annual inflows of 1,193,000 AFY, including 590,800 AFY of precipitation and 602,200 AFY of applied water (306,600 AFY of surface water and 295,600 AFY of groundwater). Balancing the current land surface water budget, the 1,193,000 AFY of outflows include evapotranspiration (496,700 AFY), surface runoff to the stream system (328,400 AFY), return flow to the stream system (178,100 AFY), deep percolation (183,500 AFY), and other flows (6,300 AFY). **Figure 6-7** summarizes the average annual current inflows and outflows in the NASb land surface water budget.

There are small but important differences between the historical and current conditions land surface system water budget. The Current Conditions Baseline uses a 50-year hydrology that is more similar to long-term average precipitation conditions in the NASb, while the 2009-2018 recent historical period is slightly drier. The more normal conditions are shown as slightly higher precipitation inflows under the Current Conditions Baseline as well as higher runoff to streams.

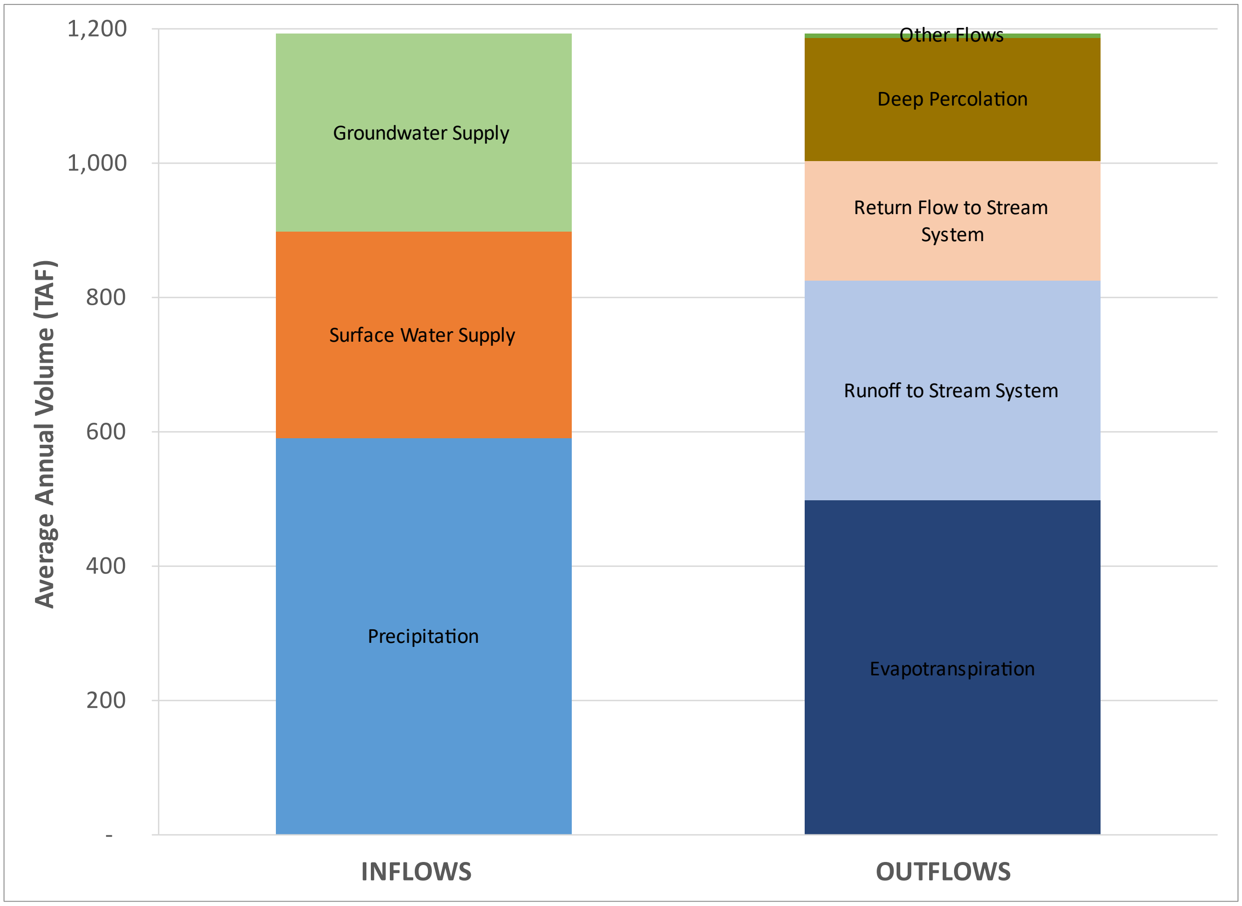


Figure 6-7. Average Annual Current Water Budget – Land Surface System, North American Subbasin

Over the simulation period, the current groundwater budget simulates annual inflows of 384,700 AFY, including 183,500 AFY of deep percolation, 134,500 AFY of stream seepage, subsurface inflows totaling 49,900 AFY, groundwater injection of 200 AFY, and 16,700 AFY of other recharge (which is primarily canal system seepage).

Similar to the historical groundwater budget, average aquifer inflows exceed the outflows under the current water budget. Groundwater production (303,300 AFY) remains the largest component of aquifer discharge, with losses to the local stream system (53,000 AFY) and subsurface outflows (13,600 AFY) bringing the total system outflows to 369,900 AFY annually.

The NASb current groundwater budget has an average annual increase in groundwater storage of about 14,900 AFY. **Figure 6-8** summarizes the average current conditions groundwater inflows and outflows in the NASb. It should be noted that groundwater conditions are variable across the

NASb, with some areas showing greater increases in groundwater storage and some areas showing lower increases or declines in groundwater storage.

Similar to the land surface system water budget, the groundwater system budget shows the influences of slightly different hydrologic conditions, but also shows influences of slightly higher groundwater levels. Higher average groundwater level conditions under current conditions, due to positive change in groundwater storage in historical conditions, results in generally lower stream seepage, higher outflow to streams, higher subsurface outflows, and lower subsurface inflows. Otherwise, the values in the historical and current groundwater budgets are generally similar.

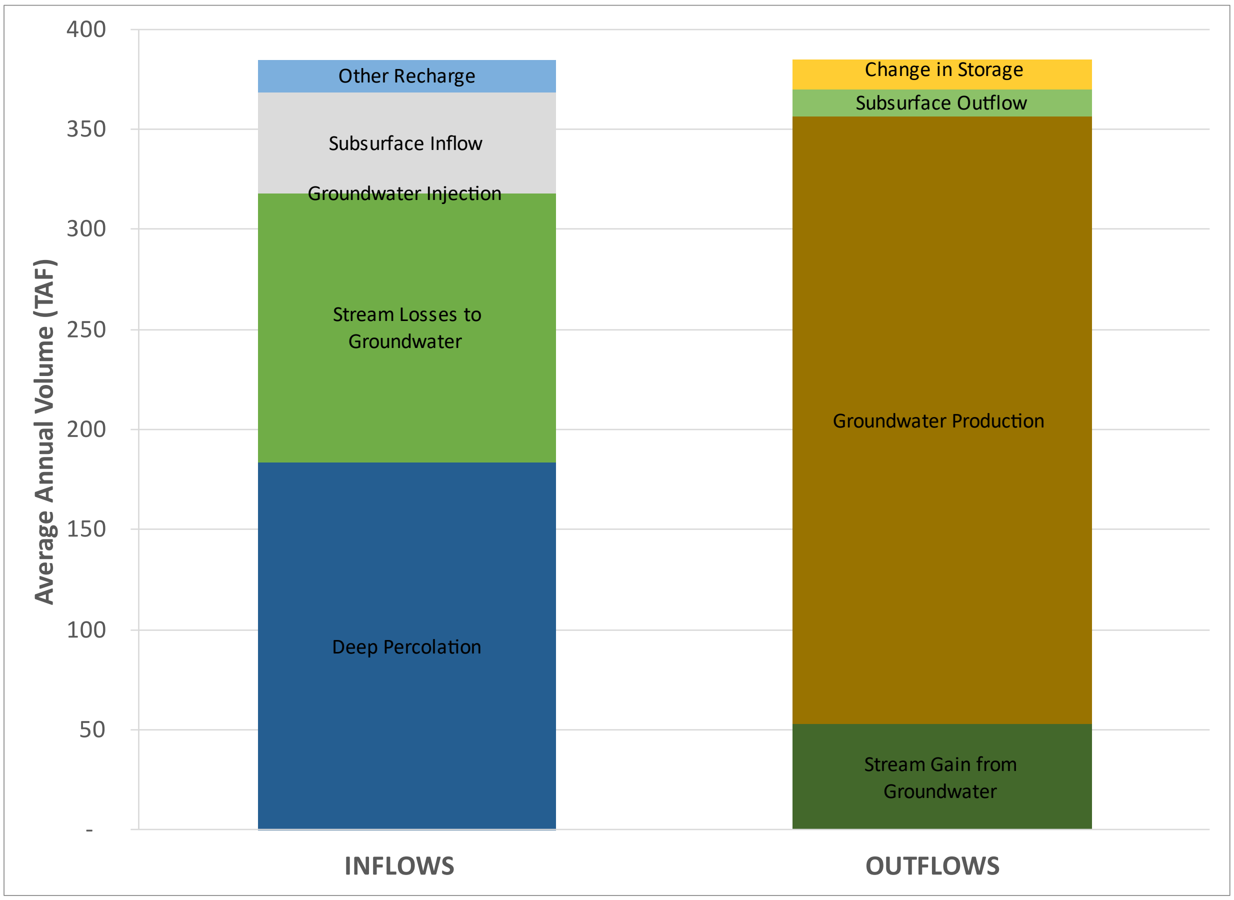


Figure 6-8. Average Annual Current Water Budget – Groundwater System, North American Subbasin

6.7 Projected Water Budget

The projected water budget is used to estimate future baseline conditions of supply, demand, and aquifer response to plan implementation. The Projected Conditions Baseline simulation of the CoSANA model is used to evaluate the projected water budget using the historical hydrology from 1970 to 2019. As previously discussed, this represents a hydrologic period of at least 50 years and has average precipitation similar to the long-term average. Development of the projected water demand is based on information reported in 2015 UWMPs, general plans, and other planning documents, or information provided by purveyors. The projected water budget then reflects the water supply and demand conditions at the projected level of development, which is set at the 2040 projections for most entities, other than the supply mix for the City of Sacramento, which is based on the city's Groundwater Master Plan.

In the Projected Conditions Baseline, average annual surface water inflows of approximately 17,014,700 AFY enter the CoSANA model boundary via the American, Feather, Bear, and Sacramento Rivers. These flows are supplemented by tributary inflows (435,500 AFY), gain from groundwater (64,800 AFY), runoff (17,400 AFY), and direct return flows (67,700 AFY). These are offset by an equal volume of stream outflows on these river reaches. Most of the streamflows flow out to the Sacramento and American Rivers (17,379,000 AFY). However, additional water exits the stream system as seepage to groundwater (83,300 AFY) and surface water diversions (138,000 AFY).

Figure 6-9 summarizes the average projected inflows and outflows in the NASb surface water network.

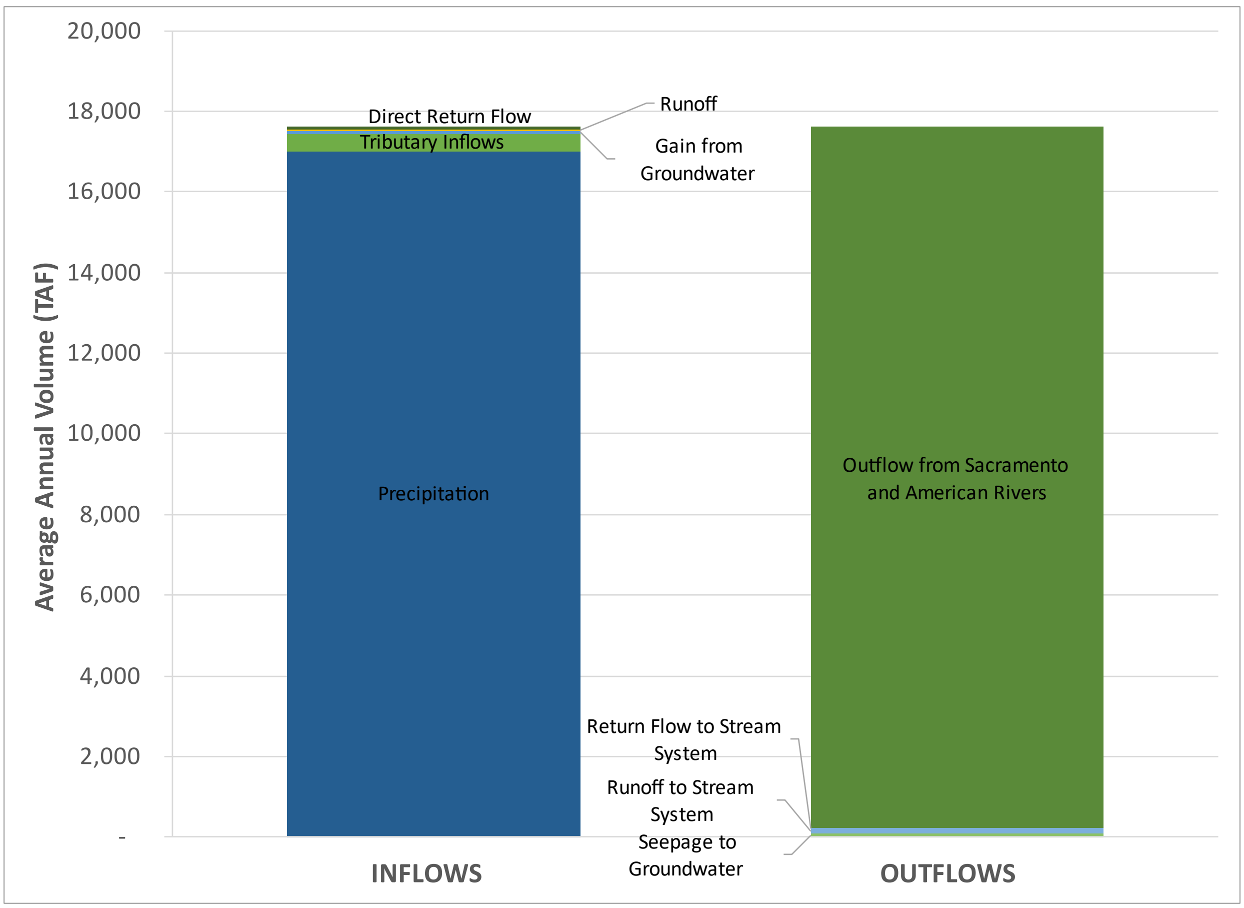


Figure 6-9. Average Annual Projected Water Budget – Stream and Canal Systems, North American Subbasin

The projected land surface water budget shows annual inflows of 1,278,400 AFY, including 590,800 AFY of precipitation and 687,600 AFY of applied water (370,000 AFY of surface water and 317,600 AFY of groundwater). Balancing the projected land surface water budget are 1,278,400 AFY of outflows, including evapotranspiration (516,100 AFY), surface runoff to the stream system (356,300 AFY), return flow to the stream system (231,300 AFY), deep percolation (167,400 AFY), and other flows (7,300 AFY). A summary of these flows can be seen below in **Figure 6-10**.

There are several key differences between the current and projected land surface system water budget. The current and projected conditions use the same hydrologic period, and as such, the rainfall amounts are same. However, runoff and percolation conditions are different due to the impact of land conversion from agricultural and native to urban land uses. The urban growth also results in increases in demand and urban water supplies. Both groundwater and surface water urban supplies increase, with the bulk of increased surface water use the result of increased supply for new developments within Placer County. Agricultural water supplies decline due to reduced irrigated acreage. These changes in inflows are also reflected in the outflows, with increased urban land and water use resulting in increased urban evapotranspiration, urban return flow, and runoff. Conversely, reduced agricultural uses and native lands results in lower levels of evapotranspiration and return flow from these areas.

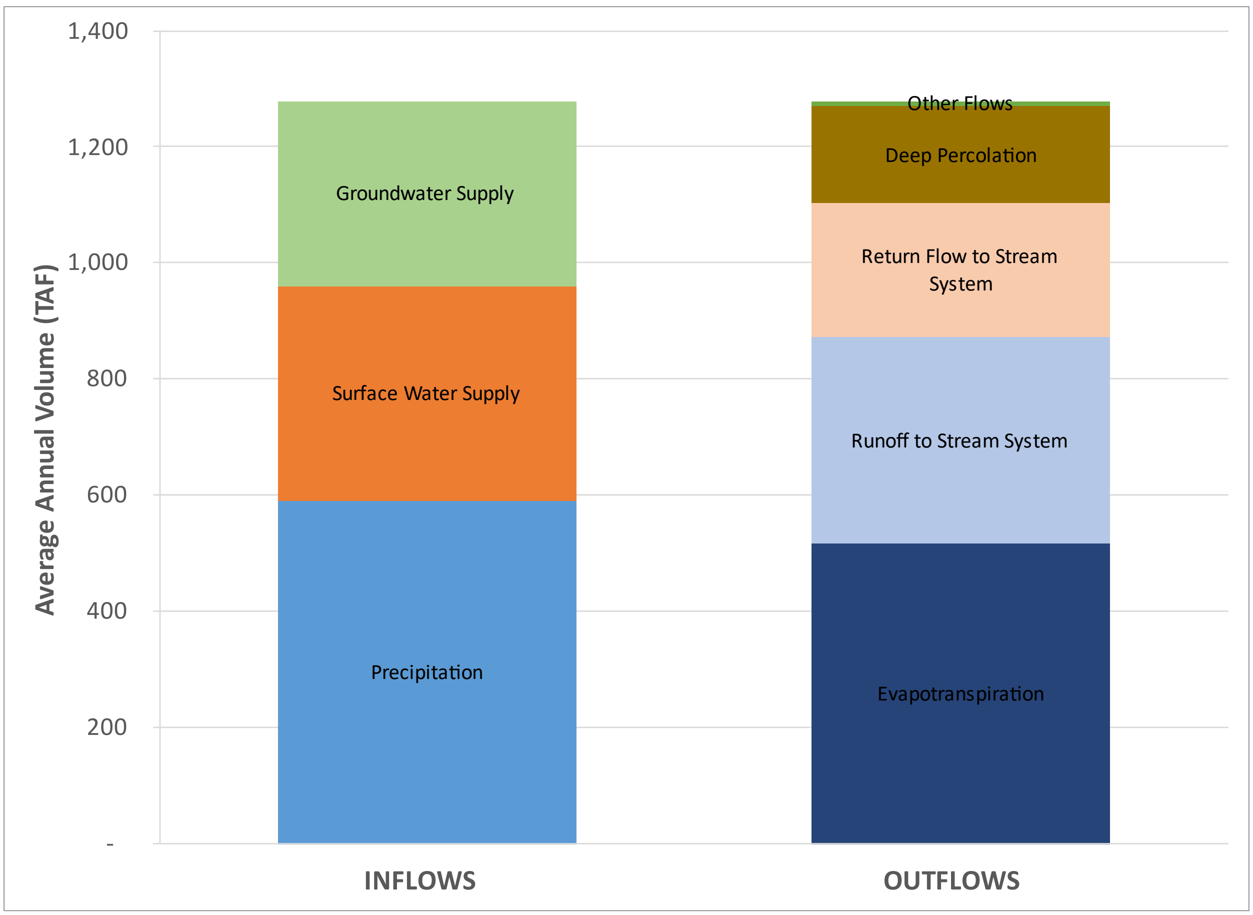


Figure 6-10. Average Annual Projected Water Budget – Land Surface System, North American Subbasin

Over the simulation period, the projected groundwater budget shows annual inflows of 393,800 AFY, including 167,400 AFY of deep percolation, 154,300 AFY of stream seepage, subsurface inflows totaling 53,600 AFY, groundwater injection of 2,100 AFY, and other recharge of 16,400 AFY (which is primarily canal system seepage).

Similar to the current and historical conditions groundwater budgets, average aquifer inflows exceed the outflows in the projected groundwater budget. Groundwater production (325,300 AFY) remains the largest point of aquifer discharge, with losses to the local stream system (46,400 AFY), and subsurface outflows (16,800 AFY) bringing the total system outflows to 388,400 AFY.

The NASb projected groundwater budget has an average annual surplus in groundwater storage of about 5,400 AFY. **Figure 6-11** summarizes the average projected groundwater inflows and outflows in the NASb.

Similar to the land surface system water budget, the groundwater system water budget shows the influences of land conversion and changes to water supplies when compared to the current water budget. Deep percolation from precipitation is lower in the Projected Conditions Baseline compared to current conditions largely due to the changes in land use and increase in impervious surfaces that comes with urban development. Changes in deep percolation of applied water are largely the result of changes in volumes of water supplies, as noted within the land surface system water budget. Stream losses increase in the Projected Conditions Baseline in comparison to the Current Conditions Baseline due to lower groundwater levels caused largely by increases in pumping for urban uses and increases in runoff from urban land.

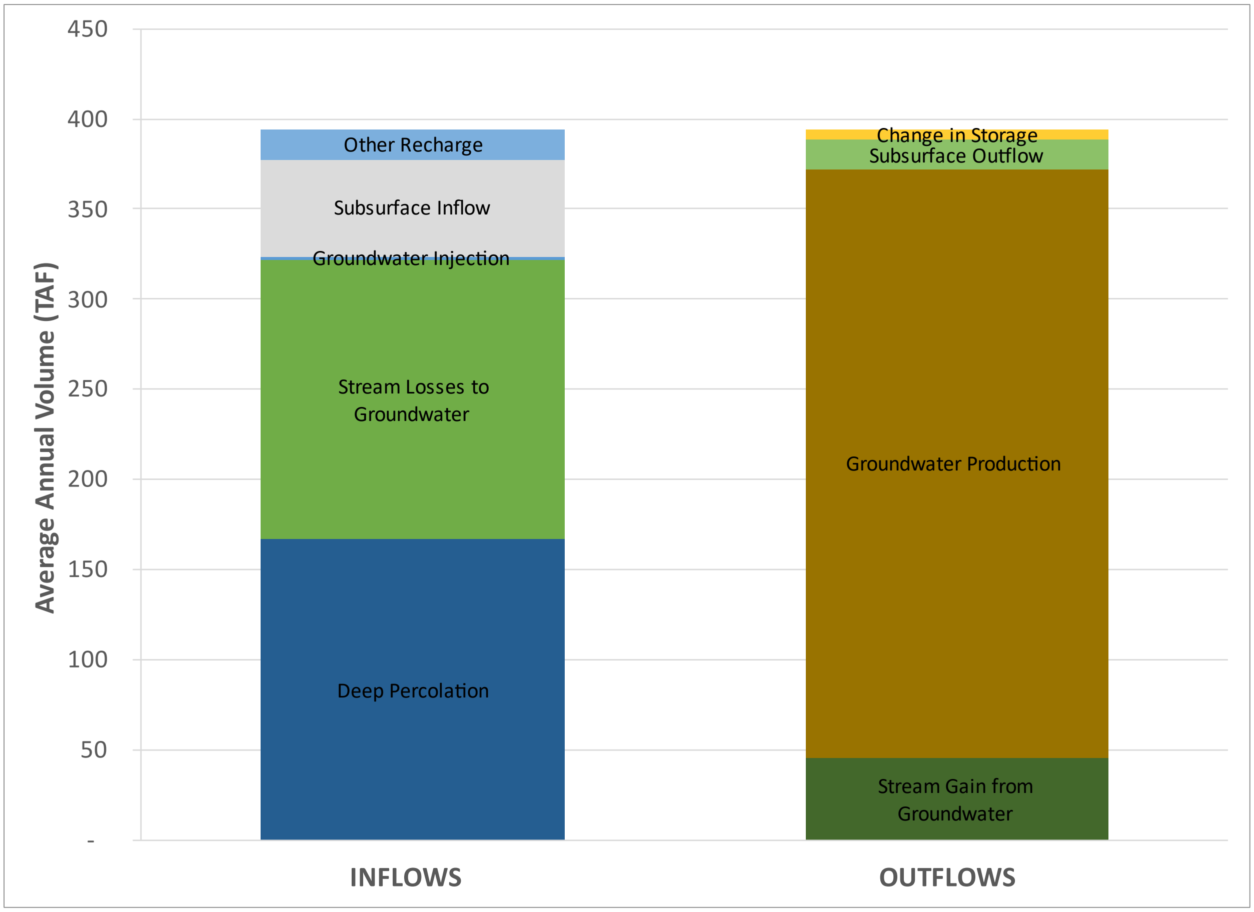


Figure 6-11. Average Annual Projected Water Budget – Groundwater System, North American Subbasin

6.8 Projected Water Budget with Climate Change

The Projected Conditions Baseline with Climate Change is used to estimate future conditions of supply, demand, and aquifer response to plan implementation with consideration of climate impacts. The Projected Conditions Baseline with Climate Change simulation of the CoSANA model is used to evaluate the Projected Conditions Baseline with Climate Change water budget using hydrology from 1970 to 2019, adjusted for projected climate change. As previously discussed, this represents a hydrologic period of at least 50 years and has average precipitation similar to the long-term average. To account for climate change, model inputs for precipitation, evapotranspiration and stream inflow were adjusted using data developed for the American River Basin Study. Additional discussion of the climate change analysis approach, including a description of a sensitivity analysis under a more extreme climate change scenario, can be found in **Appendix P**. Other model data remained the same as the Projected Conditions Baseline.

In the Projected Conditions Baseline with Climate Change water budget, average annual surface water inflows of about 14,447,500 AFY enter the CoSANA model boundary via the American, Feather, Bear, and Sacramento Rivers. These flows are supplemented by tributary inflows (432,200 AFY), gain from groundwater (55,300 AFY), runoff (17,600 AFY), and direct return flows (68,400 AFY). These are offset by an equal quantity of stream outflows on these river reaches. Most of the streamflows flow out to the Sacramento and American rivers (14,799,500 AFY). However, additional water exits the stream system as seepage to groundwater (80,900 AFY) and surface water diversions (140,600 AFY).

Figure 6-12 summarizes the average projected inflows and outflows in the NASb surface water network.

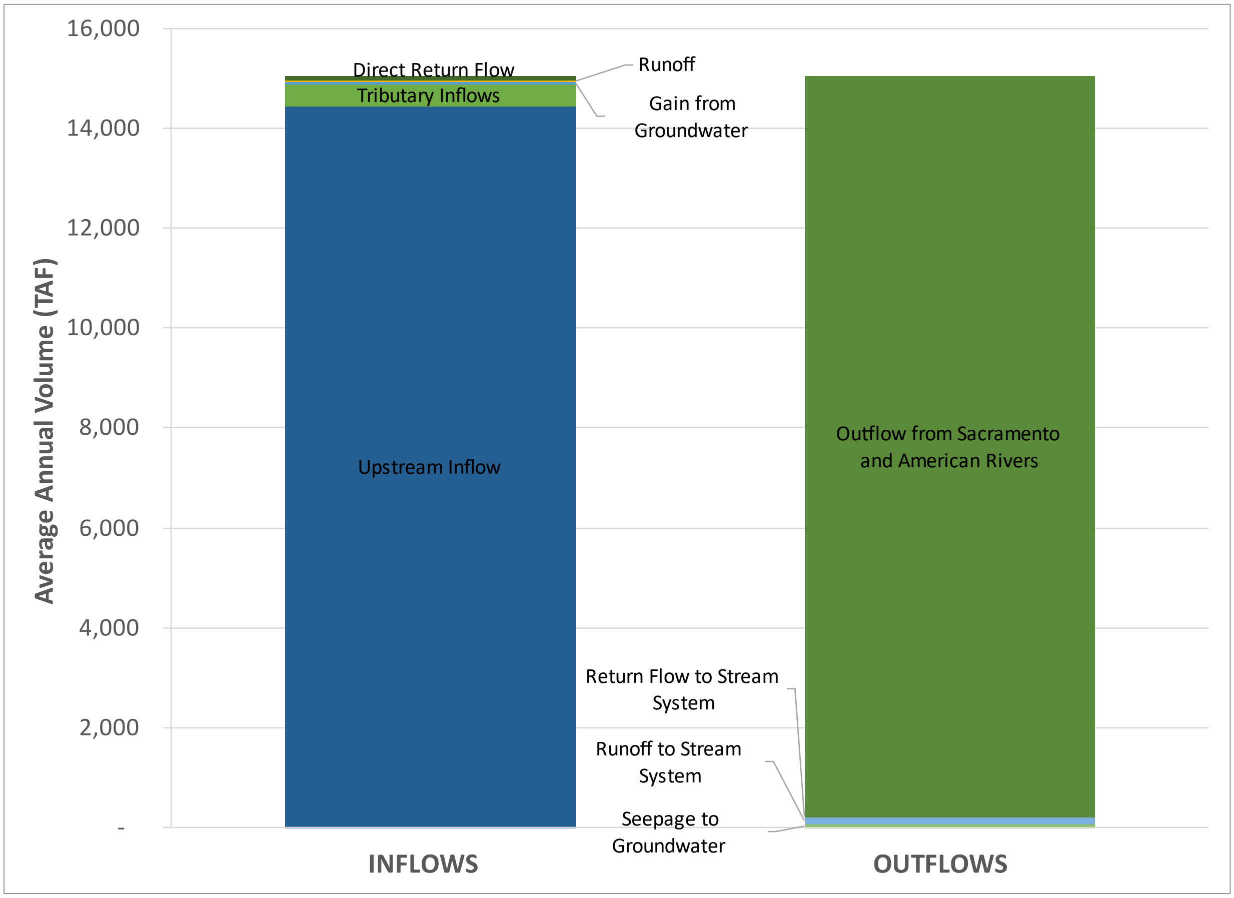


Figure 6-12. Average Annual Projected with Climate Change Water Budget – Stream and Canal Systems, North American Subbasin

The Projected Conditions Baseline with Climate Change land surface water budget shows annual inflows of 1,302,900 AFY, including 592,800 AFY of precipitation and 710,100 AFY of applied water (372,700 AFY of surface water and 337,400 AFY of groundwater). Balancing the projected land surface water budget is 1,302,900 AFY of outflows including evapotranspiration (544,600 AFY), surface runoff to the stream system (358,400 AFY), return flow to the stream system (231,700 AFY), deep percolation (161,000 AFY), and other flows (7,200 AFY). A summary of these flows can be seen below in **Figure 6-13**.

With land use conditions the same between the Projected Conditions Baseline and the Projected Conditions Baseline with Climate Change, the differences between the two associated land surface systems water budgets are the result of climate change hydrology. The substantial change in the budget is an increase in agricultural evapotranspiration. This results in an increase in irrigation needs for agricultural lands and an associated increase in agricultural groundwater production.

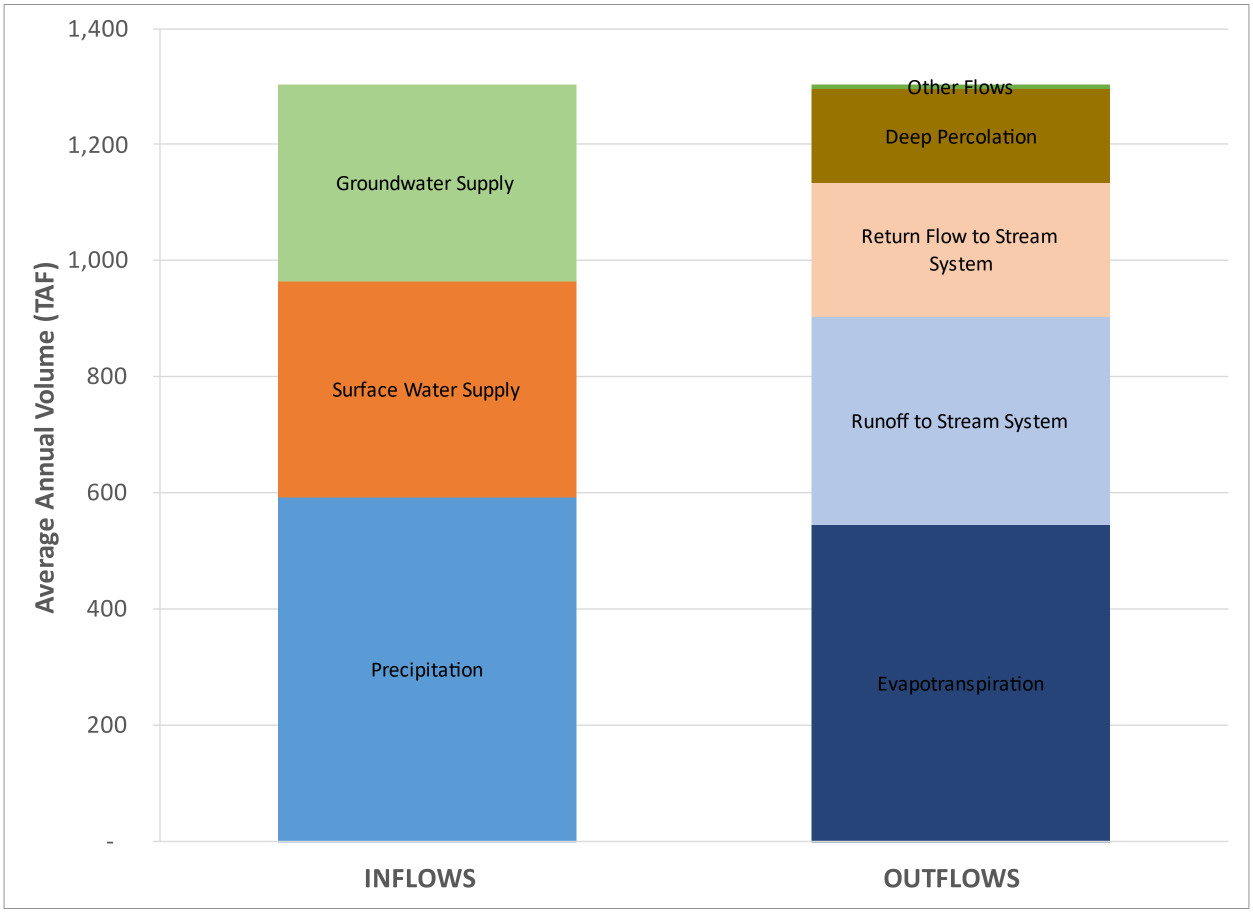


Figure 6-13. Average Annual Projected with Climate Change Water Budget – Land Surface System, North American Subbasin

Over the simulation period, the Projected Conditions Baseline with Climate Change groundwater budget simulates annual inflows of 399,500 AFY, including 161,000 AFY of deep percolation, 163,700 AFY of stream seepage, subsurface inflows totaling 56,300 AFY, groundwater injection of 2,100 AFY, and other recharge of 16,400 AFY (which is primarily canal system seepage).

In contrast to the projected, current, and historical water budgets, average aquifer outflows exceed the inflows in the Projected Conditions Baseline with Climate Change water budget. Groundwater production (345,100 AFY) remains the largest point of aquifer discharge, with losses to the local stream system (41,500 AFY), and subsurface outflows (16,300 AFY) bringing the total system outflows to 403,000 AFY.

The NASb Projected Conditions Baseline with Climate Change water budget has an average annual decline in groundwater storage of about 3,500 AFY. **Figure 6-14** summarizes the average groundwater inflows and outflows in the NASb in the projected with climate change water budget.

Similar to the land surface system water budget, the groundwater system budget shows the influences of climate change when compared to the projected groundwater budget. Changes are largely the result of increased agricultural pumping resulting from climate-related increases in evapotranspiration and associated demand. This increase in outflow is a large component of increased stream losses, which is the largest change to inflows and is primarily the result of lowered groundwater levels near the rivers and streams due primarily to increased pumping and decreased deep percolation.

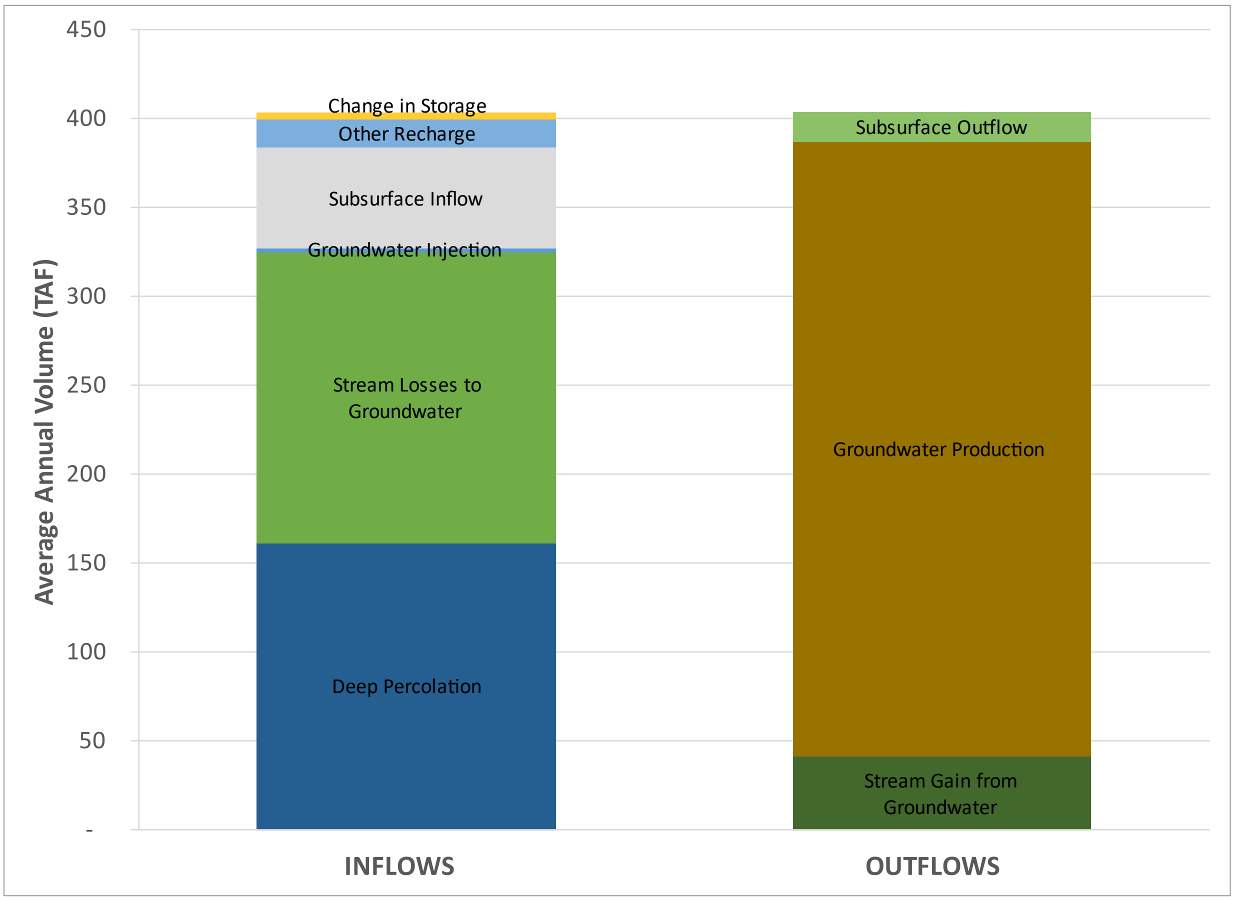


Figure 6-14. Average Annual Projected with Climate Change Water Budget – Groundwater System, North American Subbasin

6.9 Sustainable Yield Estimate

Sustainable yield is defined by the SGMA as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result." (California Water Code Section 10721(w)) In short, sustainable yield is the amount of groundwater that can be withdrawn on a long-term average basis without causing undesirable results. The value is intended to assist in identifying projects and management actions needed to achieve sustainability, if any. Note that SGMA does not incorporate sustainable yield estimates directly into the sustainable management criteria, which are the regulatory drivers of SGMA. Basinwide pumping within the sustainable yield estimate is neither a measure of, nor proof of, sustainability. Sustainability under SGMA is only demonstrated by avoiding undesirable results for the sustainability indicators (DWR, 2017).

For the NASb, the sustainable yield was estimated by identifying a level of pumping that would result in no long-term change in groundwater in storage and then verifying that this level of pumping would avoid undesirable results. This approach was selected for two primary reasons:

- Current levels of storage and current groundwater levels are broadly considered satisfactory by stakeholders and are not known to have caused significant and unreasonable conditions. Thus, maintenance of these conditions, on a subbasin scale, is a desired outcome.

- Minimum thresholds for groundwater levels and depletions of interconnected surface water, discussed later in **Section 8 – Sustainable Management Criteria**, are defined based wholly or partly on CoSANA-simulated conditions using the same modeling simulation showing zero change in storage. Simulated groundwater levels do not go below the minimum thresholds. Thus, management of pumping using the long-term sustainable yield volume is expected to prevent undesirable results for these sustainability indicators.

Pumping that achieves zero change in storage can be estimated through the sum of pumping and change in storage. A positive change in storage suggests that more pumping is possible to achieve zero change in groundwater in storage, while a negative change in storage suggests that less pumping is necessary to achieve zero groundwater in storage. Due to the complexities of groundwater systems, this method is most accurate when change in storage is small, as the relationship between change in storage and additional pumping is not one-to-one. Modeling of projected conditions with both climate change and projects and management actions estimated total NASB groundwater pumping as 336,000 AFY and an associated change in groundwater in storage of 0 AFY. With simulated zero change in storage, no additions or subtractions for storage change are necessary from the 336,000 AFY of pumping, which is thus the estimated volume of pumping that would result in zero change in storage. This value, like others in the GSP, may be updated in the future based on new information or new conditions in the Subbasin.

7. Monitoring Networks

The Subbasin has a well-established groundwater-level monitoring program that consists of dedicated monitoring, irrigation, and residential wells. Wells in the monitoring network include CASGEM program wells, ILRP-designated wells along with monitoring wells constructed by SAFCA and a few wells constructed by agencies and private entities to assess water quality near areas with releases of contaminants to the environment. They are monitored by various agencies including each of the GSAs, DWR, USGS, and consultants. Groundwater quality is monitored as part of compliance with drinking water standards and the ILRP.

Representative monitoring wells were selected from these monitoring networks to assess groundwater levels and water quality as related to the SGMA sustainability indicators. The representative monitoring well network includes those wells that will be used to track changes for each of the sustainability indicators in the Subbasin to assess short- and long-term trends for lowering of groundwater levels, reduction in storage, depletion of interconnected surface water, subsidence and water quality degradation. A monitoring network was not selected for sea water intrusion, as it is not likely to occur in the future (*refer to* **Section 5.9 – Seawater Intrusion** for further details).

Representative monitoring wells are discussed for each of the sustainability indicators in the following sections along with evidence that the wells are reflective of conditions in the principal aquifer.

7.1 Objectives

The objectives of the monitoring networks are to provide access to measure groundwater conditions that are representative of conditions throughout the Subbasin. The objectives of the monitoring well network is to:

- Have monitoring wells distributed throughout the Subbasin to assess changes in conditions and to determine if management actions are required
- Use dedicated monitoring wells, with known construction details, that will be present for the next 20 years and beyond, and that will provide measurements that are reflective of regional conditions
- Provide measurements of the groundwater conditions to demonstrate if the Subbasin is being sustainably managed within the locally established minimum thresholds and measurable objectives

- Provide measurements for future refinements of the groundwater model and water budgets
- Assess whether the pumping depression in the central area is deepening or expanding
- Track groundwater levels near surface water bodies to limit depletion and effects on groundwater dependent ecosystems (GDEs)
- Track and reduce the potential for land subsidence to occur
- Monitor groundwater quality to ensure it is not being degraded due to use of groundwater, projects, or management actions

To meet the monitoring objectives, groundwater levels and quality will be measured and compared to established minimum thresholds and measurable objectives to assess the groundwater conditions in the Subbasin and monitor progress toward achieving sustainable conditions. Monitoring protocols are provided, in detail, and that when followed, will ensure accurate and repeatable measurements.

The following sections provide a description of the 1) entire monitoring network, 2) selected representative monitoring well network along with its justification, and 3) frequency of measurement for each of the sustainability indicators.

7.2 Monitoring Network

The groundwater level monitoring network has changed over the years with a reduction in the number of production wells used for monitoring and movement towards dedicated monitoring wells.

The Subbasin has about 160 wells that are currently used to monitor groundwater levels, and most have known well construction details or at least the total constructed depth. **Table 7-1** summarizes the types of wells. Most of the 160 wells are dedicated monitoring wells. The locations of these wells are shown on **Figure 7-1.** There are over 100 nested and clustered monitoring wells that can be used to assess vertical groundwater gradients. These nested and clustered wells are located at over 30 sites distributed throughout the Subbasin and have been assigned a single map number to simplify the plotting of wells (**Figure 7-1** and subsequent figures). **Table 7-2** contains monitoring well attributes, well type, monitoring frequency, and other pertinent details. The table also lists wells currently being monitored and those that are no longer being monitored or are not recommended for monitoring. The monitoring well network is sufficient to monitor and demonstrate groundwater occurrence and flow directions, both horizontal and vertical gradients, and water table levels near surface water.

There are over 80 wells are constructed to shallow depths that are suitable to monitor unconfined groundwater conditions and can be used to evaluate surface water depletion, and groundwater levels near GDEs and domestic wells.

Table 7-1. Summary of Groundwater Level Well Types

Groundwater Level Types of Wells [1]	Number of Wells
Observation (dedicated monitoring wells)	125
Residential	14
Irrigation	20
Additional Information	Number of Wells
Nested or Clustered Monitoring Wells (at 33 sites) [2]	101
Wells with Unknow Construction Details [3]	5
Number of Shallow Wells (<200 feet) [4]	80
Notes: 1 = Only wells actively monitored 2 = Part of observation wells listed above 3 = Part of residential or irrigation wells listed above 4 = Extracted from monitoring, residential, and irrigation wells listed above	

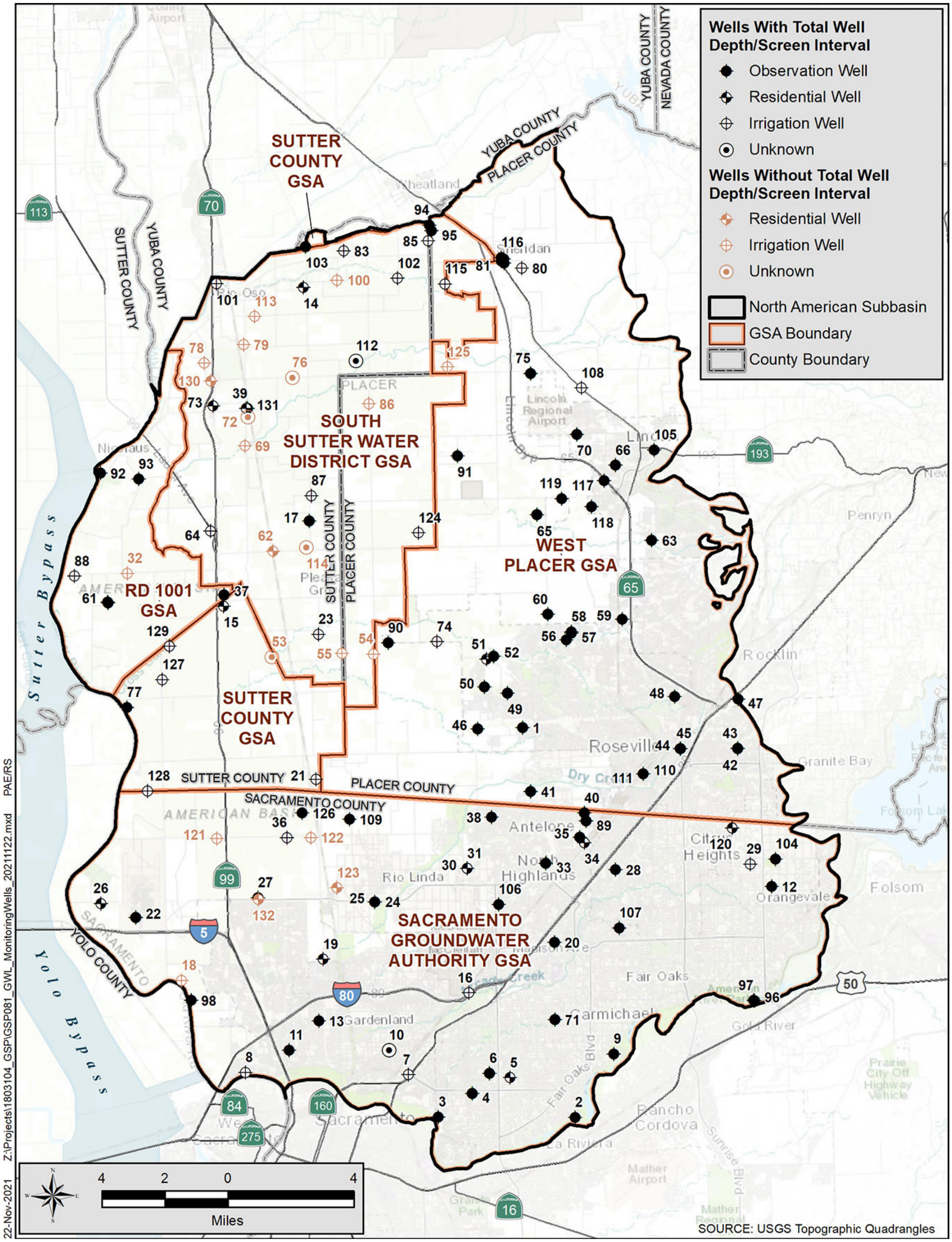


Figure 7-1. Groundwater Level Monitoring Network Wells

Table 7-2. Groundwater Level Monitoring Well Types and Distribution

Map N	CASGEM ID	Local Name	State Well Numb	Latitud	Longitud	Reference Point Elevation (ft	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Ty	Frequency of Monitorin
1	387626N1213651W001	SVMW East-2A		38.76263	-121.3651	126.02	125-135	140	M	Monthly
1	381626N1213651W001	SVMW East-2B		38.76263	-121.3651	125.83	510-520	525	M	Monthly
1	387626N1213651W002	SVMW East-2C		38.76263	-121.3651	125.75	655-665	670	M	Monthly
2	385828N1213385W001	SGA_MW06		38.58281	-121.33846	49.49	62-72	72	M	Monthly
3	385841N1214185W001	SGA_MW04		38.58414	-121.41852	38.69	55-65	65	M	Monthly
4	385947N1213985W001	MW12A		38.59472	-121.39847	41.8	200-280	285	M	Monthly
4	385947N1213985W002	MW12B		38.59472	-121.39847	41.84	360-380	385	M	Monthly
4	385947N1213985W003	MW12C		38.59472	-121.39847	41.82	590-610	615	M	Monthly
4	385947N1213985W004	MW12D		38.59472	-121.39847	41.82	810-840	845	M	Monthly
4	385947N1213985W005	MW12E		38.59472	-121.39847	41.77	960-1000	1005	M	Monthly
5	386016N1213761W001	DWR_SGA_004	09N05E25J001M	38.6016	-121.3761	66.7	Unknown	238	R	Monthly
6	386038N1213882W001	MW11A		38.6038	-121.38815	59.45	167-177	187	M	Monthly
6	386038N1213882W002	MW11B		38.6038	-121.38815	59.41	258-268	278	M	Monthly
6	386038N1213882W003	MW11C		38.6038	-121.38815	59.25	332-365	375	M	Monthly
7	386038N1214357W001	DWR_SGA_005	09N05E28K001M	38.6038	-121.4357	36.84	Unknown	250	I	
8	386061N1215313W001	SCWA_SGA_003	09N04E27F001M	38.6061	-121.5313	27.04	Unknown	320	I	Monthly
9	386117N1213150W001	SCWA_SGA_004	09N06E27D001M	38.6117	-121.315	73.5	Unknown	200	M	Monthly
10	386151N1214467W001	DWR_SGA_003	09N05E21M001M	38.6151	-121.4467	37.14	Unknown	89	U	
11	386160N1215054W001	Bannon Creek Park	09N04E23R002M	38.61603	-121.5054	13.76	33-48	48	M	Monthly
12	386874N1212206W001	SGA_MW09		38.68739	-121.22058	231.27	150-160	160	M	Monthly
13	386292N1214877W001	Chuckwagon Park	09N04E13R001M	38.62921	-121.4877	11.71	27-37	52	M	Monthly
14	389669N1214897W001	13N04E23A002M	13N04E23A002M	38.9669	-121.4897	59.28	56-83	83	R	Monthly
15	388208N1215397W001	11N04E09D002M	11N04E09D002M	38.8208	-121.5397	30.87	Unknown	100	R	
16	386410N1213995W001	DWR_SGA_002	09N05E14B001M	38.641	-121.3995	68.53	Unknown	550	I	Monthly
17	388593N1214885W003	AB-2 shallow	12N04E26J004M	38.8593	-121.4885	52.76	135-145	155	M	Continuous
17	388593N1214885W001	AB-2 deep	12N04E26J002M	38.8593	-121.4885	52.3	670-690	700	M	Continuous
17	388593N1214885W002	AB-2 middle	12N04E26J003M	38.8593	-121.4885	52.63	380-490	500	M	Continuous
18	386489N1215679W001	SCWA_SGA_002	09N04E08L001M	38.6489	-121.5679	27.51	Unknown	Unknown	I	Monthly
19	386576N1214846W001	SCWA_SGA_001	09N04E01R001M	38.6576	-121.4846	22.72	Unknown	17	R	Monthly
20	386635N1213486W001	SGA_MW05		38.66347	-121.34859	121.87	205-215	215	M	Monthly
21	387404N1214870W001		10N04E12A001M	38.7404	-121.487	45.54	Unknown	290	I	Semi-Ann
22	386782N1215943W004	AB-4 shallow	10N04E31M004M	38.6782	-121.5943	18.53	170-190	200	M	Continuous
22	386782N1215943W001	AB-4 deep	10N04E31M001M	38.6782	-121.5943	19.28	1060-1070	1080	M	Continuous
22	386782N1215943W002	AB-4 middle-deep	10N04E31M002M	38.6782	-121.5943	17.51	795-805	815	M	Continuous
22	386782N1215943W003	AB-4 middle-shallow	10N04E31M003M	38.6782	-121.5943	17.98	380-400	410	M	Continuous
23	388072N1214842W001		11N04E13D001M	38.8072	-121.4842	49.96	Unknown	535	I	Semi-Ann
24	386836N1214536W001	SGA_MW02		38.68362	-121.45363	52.39	100-110	110	M	Monthly
25	386836N1214536W002	SGA_MW03		38.68356	-121.45362	51.82	285-305	305	M	Monthly
26	386848N1216146W001	SCWA_SGA_005	10N03E35A001M	38.6848	-121.6146	23.09	Unknown	96	R	Monthly
27	386864N1215222W003	AB-3 shallow	10N04E27R004M	38.6864	-121.5222	28.31	190-210	220	M	Continuous
27	386864N1215222W001	AB-3 deep	10N04E27R002M	38.6864	-121.5222	27.84	745-995	995	M	Continuous
27	386864N1215222W002	AB-3 middle	10N04E27R003M	38.6864	-121.5222	28.09	470-500	500	M	Continuous
28	386964N1213120W001	Twin Creeks Park	10N06E27F001M	38.6964	-121.31203	121.8	183-193	193	M	Monthly
29	386979N1212329W001	SCWA_SGA_012	10N07E29G001M	38.6979	-121.2329	219.57	150-240	240	I	Monthly
30	386982N1213992W001	SCWA_SGA_008	10N05E14Q002M	38.6982	-121.3992	88.51	116-227	227	R	Monthly
31	386982N1213992W002	SCWA_SGA_009	10N05E26B002M	38.6982	-121.3992	83.81	Unknown	150	R	Monthly
32	388361N1215959W001	MLF Well #1	11N03E01D001M	38.83664	-121.59591	24.45	Unknown	Unknown	I	Monthly
33	387000N1213529W001	Monument (A)		38.70005	-121.35288	173.39	226-274	274	M	
33	387000N1213529W002	Monument (B)		38.70005	-121.35288	173.26	324-334	334	M	
33	387000N1213529W003	Monument (C)		38.70005	-121.35288	173.26	380-450	450	M	
33	387000N1213529W004	Monument (D)		38.70005	-121.35288	173.24	498-544	544	M	
34	387092N1213300W001	SCWA_SGA_010	10N06E21F002M	38.7092	-121.33	161.51	Unknown	144	R	Monthly
35	387117N1213327W001	Poker (A)		38.71174	-121.33271	151.74	104-124	134	M	
35	387117N1213327W002	Poker (B)		38.71174	-121.33271	151.77	156-166	176	M	
35	387117N1213327W003	Poker (C)		38.71174	-121.33271	151.76	274-310	320	M	
35	387117N1213327W004	Poker (D)		38.71174	-121.33271	151.75	370-460	470	M	
36	387138N1215047W001	SCWA_SGA_006	10N04E23A001M	38.7138	-121.5047	17.97	Unknown	85	I	Monthly
37	388260N1215394W004	SUT-P1	11N04E04N004M	38.826	-121.5394	32.31	110-120	120	M	Continuous
37	388260N1215394W001	SUT-P4	11N04E04N001M	38.826	-121.5394	31.81	880-890	890	M	Continuous
37	388260N1215394W002	SUT-P3	11N04E04N002M	38.826	-121.5394	31.95	295-305	305	M	Continuous
37	388260N1215394W003	SUT-P2	11N04E04N003M	38.826	-121.5394	32.13	185-195	195	M	Continuous
38	387216N1213842W001	Lone Oak Park	10N05E13F001M	38.72163	-121.38417	105.77	151-161	166	M	Monthly
39	389116N1215238W003	AB-1 shallow	12N04E03N004M	38.9116	-121.5238	50.58	170-180	190	M	Continuous
39	389116N1215238W001	AB-1 deep	12N04E03N001M	38.9116	-121.5238	49.83	950-970	980	M	Continuous
39	389116N1215238W002	AB-1 middle-deep	12N04E03N002M	38.9116	-121.5238	50.23	680-700	710	M	Continuous
39	389117N1215238W001	AB-1 middle-shallow	12N04E03N003M	38.9116	-121.5238	50.37	390-520	530	M	Continuous
40	387228N1213298W001	Antelope North (A)		38.7228	-121.32976	133.68	253-273	283	M	
40	387228N1213298W002	Antelope North (B)		38.7228	-121.32976	133.71	328-468	473	M	
41	387331N1213610W001	WPMW-5A		38.73311	-121.36099	100.42	80-100	100	O	Continuous
41	387331N1213610W002	WPMW-5B		38.73311	-121.36099	100.35	630-650	650	O	Continuous
42	387510N1212390W001	WPMW-8A		38.75099	-121.23895	234.17	30-50	50	O	Continuous
42	387510N1212390W002	WPMW-8B		38.75099	-121.23895	234.09	95-115	115	O	Continuous
43	387512N1212390W001	WPMW-7A		38.75119	-121.239	225.97	35-45	45	O	Continuous
44	387515N1212725W001	WPMW-10A		38.75149	-121.27251	153.21	26-36	36	O	Continuous
44	387515N1212725W002	WPMW-10B		38.75149	-121.27251	153.18	80-100	100	O	Continuous

Map No	CASGEM ID	Local Name	State Well Number	Latitude	Longitude	Reference Point Elevation (ft)	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Frequency of Monitoring
44	387515N1212725W003	WPMW-10C		38.75149	-121.27251	153.12	240-260	260	O	Continuous
45	387517N1212727W001	WPMW-9A		38.75167	-121.27266	154.66	26-36	36	O	Continuous
46	387623N1213915W001	SVMW West - 1A		38.76232	-121.39153	94.25	120-140	145	O	Monthly
46	387623N1213915W002	SVMW West - 1B		38.76233	-121.39153	94.17	535-555	560	O	Monthly
46	387623N1213915W003	SVMW West - 1C		38.76233	-121.39153	94.05	725-745	750	O	Monthly
47	387739N1212382W001	WPMW-6A		38.7739	-121.23818	207.61	35-65	65	O	Continuous
48	387755N1212753W001	WPMW-4A		38.77554	-121.27525	181.67	120-140	145	O	Monthly
48	387755N1212753W002	WPMW-4B		38.77554	-121.27526	181.52	275-295	300	O	Monthly
49	387786N1213737W002	WPMW-1B	11N05E25	38.7786	-121.3737	107.31	460-480	480	O	Monthly
49	387786N1213737W001	WPMW-1A		38.7786	-121.3737	107.83	110-120	120	O	Monthly
49	387786N1213737W003	WPMW-1C		38.7786	-121.3737	106.75	535-545	545	O	Monthly
50	387816N1213870W001	W-77MW-A		38.78158	-121.38702	97.2	486-506	516	O	Monthly
50	387816N1213870W002	W-77MW-B		38.78158	-121.38702	97.2	584-594	604	O	Monthly
51	387943N1213856W001	O'Brien well	11N05E23B001M	38.7943	-121.3856	90.86	Unknown	195	R	
52	387957N1213813W001	CVMW-1A		38.79566	-121.38126	87.11	260-280	285	O	Monthly
52	387957N1213813W002	CVMW-1B		38.79565	-121.38126	86.95	460-490	495	O	Monthly
52	387957N1213813W003	CVMW-1C		38.79566	-121.38126	86.84	565-585	590	O	Monthly
53	387971N1215119W001		11N04E15Q001M	38.7971	-121.5119	35.98	Unknown	Unknown	U	
54	387977N1214521W001		11N05E18R001M	38.7977	-121.4521	64.37	Unknown	Unknown	I	
55	387982N1214704W001		11N04E13R001M	38.7982	-121.4704	53.37	Unknown	Unknown	I	
56	388027N1213384W001	DCMW-3		38.80271	-121.33843	99.82	400-515	520	O	Monthly
57	388058N1213355W001	DCMW-1		38.80576	-121.3355	119.94	320-450	455	O	Monthly
58	388063N1213354W001	DCMW-2		38.80629	-121.33542	120.22	322-432	437	O	Monthly
59	388116N1213054W001	Tinker MW		38.81159	-121.30539	132.2	117-177	177	O	Monthly
60	388145N1213491W001	WPMW-2A		38.8145	-121.34914	108.2	215-225	230	O	Monthly
60	388145N1213491W002	WPMW-2B		38.8145	-121.34914	108.09	400-420	425	O	Monthly
61	388235N1216079W001	Sutter County MW-5A	11N03E02Q002M	38.82324	-121.60763	26.45	130-160	170	O	Continuous
61	388235N1216079W002	Sutter County MW-5B	11N03E02Q003M	38.82324	-121.60763	26.28	655-675	675	O	Continuous
61	388235N1216079W003	Sutter County MW-5C	11N03E02Q004M	38.82324	-121.60763	26.22	910-920	930	O	Continuous
61	388235N1216079W004	Sutter County MW-5D	11N03E02Q005M	38.8235	-121.6079	26.12	1205-1215	1225	O	Continuous
62	388458N1215100W001		12N04E34H001M	38.8458	-121.51	42.83	Unknown	Unknown	R	
63	388476N1212872W001	WPMW-3A		38.84761	-121.28719	150.95	48-53	53	O	Monthly
63	388476N1212872W002	WPMW-3B		38.84761	-121.28719	150.34	130-140	140	O	Monthly
64	388555N1215468W001		12N04E29J001M	38.8555	-121.5468	34.84	Unknown	285	I	
65	388604N1213544W003	MW 1-3		38.86038	-121.35438	113.81	184-204	204	O	Monthly
65	388604N1213544W001	MW 1-1		38.86038	-121.35438	113.6	378-398	398	O	Monthly
65	388604N1213544W002	MW 1-2		38.86038	-121.35438	113.76	298-318	318	O	Monthly
65	388604N1213544W004	MW 1-4		38.86038	-121.35438	113.61	82-92	92	O	Monthly
66	388826N1213078W001	MW 5-1		38.88258	-121.30775	148.7	80-100	100	O	Monthly
66	388826N1213078W002	MW 5-2		38.88258	-121.30775	148.65	52-62	62	O	Monthly
69	388944N1215257W001		12N04E16A004M	38.8944	-121.5257	42.82	Unknown	Unknown	I	
70	388971N1213301W001	MW 3-1		38.89713	-121.33008	130.5	118-133	133	O	Monthly
70	388971N1213301W002	MW 3-2		38.89713	-121.33008	130.5	65-75	75	O	Monthly
71	386280N1213493W001	WCMSS		38.62799	-121.34925	90.74	130-150	170	O	Monthly
71	386280N1213493W002	WCMSM		38.62799	-121.34925	90.53	230-270	290	O	Monthly
71	386280N1213493W003	WCMSD		38.62799	-121.34925	90.23	490-510	530	O	Monthly
72	389075N1215237W001		12N04E10D002M	38.9075	-121.5237	51.32	Unknown	Unknown	U	
73	389130N1215441W001		12N04E05R004M	38.913	-121.5441	44.32	Unknown	90	R	Semi-Ann
74	388029N1214145W001		11N05E16H001M	38.8029	-121.4145	90.36	135-460	460	I	Semi-Ann
75	389255N1213566W003	MW 2-3		38.92547	-121.35663	127.67	75-85	85	O	Monthly
75	389255N1213566W002	MW 2-2		38.92547	-121.35663	127.67	160-170	170	O	Monthly
75	389255N1213566W001	MW 2-1		38.92547	-121.35663	127.7	290-310	310	O	Monthly
76	389255N1214969W001		13N04E35Q002M	38.9255	-121.4969	57.9	Unknown	Unknown	U	
77		SREL-1-27-F1		38.77491	-121.59754		Unknown	46.32	O	Continuous
78	389328N1215489W001		13N04E32G001M	38.9328	-121.5489	48.32	Unknown	Unknown	I	
79	389410N1215254W001		13N04E28R001M	38.941	-121.5254	51.31	Unknown	Unknown	I	
80	389740N1213606W001	Cemetery		38.97403	-121.36062	135.28	70-111	111	I	Monthly
81	387432N1215588W001	MW 1		38.97846	-121.37132	109.71	30-40	40	O	Monthly
81	389764N1213710W001	MW-2		38.97643	-121.371	113.69	24.3-44.3	45	O	Monthly
81	389774N1213728W001	MW-3		38.97741	-121.37284	103.41	19.5-34.5	35	O	Monthly
82	387222N1212920W001	Whyte A		38.722168	-121.29196	167.31	200-220	226	O	Monthly
82	387222N1212920W002	Whyte B		38.722168	-121.29196	167.35	280-300	306	O	Monthly
83	389834N1214655W001	South Sutter WD	13N05E18C001M	38.9834	-121.4655	71.85	Unknown	210	I	Semi-Ann
84	389867N1213654W002	Spencer (SVWQC00008)		38.986724	-121.36542	134.5	96-107	107	R	Monthly
85	389873N1214156W001	13N05E09R001M	13N05E09R001M	38.9873	-121.4156	86	Unknown	150	I	Semi-Ann
86	389128N1214522W001		12N05E06R001M	38.9128	-121.4522	71.3	Unknown	Unknown	I	
87	388710N1214870W001		12N04E24M002M	38.871	-121.487	54.32	Unknown	340	I	Semi-Ann
88	388357N1216273W001		11N03E03C002M	38.8357	-121.6273	28.79	Unknown	97	I	Semi-Ann
89		Roseview Park - 315		38.71912	-121.32879	156.84	295-305	315	O	Monthly
89		Roseview Park - 370		38.71912	-121.32879		350-360	370	O	Monthly
89		Roseview Park - 465		38.71912	-121.32879	156.76	445-455	465	O	Monthly
90	388026N1214432W002	WPMW-12A	11N05E17	38.80264	-121.44322	69.62	260-280	300	O	Continuous
90	388026N1214432W004	WPMW-12B	11N05E17	38.80264	-121.44322	69.57	508-528	550	O	Continuous
91	388882N1214005W002	WPMW-11A	12N05E15	38.88816	-121.40046	92.07	132-152	162	O	Continuous
91	388882N1214005W004	WPMW-11B		38.88816	-121.40046	91.7	264-304	309	O	Continuous
92		RDMW-101		38.88294	-121.61105	30.18	28-43	48	O	Continuous

Map N	CASGEM ID	Local Name	State Well Numb	Latitud	Longitud	Reference Point Elevation (ft	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Ty	Frequency of Monitorin
92		RDMW-101		38.88294	-121.61105	30.18	28-43	48	O	Continuous
93		RDMW-102		38.87987	-121.58853	30.47	28-43	48	O	Continuous
94	389950N1214148W002	RDMW-103	13N05E10	38.99461	-121.41479	89.38	28-43	48	O	Continuous
95	389919N1214141W002	RDMW-104	13N05E10	38.99195	-121.4135	87.68	28-43	48	O	Continuous
96		1516		38.63487	-121.23192	88.38	13-33	40	O	Continuous
97		1518		38.63513	-121.23231	130.71	55-75	80	O	Continuous
98		URS71000-700+00C		38.6397	-121.56244	41.7	Unknown	45.24	O	Continuous
99		URS71000-700+00F		38.63954	-121.56154	24.2	Unknown	45.14	O	
100		13N04E13R001M	13N04E13R001M	38.97	-121.4697	71.57	Unknown	Unknown	I	
101		13N04E16N001M	13N04E16N001M	38.9692	-121.5408		Unknown	500	I	Semi-Ann
102	389704N1214340W001	13N05E17R001M	13N05E17R001M	38.9704	-121.434		Unknown	480	I	Semi-Ann
103	389857N1214880W001	BR-1B	13N04E11R002M	38.9857	-121.488		78-98	98	O	Continuous
103	389857N1214880W004	BR-1A	13N04E11R005M	38.9857	-121.488		28-48	48	O	Continuous
103	389857N1214880W002	BR-1C	13N04E11R003M	38.9857	-121.488		215-245	245	O	Continuous
103	389857N1214880W003	BR-1D	13N04E11R004M	38.9857	-121.488		320-331	331	O	Continuous
104	387000N1212180W001	SGA_MW08		38.69998	-121.21795	218.06	130-140	140	O	Monthly
105	388893N1212847W001	MW 4		38.88928	-121.28468	183.87	15-25	25	O	Monthly
106	386814N1213809W001	MW-15	09N06E06A001M	38.68144	-121.38093		205-481	486	O	Monthly
107	386697N1213106W001	MW-N28	09N06E03C001M	38.66967	-121.31058		170-452	454	O	Monthly
108	389185N1213268W001	Swainson		38.91846	-121.32684	140.65	44.1-91.9	92	I	Monthly
109	387218N1214677W001	SGA_MW01		38.72178	-121.46771	47.59	100-110	110	O	Monthly
110		Dpool A		38.74034	-121.29462		190-210	245	O	Monthly
111		Dpool B		38.74034	-121.29462		310-330	336	O	Monthly
112	389327N1214594W001		13N05E31K001M	38.9327	-121.4594	70.29	Unknown	393	U	
113	389539N1215186W001		13N04E27C003M	38.9539	-121.5186	54.47	Unknown	Unknown	I	
114	388473N1214905W001	12N04E35H001M	12N04E35H001M	38.8473	-121.4905	50.73	Unknown	Unknown	U	
115	389674N1214063W001		13N05E22C003M	38.9674	-121.4063		Unknown	400	I	
116	389791N1213727W001	Old Well #2	13N05E13D003M	38.97913	-121.37269	107	144-209	209	O	Monthly
117	388755N1213144W001	SLC-1		38.87548	-121.3144	145	142-249	249	O	Monthly
118	388637N1213222W001	SLC-2		38.86373	-121.32218	126.47	144-293	293	O	Monthly
119	388677N1213397W001	SLC-3		38.86768	-121.33973	117.98	132-311	311	O	Monthly
120	387141N1212431W001	SCWA_SGA_011	10N07E20D001M	38.71469	-121.2431	207.57	Unknown	185	R	Monthly
121	387139N1215459W001	10N04E21B002M	10N04E21B002M	38.7139	-121.5459	18.97	Unknown	Unknown	I	Semi-Ann
122	387137N1214906W001	SCWA_SGA_007	10N04E24B001M	38.7137	-121.4906	30.17	Unknown	Unknown	I	Monthly
123	386904N1214757W001	10N05E30L001M	10N05E30L001M	38.6904	-121.4757	38.99	Unknown	Unknown	R	Semi-Ann
124	388531N1214244W001		12N05E33C001M	38.8531	-121.4244	69.33	Unknown	610	I	
125	389292N1214056W001	35633	13N05E34P001M	38.9292	-121.4056	89.3	Unknown	Unknown	I	
126	384330121293901		10N04E13F001M	38.72512	-121.49544	22	Unknown	50	O	Monthly
127	387874N1215764W001	Spangler		38.7874	-121.5764	27	150-170	252	I	Monthly
128	387363N1215862W001	TNBC Atkinson		38.73631	-121.5862	31.39	110-288	288	I	Semi-Ann
129	388028N1215720W001	TNBC Lucich North		38.8028	-121.57205	28.91	150-160	226	I	Semi-Ann
129	388028N1215720W001	TNBC Lucich North		38.8028	-121.57205	28.91	150-160	226	I	Semi-Ann

Notes: Wells destroyed, no longer monitored or not recommended for monitoring

O = observation well (dedicated monitoring well)

I = irrigation well

R = residential well

U = unknown

7.3 Representative Monitoring Network

Representative monitoring wells were selected to represent general conditions for areas within the Subbasin for each of the sustainability indicators and where minimum thresholds and measurable objectives will be established. Monitoring will continue at the monitoring network wells for a more thorough analysis of conditions and groundwater contour development. Representative monitoring networks are discussed by sustainability indicators in the following sections along with evidence that the locations reflect general conditions in the areas.

The entire monitoring well network (*refer to* **Figure 7-1**) was evaluated and a subset of the monitoring sites were selected to be representative of the groundwater level conditions in the Subbasin.

Criteria considered for selecting representative monitoring wells included:

- Dedicated monitoring wells were selected over voluntary wells which may be being used for water supply and measurements may be affected by pumping.
- Wells with known construction details or at least the total depth.
- Wells near sensitive beneficial users (e.g., GDEs, domestic wells, and wells in areas solely supplied by groundwater). Protection of these sensitive beneficial users would then be protective of agriculture and municipal beneficial users as their wells are typically deeper.
- Ability to monitor the pumping depression depth and extent.
- Wells that are constructed to similar depths as beneficial users.
- A geographic distribution of monitoring wells over the entire Subbasin.

The selection criteria were used to select a representative monitoring network. **Figure 7-2** illustrates the selected groundwater level representative monitoring wells for chronic lowering of groundwater levels, reduction in groundwater storage and for surface water depletion and their geographic distribution in the Subbasin. Monitoring wells were not selected in the area north or Lincoln and east of Old Highway 65 because this area has perched groundwater resting on top of marine deposits. Table 7-3 provides a list of the representative monitoring wells, their construction details and their purpose for monitoring.

Representative monitoring wells for chronic lowering of groundwater levels were selected based on sensitive beneficial users (GDEs and domestic wells), areas that rely on groundwater and a few supplemental wells to provide complete coverage over the Subbasin. Figures 7-3 through 7-7 illustrate the distribution of the groundwater level representative monitoring wells as they relate to these beneficial users and are discussed in more detail in the following sections.

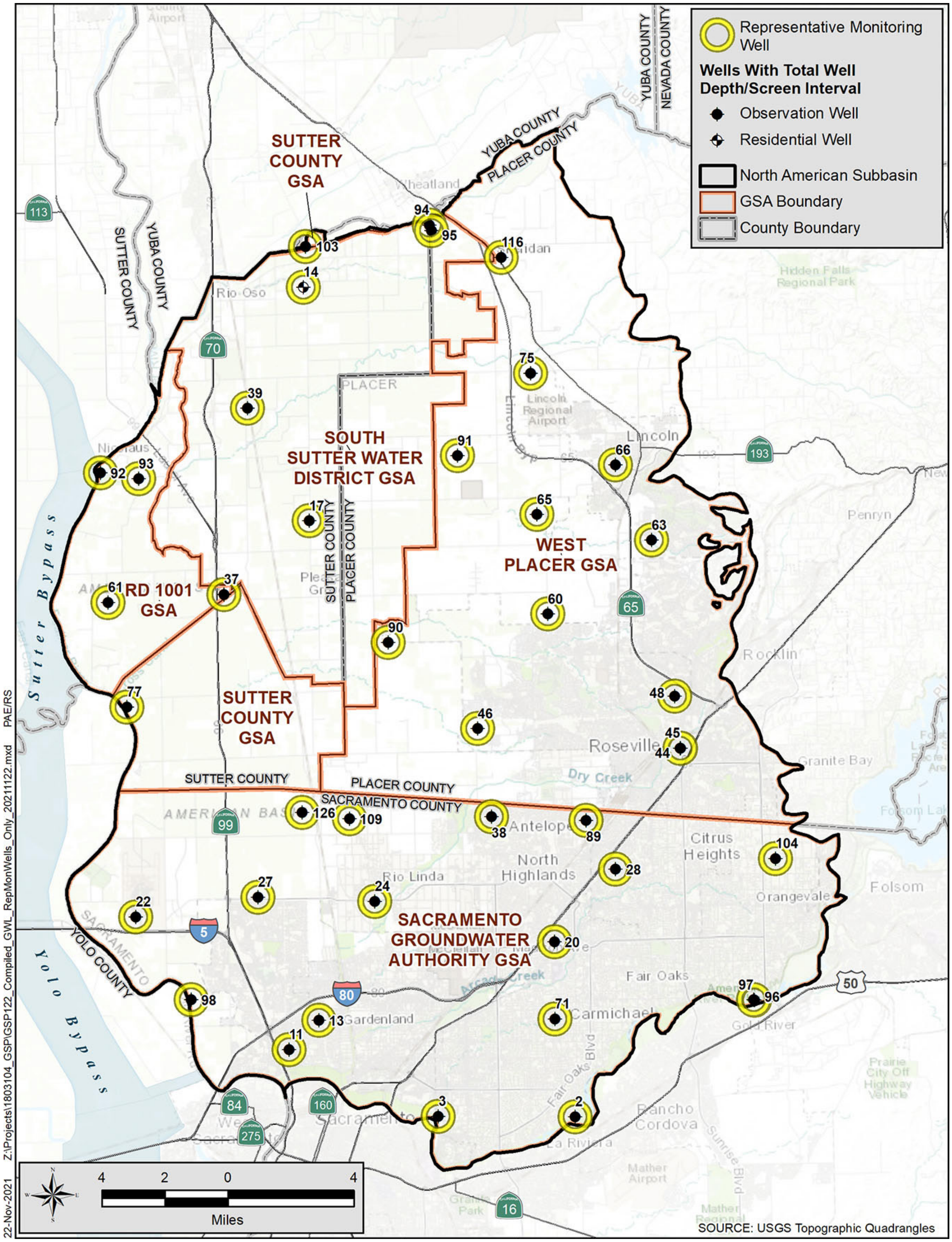


Figure 7-2. Representative Groundwater Level Monitoring Wells

This page left intentionally blank

Table 7-3. Representative Groundwater Level Monitoring Wells

Map No.	CASGEM ID	Local Name	State Well Number	Latitude	Longitude	Reference Point Elevation (ft)	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Frequency of Monitoring	GDE Representative Wells	Domestic Well Density Representative Wells	Areas Solely Reliant on Groundwater Representative Wells	Surface Water Depletion
2	385828N1213385W001	SGA_MW06		38.58281	-121.33846	49.49	62-72	72	O	Monthly		X		X
3	385841N1214185W001	SGA_MW04		38.58414	-121.41852	38.69	55-65	65	O	Daily	X	X		X
11	386160N1215054W001	Bannon Creek Park	09N04E23R002M	38.61603	-121.5054	13.76	33-48	48	O	Monthly	X	X		X
13	386292N1214877W001	Chuckwagon Park	09N04E13R001M	38.62921	-121.4877	11.71	27-37	52	O	Monthly		X		X
14	389669N1214897W001	13N04E23A002M	13N04E23A002M	38.9669	-121.4897	59.28	56-83	83	R	Semi-Annual	X			X
17	388593N1214885W003	AB-2 shallow	12N04E26J004M	38.8593	-121.4885	52.76	135-145	155	O	Daily		X		
20	386635N1213486W001	SGA_MW05		38.66347	-121.34859	121.87	205-215	215	O	Semi-Annual		X		
22	386782N1215943W004	AB-4 shallow	10N04E31M004M	38.6782	-121.5943	18.53	170-190	200	O	Daily	X	X		X
24	386836N1214536W001	SGA_MW02		38.68362	-121.45363	52.39	100-110	110	O	Monthly		X	X	
27	386864N1215222W003	AB-3 shallow	10N04E27R004M	38.6864	-121.5222	28.31	190-210	220	O	Daily				X
28	386964N1213120W001	Twin Creeks Park	10N06E27F001M	38.6964	-121.31203	121.8	183-193	193	O	Monthly		X		
37	388260N1215394W004	SUT-P1	11N04E04N004M	38.826	-121.5394	32.31	110-120	120	O	Daily	X			X
38	387216N1213842W001	Lone Oak Park	10N05E13F001M	38.72163	-121.38417	105.77	151-161	166	O	Monthly		X		
39	389116N1215238W003	AB-1 shallow	12N04E03N004M	38.9116	-121.5238	50.58	170-180	190	O	Daily	X	X	X	X
44	387515N1212725W001	WPMW-10A		38.75149	-121.27251	153.21	26-36	36	O	Daily	X			X
45	387517N1212727W001	WPMW-9A		38.75167	-121.27266	154.66	26-36	36	O	Daily				X
46	387623N1213915W001	SVMW West - 1A		38.76232	-121.39153	94.25	120-140	145	O	Monthly			X	
48	387755N1212753W001	WPMW-4A		38.77554	-121.27525	181.67	120-140	145	O	Monthly	X			
60	388145N1213491W001	WPMW-2A		38.8145	-121.34914	108.2	215-225	230	O	Monthly			X	
61	388235N1216079W001	Sutter County MW-5A	11N03E02Q002M	38.82324	-121.60763	26.45	130-160	170	O	Daily	X			X
63	388476N1212872W001	WPMW-3A		38.84761	-121.28719	150.95	48-53	53	O	Monthly				X
65	388604N1213544W003	MW 1-3		38.86038	-121.35438	113.81	184-204	204	O	Monthly		X	X	
66	388826N1213078W002	MW 5-2		38.88258	-121.30775	148.65	52-62	62	O	Monthly		X		X
71	386280N1213493W001	WCMSS		38.62799	-121.34925	90.74	130-150	170	O	Monthly		X		
75	389255N1213566W003	MW 2-3		38.92547	-121.35663	127.67	75-85	85	O	Monthly			X	X
77		SREL-1-27-F1		38.77491	-121.59754		Unknown	46	O	Daily	X			X
89		Roseview Park - 315		38.71912	-121.32879	156.84	295-305	315	O	Monthly		X		
90	388026N1214432W002	WPMW-12A	11N05E17	38.80264	-121.44322	69.62	260-280	300	O	Daily			X	
91	388882N1214005W002	WPMW-11A	12N05E15	38.88816	-121.40046	92.07	132-152	162	O	Daily		X	X	
92		RDMW-101		38.88294	-121.61105	30.18	28-43	48	O	Daily				X
93		RDMW-102		38.87987	-121.58853	30.47	28-43	48	O	Daily	X			X
94	389950N1214148W002	RDMW-103	13N05E10	38.99461	-121.41479	89.38	28-43	48	O	Daily				X
95	389919N1214141W002	RDMW-104	13N05E10	38.99195	-121.4135	87.68	28-43	48	O	Daily	X			X
96		1516		38.63487	-121.23192	88.38	13-33	40	O	Daily				X
97		1518		38.63513	-121.23231	130.71	55-75	80	O	Daily				X
98		URS71000-700+00C		38.6397	-121.56244	41.7	Unknown	45	O	Daily				X
103	389857N1214880W001	BR-1B	13N04E11R002M	38.9857	-121.488	65.57	78-98	98	O	Daily	X	X		X
104	387000N1212180W001	SGA_MW08		38.69998	-121.21795	218.06	130-140	140	O	Semi-Annual		X		
109	387218N1214677W001	SGA_MW01		38.72178	-121.46771	47.59	100-110	110	O	Semi-Annual		X	X	
116	389791N1213727W001	Old Well #2	13N05E13D003M	38.97913	-121.37269	107	144-209	209	O	Semi-Annual		X	X	
126	384330121293901	10N04E13F001M	10N04E13F001M	38.72512	-121.49544	22	Unknown	50	O	Monthly	X			

Notes: O = Monitoring well
R = Residential well

This page intentionally left blank

7.4 Chronic Lowering of Groundwater Levels

The Subbasin has a long history of groundwater management and has developed an extensive groundwater monitoring network capable of collecting data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the Subbasin and to evaluate changing conditions. Representative wells have been selected to demonstrate groundwater occurrence, flow directions, and hydraulic gradients within the Subbasin.

Declining groundwater levels in the Subbasin have been a concern for local water resource managers for decades. Groundwater levels were dropping on a long-term average of about 3 feet per year for several decades prior to 1980 (refer to Section 5.2 – Groundwater Levels). A cone of depression formed in the center of the Subbasin that, although it is smaller than it once was, it still remains. The current state of this depression is a substantial improvement over the situation in the mid-1990s when the depth to groundwater at the center of the depression was about 20 feet deeper than it is now. This improvement is largely the result of local groundwater management, especially conjunctive use operations. Groundwater levels along the western and eastern portions of the Subbasin have remained stable for nearly 100 years.

Currently, the groundwater depression is being managed to benefit the groundwater cleanup efforts associated with groundwater contamination at the former McClellan AFB. The depression has benefits to water resources management as it can be used to store groundwater (groundwater banking). In general, the remainder of the Subbasin does not show distinctive regional groundwater elevation patterns other than to mimic the local topography. This results in groundwater generally flowing from the edges of the Subbasin from the east and west towards the central groundwater depression.

7.4.1 GDE Representative Monitoring Network

Representative groundwater level monitoring wells were selected to be protective of GDEs. **Section 5.12 – Groundwater Dependent Ecosystems** provide details of the evaluation of the process to refine potential GDEs to those that are likely to be supported by groundwater from the principal aquifer. Since GDEs in the Subbasin typically have shallow rooting depths (less than 30 feet), representative monitoring wells were selected near likely GDEs that monitor water table conditions (wells with depths less than 200 feet). **Figure 7-3** show the locations of likely and less likely GDEs and selected representative shallow monitoring wells in the Subbasin. A 3-mile radius around each well is also shown to approximate a minimum density of about three monitoring wells per 100 square miles, to illustrate whether there is sufficient monitoring coverage. **Table 7-3** provides a list of the representative monitoring wells, their screen intervals, and well depths.

7.4.2 Domestic Well Representative Monitoring Network

Representative groundwater level monitoring wells were also selected to be protective of domestic well owners. Selected representative monitoring wells have similar or shallower depths as the domestic wells and are located near high densities of domestic wells. Representative wells were also selected to provide coverage throughout the Subbasin where lower densities of domestic wells are present. **Figure 7-4** shows the density of the domestic wells in the Subbasin and locations of selected representative monitoring wells. A 3-mile radius around each monitoring well is shown to illustrate the Subbasin has an adequate monitoring network for this beneficial user. Representative monitoring wells listed in **Table 7-3** were selected with similar or shallower depths as the shallowest top of well screens in domestic wells. **Figure 7-5** provides the top of domestic well screen depths and the locations of the representative monitoring wells, which along with **Table 7-3** illustrates the selected monitoring wells are representative for domestic wells.

Figure 7-6 shows domestic well minimum depths (DWR, 2019) in comparison to both agriculture and municipal well depths using DWR's database to illustrate that selection of representative monitoring wells for domestic wells would be protective of municipal and agricultural wells, which are typically deeper than domestic wells.

7.4.3 Groundwater Only Area Representative Monitoring Network

Some portions of the Subbasin rely solely on groundwater as their source of water (**Figure 7-7**). **Table 7-3** lists these selected representative wells. Representative monitoring wells were selected in these areas to be protective of domestic and irrigation wells owners. The approach to select representative monitoring wells for these areas was the same as used for selection of representative monitoring wells for domestic well owners.

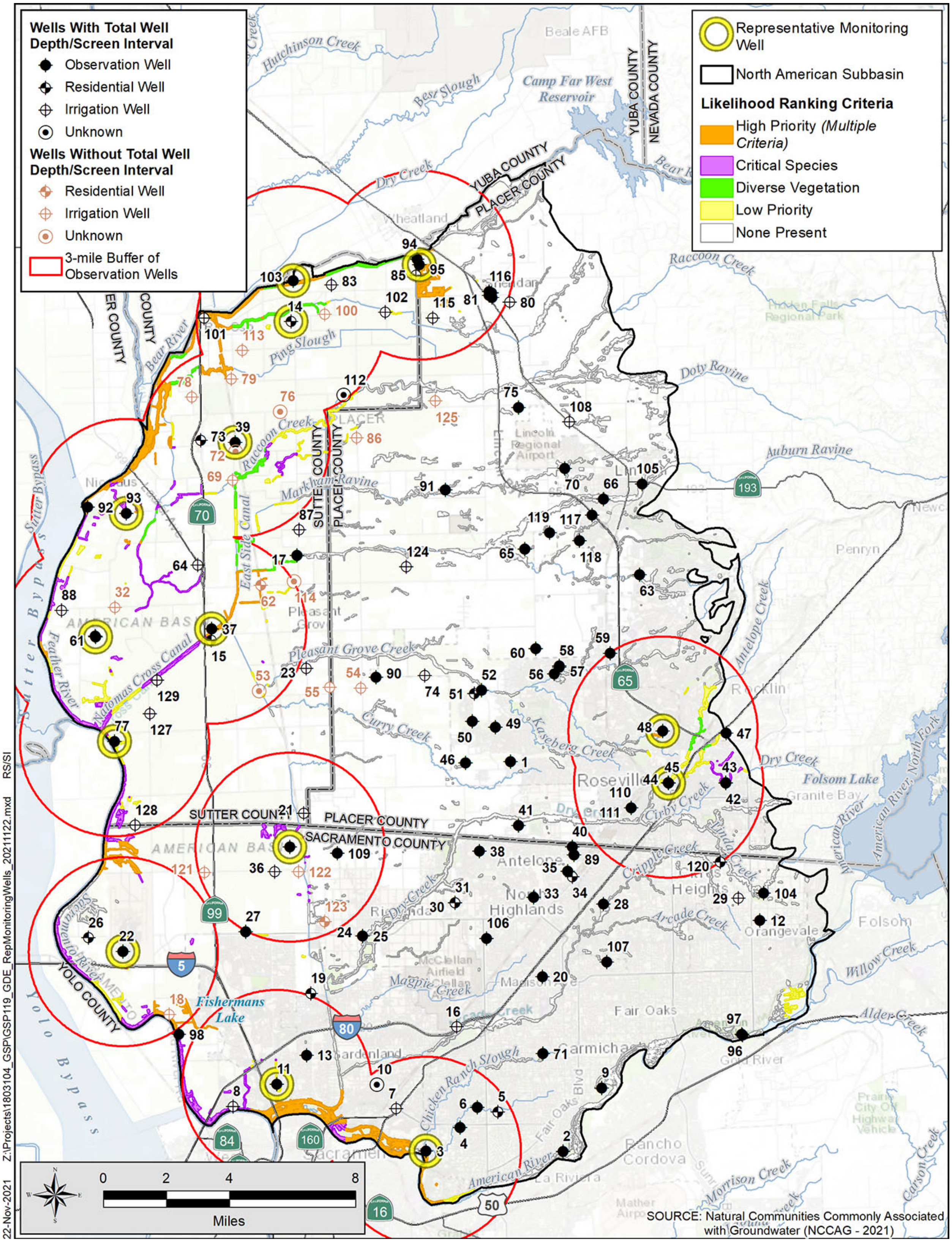


Figure 7-3. Representative Groundwater Level Monitoring Wells for GDEs

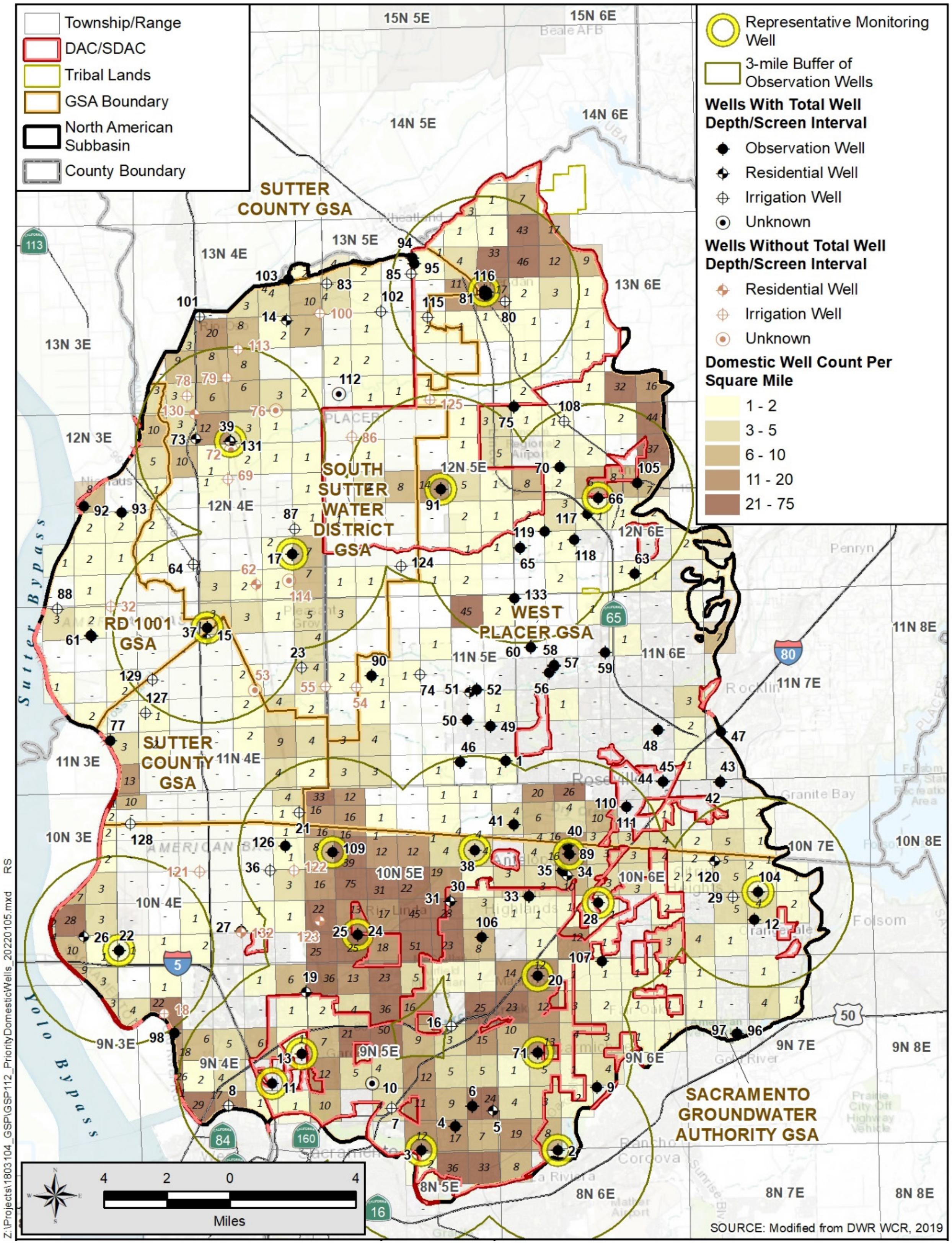


Figure 7-4. Representative Monitoring Wells Selection for Domestic Wells

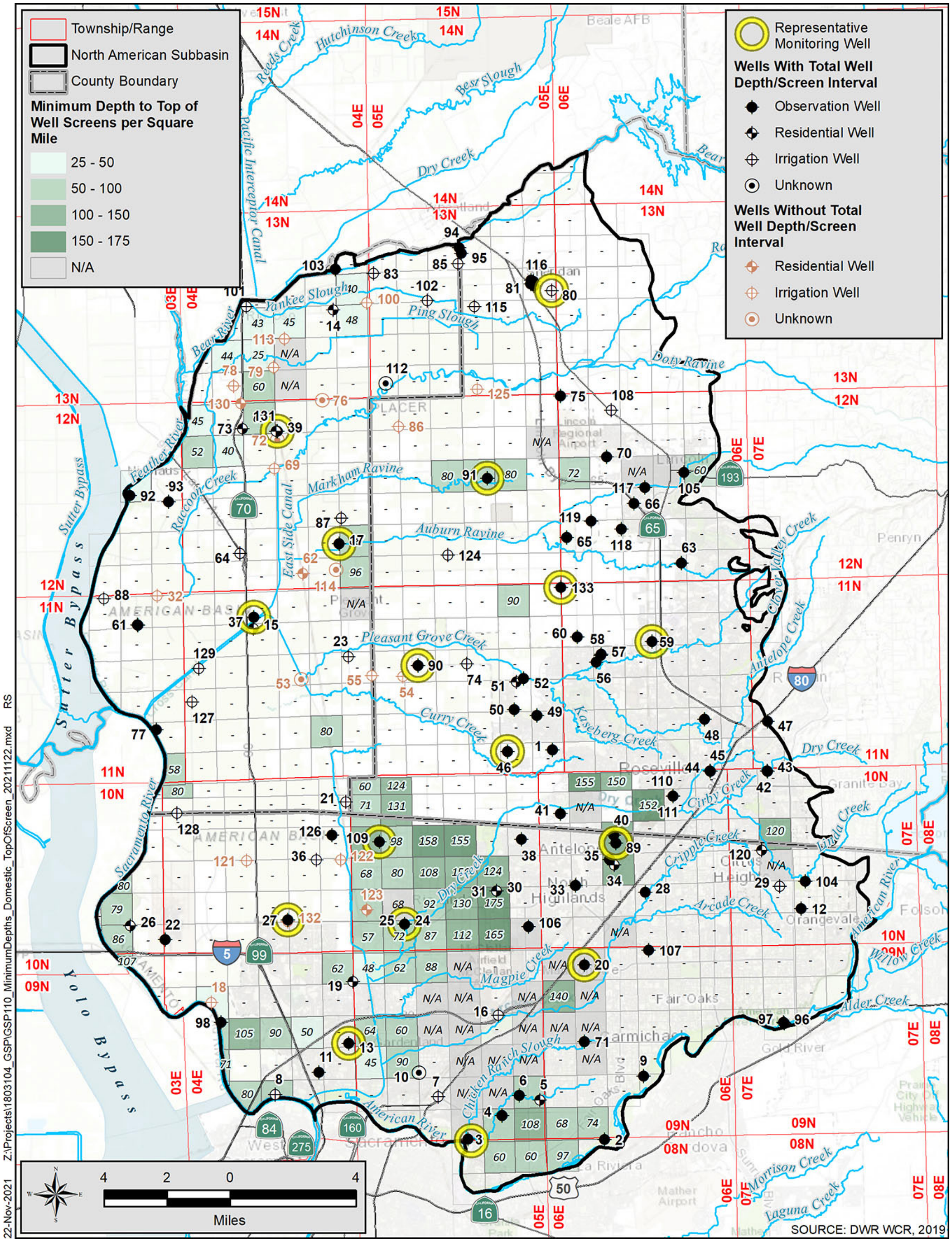


Figure 7-5. Depth to Domestic Well Top of Screens and Representative Monitoring Wells

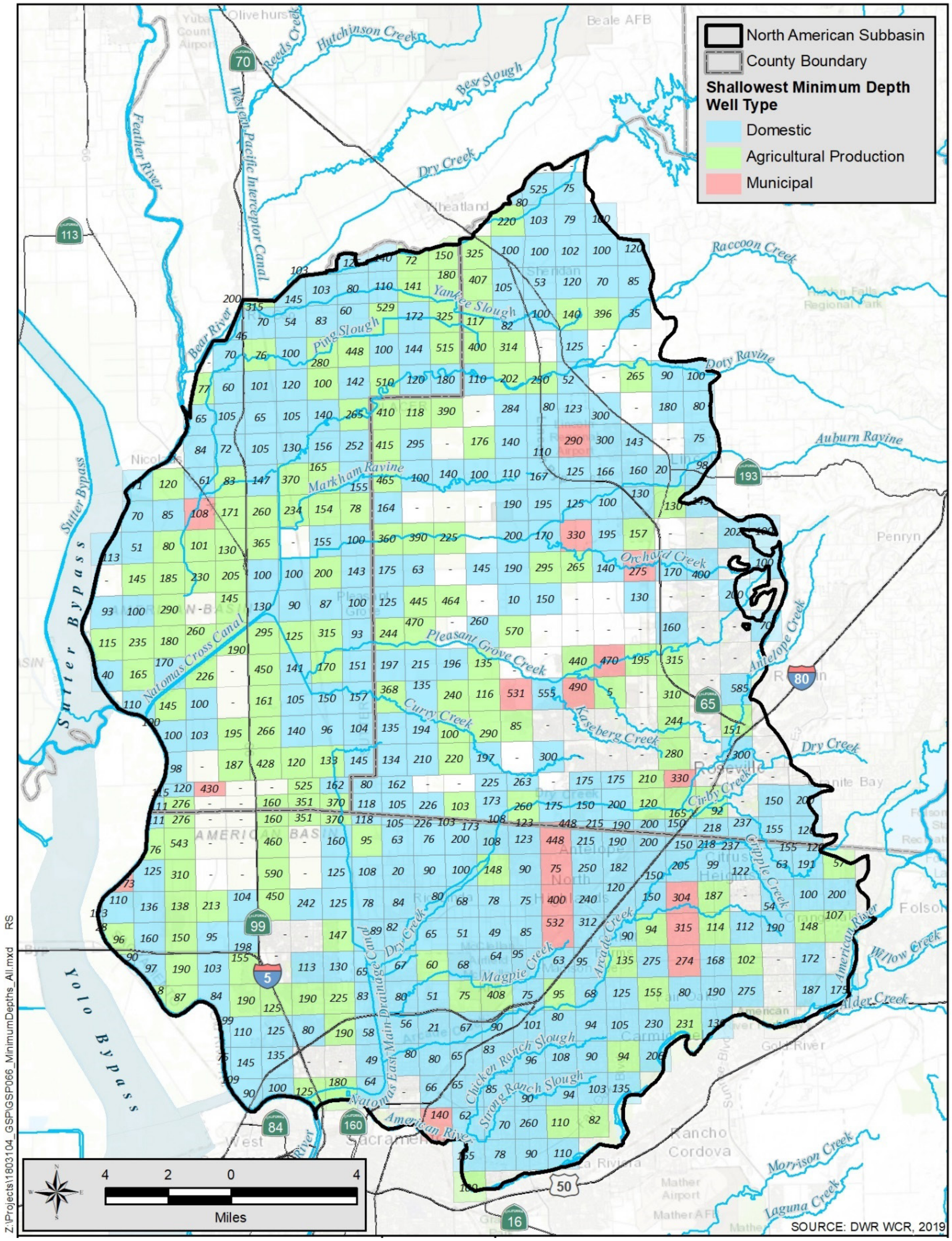


Figure 7-6. Comparison of Domestic Well Minimum Depths to Agricultural and Municipal Well Depths

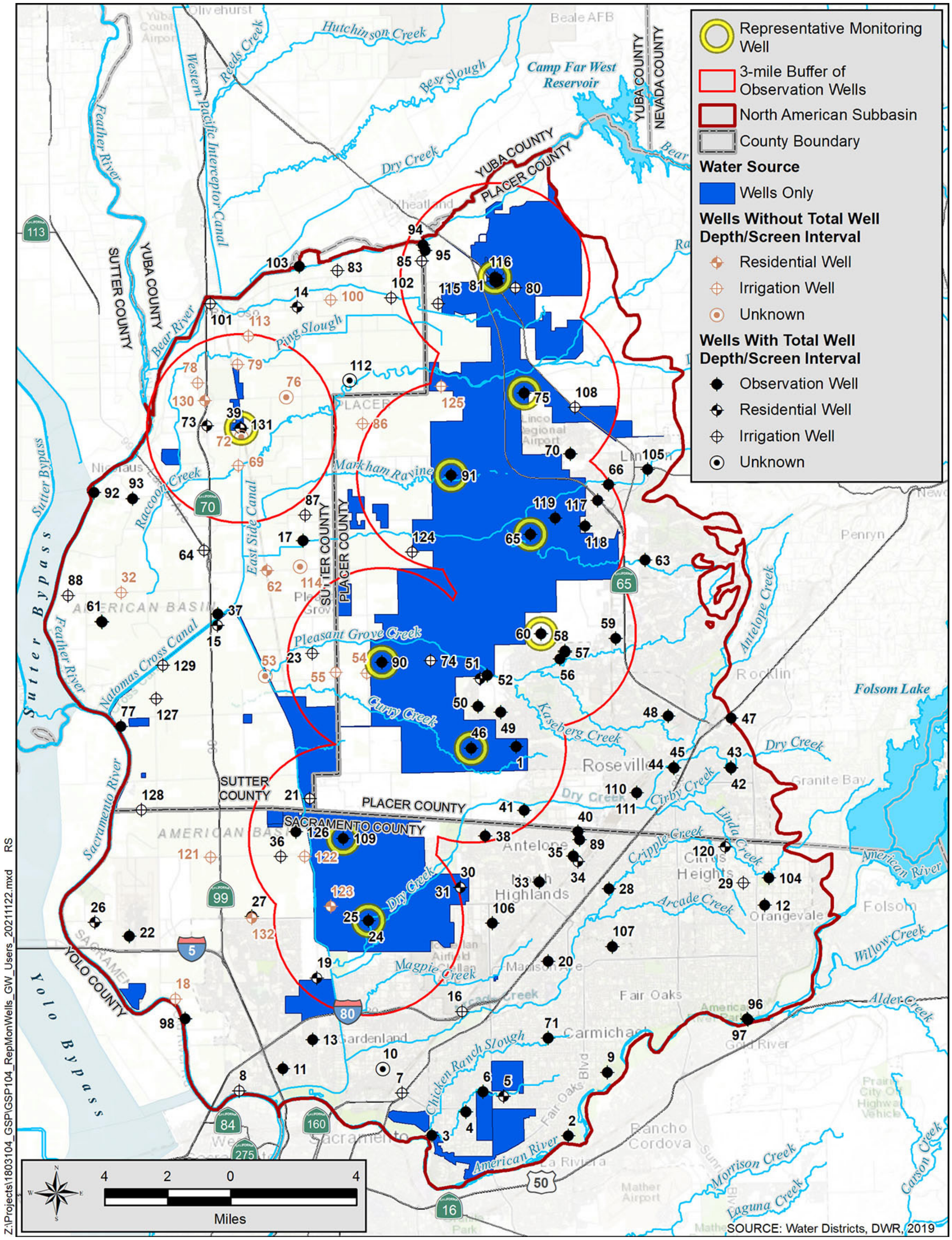


Figure 7-7. Representative Monitoring Wells for Areas Solely Dependent on Groundwater

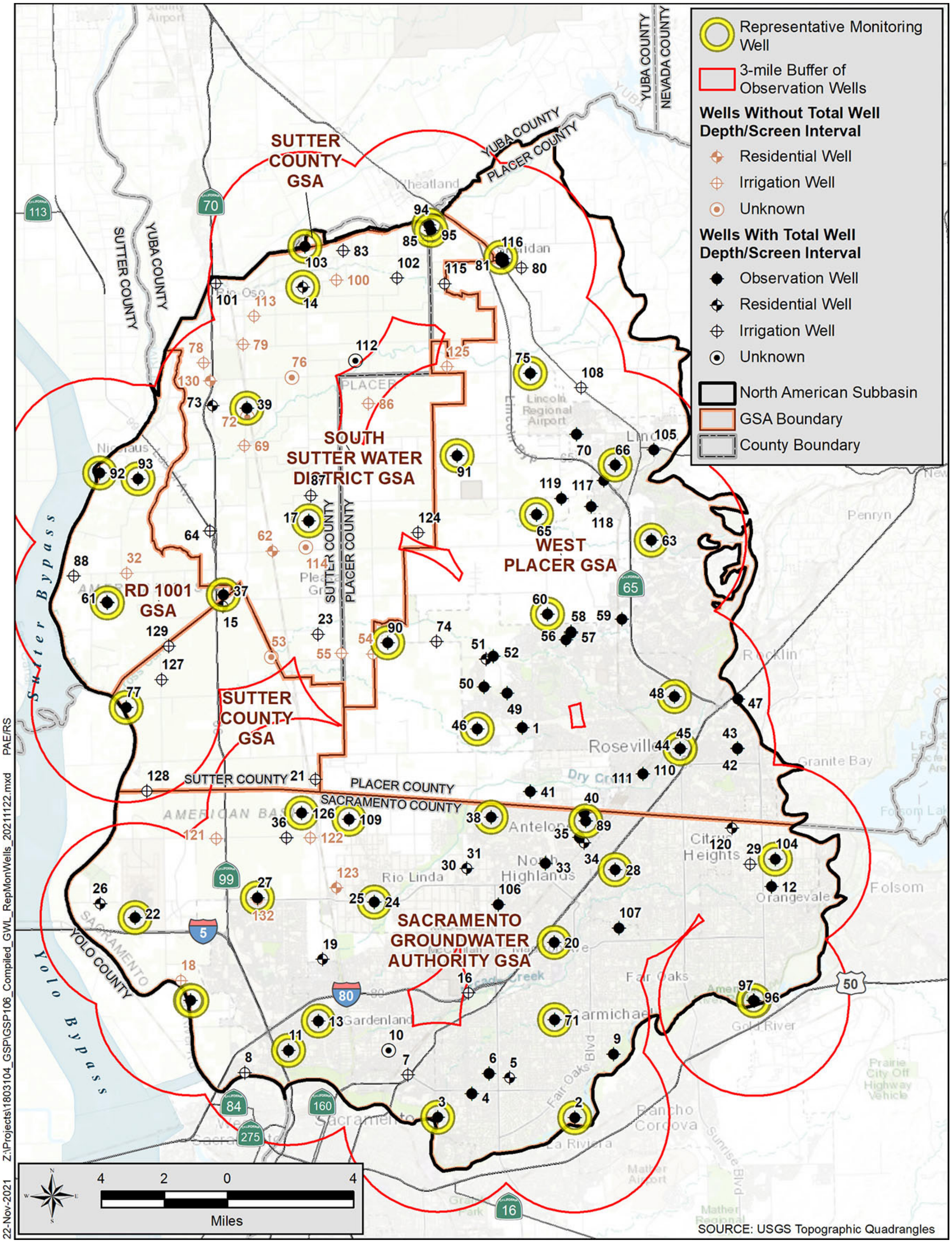


Figure 7-8. Representative Monitoring Wells for Chronic Lowering of Groundwater

7.4.4 Groundwater Level Monitoring Frequency

Frequency of groundwater level monitoring is cited in the Draft Monitoring Networks and Identification of Data Gaps Best Management Practice (DWR, 2016a), which presents guidance on monitoring frequency based on the type of monitoring, aquifer type, confinement, recharge rate, hydraulic conductivity, and withdrawal rate. Historically, DWR has monitored groundwater levels on a semi-annual basis. Because groundwater levels are being used to assess sustainability indicators, more frequent monitoring at some locations is warranted. Sampling frequencies were developed based on this guidance in combination with a consideration of monitoring costs.

Based on the analysis of groundwater level monitoring data in the Subbasin, dating back several decades, the GSA's have determined that semi-annual groundwater level measurements are sufficient to identify groundwater level trends in the Subbasin**.** However, at some representative wells, the frequency of monitoring has been increased to monthly or daily near areas with groundwater dependent ecosystems and surface water depletion to better define seasonal variations. **Table 7-3** provides the monitoring schedule for each representative monitoring well (note that where daily is listed as the frequency the well is equipped with a pressure transducer that can be set at daily or to match the measurement frequency at nearby surface water gaging stations).

Semi-annual groundwater levels will be collected in the Spring and Fall at all wells (*refer to* **Figure 7-2**). In the Spring, groundwater levels are typically higher than any other time of the year and groundwater pumping stresses are usually minimal. The Spring levels are reflective of regional high groundwater levels after recharge to the aquifer from winter rains. Fall measurements are taken after the heaviest pumping has occurred during the summer months and before substantial recharge has occurred from precipitation. The fall measurement is considered to be the regional minimum groundwater level for a given year. The work will be completed during a 2-week window on either side of target dates (April 15 and October 15) to accommodate for inclement weather and scheduling conflicts. This frequency of monitoring is more than sufficient to demonstrate seasonal, short-term (1-5 years), and long-term (5-10 years) trends in groundwater and related surface conditions and yield representative information about groundwater conditions.

Under some conditions, groundwater level measurements may be increased. For example, if agencies are participating in water transfers, groundwater level measurements are required to be collected weekly to monthly, from the beginning of the water transfer pumping until groundwater levels recovered to their seasonal highs the following Spring.

The monitoring frequency at representative monitoring wells have been adjusted to better track the groundwater levels near sensitive beneficial users that may be more effected by short-term groundwater level fluctuations. Wells monitoring more sensitive areas, such as GDE's and surface water interaction areas, have been increased to monthly (when measurements are made manually) or daily (using pressure transducers) to track groundwater levels that semi-annual monitoring would not capture.

7.4.5 Groundwater Level Monitoring Spatial Density

The Subbasin extends over an area of about 535 square miles (342,000 acres) and supplies about 208,000 acre-feet of groundwater annually for drinking water and irrigation (DWR, BMP 2019). This equates to about 39,000 AFY per 100 square miles.

A groundwater level well monitoring density goal ranges from 0.2 to 10 wells per 100 square miles (DWR, 2016a). The monitoring well density goals can also be based on the amount of groundwater use. For basins were groundwater pumping more than 10,000 AFY per 100 square miles, four wells per 100 square miles is recommended. Professional judgement is also essential to determining an adequate level of monitoring, frequency, and density based on the need to observe aquifer response near high pumping areas, cones of depression, significant recharge areas, and specific projects.

There are 37 representative monitoring wells selected to monitor for chronic lowering of groundwater levels in the Subbasin, equating to a density of about seven wells per 100 square miles. **Figure 7-8** shows the distribution of representative wells in the Subbasin. Of these 37 representative monitoring wells, 16 were selected to monitor areas with GDEs, which are present in about a 200-square-mile area, equating to a density of about eight wells per 100 square miles. The density of these representative monitoring wells exceeds the recommended density goals of four wells per 100 square miles and are therefore sufficient to provide representative groundwater levels throughout the Subbasin to assess groundwater lowering.

7.4.6 Data Gaps

As illustrated on **Figures 7-3 through 7-8**, there is an adequate density of representative monitoring wells in most of the Subbasin. However, two additional dedicated shallow monitoring wells are needed near high priority GDEs close to the Sacramento River (near well 128) and near the junction of the Bear and Feather rivers (near well 78) (*refer to* **Figure 7-3**). Alternatively, surface water observation stations may be established along Ping Slough at road crossings as groundwater and surface water are interconnected in this area. Another data gap area is present near well 112, (*refer to* **Figure 7-8**). A new monitoring well should be constructed in this vicinity.

7.5 Reduction in Groundwater Storage

Change in groundwater storage will use the same wells as designated for the representative groundwater level monitoring network (*refer to* **Section 7.3 – Representative Monitoring Network**), for the chronic lowering of groundwater levels. For decades, DWR has utilized changes in groundwater elevations, along with specific yield, to estimate changes in storage.

The Subbasin will use groundwater levels as a proxy for the change in groundwater storage. Groundwater storage changes will be calculated by evaluating the volumetric difference between changes in groundwater surfaces created based on groundwater level data collected in the Spring of each year.

Because groundwater levels will be used as a proxy for groundwater storage changes, discussions of monitoring frequency and spatial density will be the same as for chronic lowering of groundwater levels (*refer to* **Section 7.4.4 – Groundwater Level Monitoring Frequency** and **Section 7.4.5 – Groundwater Level Monitoring Spatial Density**.

7.6 Seawater Intrusion

As stated previously, in **Section 5.9 – Seawater Intrusion**, the Subbasin is more than 80 miles inland from the Pacific Ocean which precludes the consideration of seawater intrusion as a sustainability indicator. Saline water intrusion into waterways is more than 40 miles south of the Subbasin. Therefore, seawater intrusion is not likely to occur in the vicinity of the Subbasin and a representative monitoring network and monitoring is not required for this sustainability indicator.

7.7 Groundwater Quality

The groundwater quality in the Subbasin is good and meets the needs of urban, municipal, industrial, and agricultural uses based on salinity and nitrate concentrations. The concentrations of salinity and nitrate, for the most part, are below drinking water standards and agricultural water quality objectives. Poorer groundwater quality (higher salinity) has been noted in a few wells:

- In the western portion of the Subbasin, adjacent to the Sacramento and Feather rivers, due to this area historically being a slough and a salt sink or due to migration groundwater from adjacent subbasins
- Along the eastern portion of the Subbasin, near Lincoln, Roseville and Lincoln, due to shallow marine sediments

Between 2013 and 2017, water quality samples were collected by the USGS from 24 domestic wells with screen intervals ranging from 129 to 178 feet below ground surface (bgs). The results showed TDS ranged between 70 and 459 milligrams per liter (mg/L). Nitrate (as nitrogen) ranged between 0.1 and 1.4 mg/L (Bennett, 2019). The concentrations indicate the water is suitable for drinking water with all concentrations below the primary and recommended secondary drinking water standards. However, about 15 percent of the wells had arsenic and manganese above the MCL (Bennett, 2019). The locations and owners of these wells are confidential and cannot be released to the GSAs so they cannot be used as part of the monitoring network.

7.7.1 Monitoring Network

Groundwater quality in the Subbasin is monitored in 247 public water supply wells (PWS) and in one well designated for the ILRP water quality trend monitoring program. Groundwater quality is also monitored by agencies and private entities to assess water quality near areas with releases of contaminants to the environment. Groundwater quality monitoring is also required during water transfers.

An extensive record of water quality data from the PWS wells, dating from as far back as 1964 to the present, is available. Every PWS well is required by the California DDW to collect and analyze water quality samples. However, wells used by the small community systems are only required to collect samples for nitrate, with infrequent electrical conductivity measurements or TDS. A list of the PWS locations and attributes is not provided due to them being critical infrastructure.

As part of ILRP Water Quality Trend monitoring program, the Sacramento Valley Water Quality Coalition, collects samples from one monitoring well to be representative of water quality in the Subbasin. The well is screened in the upper portions of the aquifer to provide a regional representation of groundwater quality within a time frame that enables the evaluation of trends in groundwater quality resulting from the effects of agricultural practices and changes in land use practices. The well is required to be sampled annually for TDS and nitrate. The California Rice Commission has no monitoring wells in the Subbasin.

The USGS, National Water-Quality Assessment Program (NAWQA) has one well (monitoring well number 126) in the Subbasin that was sampled to assess groundwater quality near rice growing areas. This well has historically been sampled 10 times since 1997 and was last sampled in 2017. The next time the well is to be sampled is unknown. As part of the NAWQA, 25 domestic wells were sampled. The USGS attempts to resample wells about once every 5 years dependent upon funding. The USGS does not release domestic well location information to allow sampling of these wells by the GSAs.

As described in **Section 7.2 – Monitoring Network**, dedicated groundwater monitoring wells have been constructed in the Subbasin by the GSAs, DWR, and the USGS. These monitoring wells are used to measure groundwater levels but can be used to collect water quality samples, but at a higher cost as they are not equipped with pumps. The location of these wells is shown on **Figure 7-1**.

Additional dedicated monitoring wells have been constructed by agencies and private entities to assess water quality near areas with releases of contaminants to the environment. These monitoring wells were not considered during preparation of this GSP as water quality from these wells is reported to regulatory agencies who manage investigation and cleanup of groundwater.

There are a couple of areas of poorer quality groundwater with TDS greater than the drinking water MCL of 500 mg/L, in the western and eastern portions of the Subbasin. A groundwater quality sentry monitoring network was developed using selected groundwater level monitoring wells that are downgradient of these occurrences of poorer quality water. They were selected to assess if the poorer quality groundwater is migrating into the Subbasin and affecting water quality. Some of the sentry wells were also selected to monitor near the base-of-fresh water to assess for the potential upwelling of saline water from underlying marine sediments. These sentry wells are not being designated as representative wells. **Figure 7-9** shows the location of the sentry wells, with several of the wells being nested monitoring wells which can monitor various depths in the aquifer. **Table 7-4** lists the sentry monitoring well construction details. Sentry wells are planned to be sampled once every 2 years, in the fall.

Table 7-4. Sentry Monitoring Wells

Map No.	CASGEM or PWS ID	Local Name	Latitude	Longitude	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Monitoring Frequency
Monitoring Wells								
17	388593N1214885W003	AB-2 shallow	38.8593	-121.4885	135-145	155	O	Biennial
17	388593N1214885W002	AB-2 middle	38.8593	-121.4885	380-490	500	O	Biennial
17	388593N1214885W001	AB-2 deep	38.8593	-121.4885	670-690	700	O	Biennial
27	386864N1215222W002	AB-3 middle	38.6864	-121.5222	470-500	500	O	Biennial
37	388260N1215394W004	SUT-P1	38.826	-121.5394	110-120	120	O	Biennial
37	388260N1215394W003	SUT-P2	38.826	-121.5394	185-195	195	O	Biennial
37	388260N1215394W002	SUT-P3	38.826	-121.5394	295-305	305	O	Biennial
65	388604N1213544W001	MW 1-1	38.86038	-121.35438	378-398	398	O	Biennial
65	388604N1213544W002	MW 1-2	38.86038	-121.35438	298-318	318	O	Biennial
65	388604N1213544W003	MW 1-3	38.86038	-121.35438	184-204	204	O	Biennial
65	388604N1213544W004	MW 1-4	38.86038	-121.35438	82-92	92	O	Biennial
75	389255N1213566W002	MW 2-2	38.92547	-121.35663	160-170	170	O	Biennial
75	389255N1213566W003	MW 2-3	38.92547	-121.35663	75-85	85	O	Biennial
90	388026N1214432W002	WPMW-12A	38.80264	-121.44322	260-280	300	O	Biennial
90	388026N1214432W004	WPMW-12B	38.80264	-121.44322	508-528	550	O	Biennial
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	132-152	162	O	Biennial
91	388882N1214005W004	WPMW-11B	38.88816	-121.40046	264-304	309	O	Biennial
131		SSWD- supply	38.91158	-121.52438	85-140	140	R	Biennial
132		NCMWC - supply	38.68561	-121.52211	Unknown	Unknown	R	Biennial

Notes: O = Monitoring well
R = Residential well

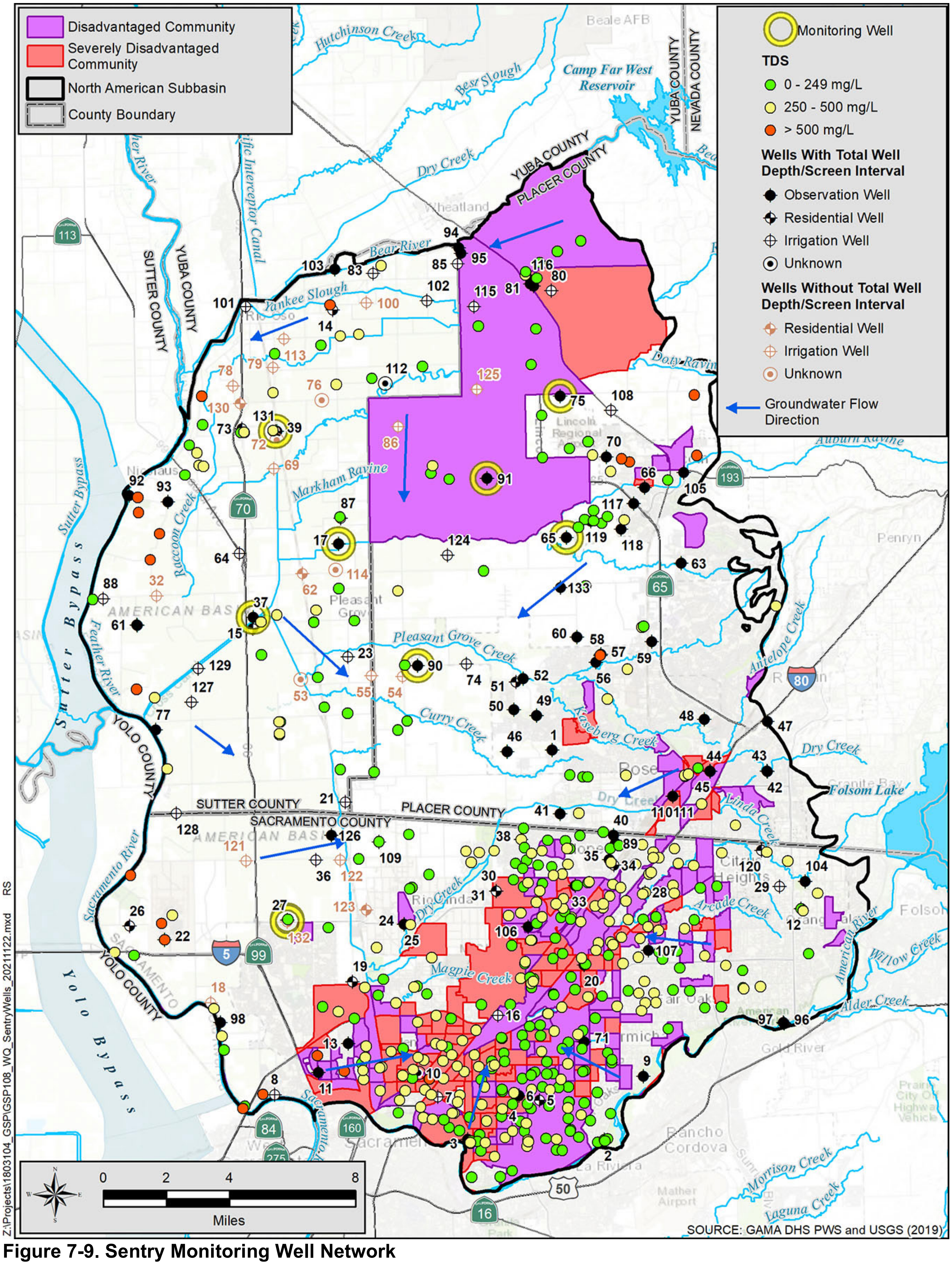


Figure 7-9. Sentry Monitoring Well Network

7.7.2 Representative Monitoring Wells

Representative monitoring wells were selected for groundwater quality degradation in the Subbasin where minimum thresholds and measurable objectives will be established to be protective of domestic, agricultural, and municipal well beneficial users.

The entire groundwater level monitoring well network and PWS wells were evaluated and a subset of the monitoring and PWS wells were selected to be representative of the groundwater quality conditions in the Subbasin.

Criteria used to select the representative monitoring well network for the Subbasin is based on:

- Wells with construction details
- Whether the wells are part of another regulatory program that requires sampling, reducing the overall costs
- The distribution of wells throughout the Subbasin
- Whether they are representative of beneficial users
- Whether the wells are located near or downgradient of known areas of poorer quality groundwater to assess degradation of water quality

Based on these considerations two representative monitoring networks were selected one for the shallow portions of the aquifer and one for the deeper portions of the aquifer.

The shallow portion of the aquifer is used by domestic wells. **Figure 7-10** shows the location of representative monitoring wells selected in relation to areas where high densities of domestic wells are present and for distribution across the entire Subbasin. Monitoring wells and a few shallow PWS wells with well screen intervals at depths at about the average depth of domestic wells (about 175 feet bgs; *refer to* **Appendix B**), were selected to be representative wells for the shallow portion of the aquifer. **Table 7-5** provides the attributes for these shallow aquifer representative wells.

There are 247 PWS wells in the Subbasin and construction details have been acquired for 205 of the wells. The details show that the average well depth is about 420 feet bgs, deeper than the average domestic wells depths. There are some PWS wells, about 20, with known well construction details and up to 42 wells with unknown details, with total well depths about the same as the domestic wells, but overall, the PWS wells are mostly reflective of the deeper portions of the aquifer. As illustrated on **Figure 7-11**, there is a high density of PWS in the southern portion of the Subbasin with lesser density in the northern portion of the Subbasin. All of the PWS wells will be used as a representative monitoring network.

Table 7-5. Shallow Aquifer Water Quality Representative Monitoring Wells

Map No.	CASGEM or PWS ID	Local Name	Latitude	Longitude	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Monitoring Frequency
Monitoring Wells								
17	388593N1214885W003	AB-2 shallow	38.8593	-121.4885	135-145	155	O	Biennial
20	386635N1213486W001	SGA_MW05	38.66347	-121.34859	205-215	215	O	Biennial
24	386836N1214536W001	SGA_MW02	38.68362	-121.45363	100-110	110	O	Biennial
27	386864N1215222W003	AB-3 shallow	38.6864	-121.5222	190-210	220	O	Biennial
37	388260N1215394W004	SUT-P1	38.826	-121.5394	110-120	120	O	Biennial
39	389116N1215238W003	AB-1 shallow	38.9116	-121.5238	170-180	190	O	Biennial
46	387623N1213915W001	SVMW West - 1A	38.76232	-121.39153	120-140	145	O	Biennial
80	389740N1213606W001	Cemetery (IRLP)	38.97403	-121.36062	70-111	111	O	Annual
89		Roseview Park - 315	38.71912	-121.32879	295-305	315	O	Biennial
90	388026N1214432W002	WPMW-12A	38.80264	-121.44322	260-280	300	O	Biennial
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	132-152	162	O	Biennial
109	387218N1214677W001	SGA_MW01	38.72178	-121.46771	100-110	110	O	Biennial
133		LW-1	38.83731	-121.35831	68-108	108	O	Annual
Public Water Supply Wells								
298	3110025-014	Tinker Road Well			117-177	177	M	Tri annual
99	3400396-001	Main Well			53-71	73	M	Tri annual
177	3410002-013	Well 22 - Northrop			113-225	265	M	Tri annual

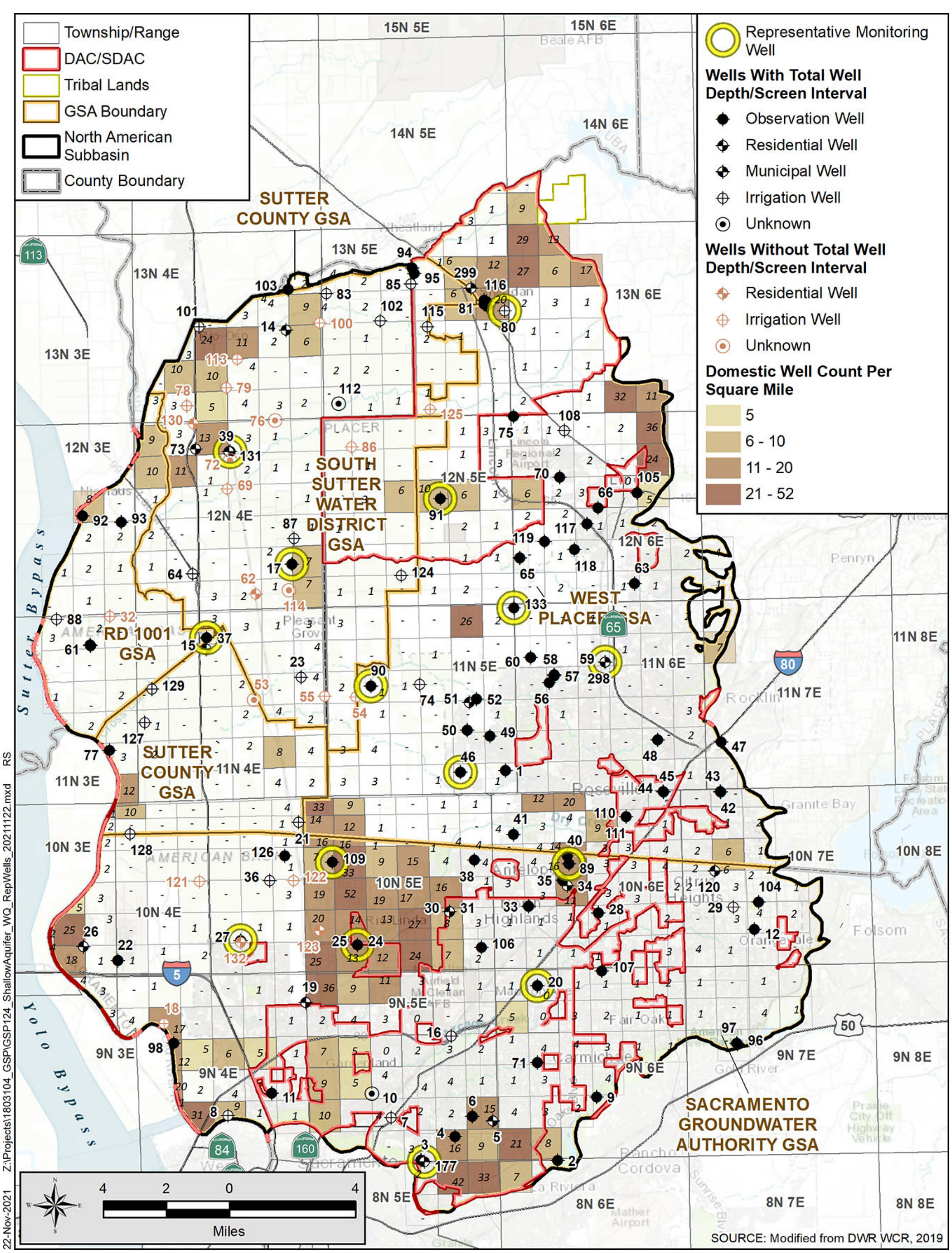


Figure 7-10. Shallow Aquifer Water Quality Representative Monitoring Wells

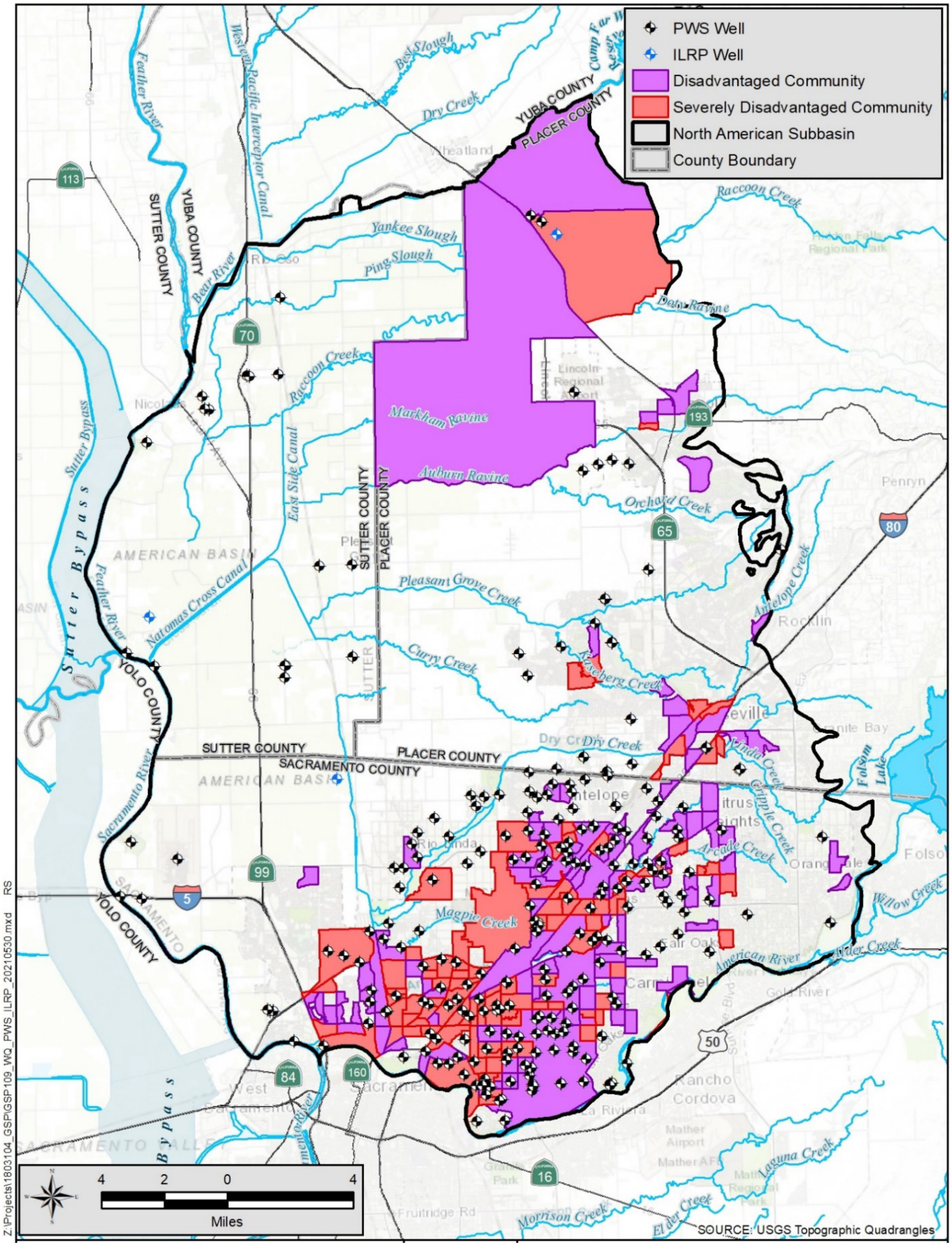


Figure 7-11. Deep Aquifer Groundwater Quality Representative Monitoring Network

7.7.3 Groundwater Quality Monitoring Frequency

The water quality monitoring frequency will vary based on the type of well.
DDW requires monitoring of community PWS wells for Title 22 requirements (such as organic and inorganic compounds, metals, microbial, and radiological analytes). Salinity (TDS) is typically required to only be monitored once every 3 years. Nitrate sampling frequency varies from monthly to annually. For small community water systems, the frequency and the list of analytes is typically different than community PWS wells. The sampling schedule varies by PWS and well and does not occur in all wells in a single year.

ILRP wells are monitored on an annual basis, typically in the fall of each year. Well LW-1 is part of a water quality compliance program and is sampled in the fall of each year.

Shallow aquifer monitoring wells are planned to be sampled once every 2 years, in the fall. The frequency of monitoring is provided in **Table 7-5**.

7.7.4 Groundwater Quality Monitoring Spatial Density

DWR's Monitoring Networks and Identification of Data Gaps BMP identifies different sources and calculations for establishing water quality monitoring network densities (DWR, 2016a). A specific density of water quality monitoring wells per 100 square miles was not provided by DWR, but methods are available to assess an adequate density by performing a water quality needs assessment. The Groundwater Assessment Reports prepared for the ILRP and subsequent Water Quality Trends Monitoring Programs designated one monitoring well in the Subbasin, or one well per 535 square miles.

As demonstrate in **Table 7-4**, the 17 designated shallow representative monitoring wells has a density of about three wells per 100 square miles. As demonstrated on Figure 7-10, the monitoring wells are located specifically near areas with high densities of domestic wells and for distribution across the Subbasin and therefore is sufficient to assess trends for water quality degradation.

This GSP is proposing to use 247 PWS representative monitoring wells, or about 70 wells per 100 square miles, for monitoring the deeper portion of the aquifer. This is higher than the density recommended for groundwater level monitoring well densities. The water quality well density for the deeper portions of the aquifer in the Subbasin, is sufficient to assess trends for water quality degradation.

7.7.5 Data Gaps

At this time there is abundant water quality data through DDW, IRLP, and other regulatory compliance programs to assess water quality in the shallow and deeper portions of the aquifer and along with the sentry wells to detect movement of poorer quality water in the Subbasin. Construction details will be acquired for well 132 in the near future using a video survey. There are no data gaps for the water quality monitoring network.

7.8 Land Subsidence

The subsidence monitoring network will consist of using groundwater levels as a proxy for the rate of land subsidence. **Section 5.10, Land Subsidence** provided hydrographs in comparison to benchmark surveys and an extensometer. A historical analysis showed about 0.01 foot of subsidence per foot of groundwater level decline occurred between 1950s and 1970s during the development of the pumping depression beneath the central portion of the Subbasin. Benchmark surveys that include the period during the 2012 to 2016 drought did not detect subsidence exceeding the instrumentation accuracy.

7.8.1 Land Subsidence Monitoring Network

Subsidence has been monitored using benchmarks established by DWR in 2007. The benchmark network is shown on **Figure 7-12** along with the difference in elevations (in feet) from 2007 to 2018.

DWR constructed the Sutter extensometer (SUT-Ext) and nested monitoring wells (SUT-P1 through SUT-P4) in the western area of the Subbasin and is shown on **Figure 7-12**. DWR is also using satellite-based data (InSAR) to assess subsidence throughout the Central Valley.

The Subbasin has a network of groundwater level monitoring wells that can be used as a proxy to subsidence rates, as listed in **Table 7-1** and shown on **Figure 7-1**.

7.8.2 Representative Monitoring Locations

The subsidence representative monitoring network will consist of using groundwater levels as a proxy to limit the potential for subsidence. Groundwater levels will be made on a monthly basis and provide greater assurance in a timely manner that land subsidence will not create undesirable results. The rate of land subsidence will be tracked at an existing extensometer (SUT-Ext) which is located near nested representative monitoring wells (SUT-P1 through SUT-P4).

Criteria used to select representative monitoring wells were selected based on their proximity to:

- Major transportation infrastructure (highways and freeways)
- Sacramento Metropolitan International Airport

- Levees near rivers
- The existing groundwater depression
- Proximity to the SUT-Ext extensometer

Twelve representative monitoring wells were selected to monitor groundwater levels to be used to avoid the undesirable result of land subsidence associated with groundwater pumping. **Figure 7-13** shows the representative monitoring well locations, infrastructure and the pumping depression (a groundwater surface topographic map). **Tables 7-3** and **7-6** lists the representative groundwater level monitoring wells to be used to assess subsidence. **Table 7-6** lists their purpose and relation to major infrastructure in the area. All wells other wells are positioned to assess the potential for deepening or expansion of the pumping depression and increasing the potential for subsidence.

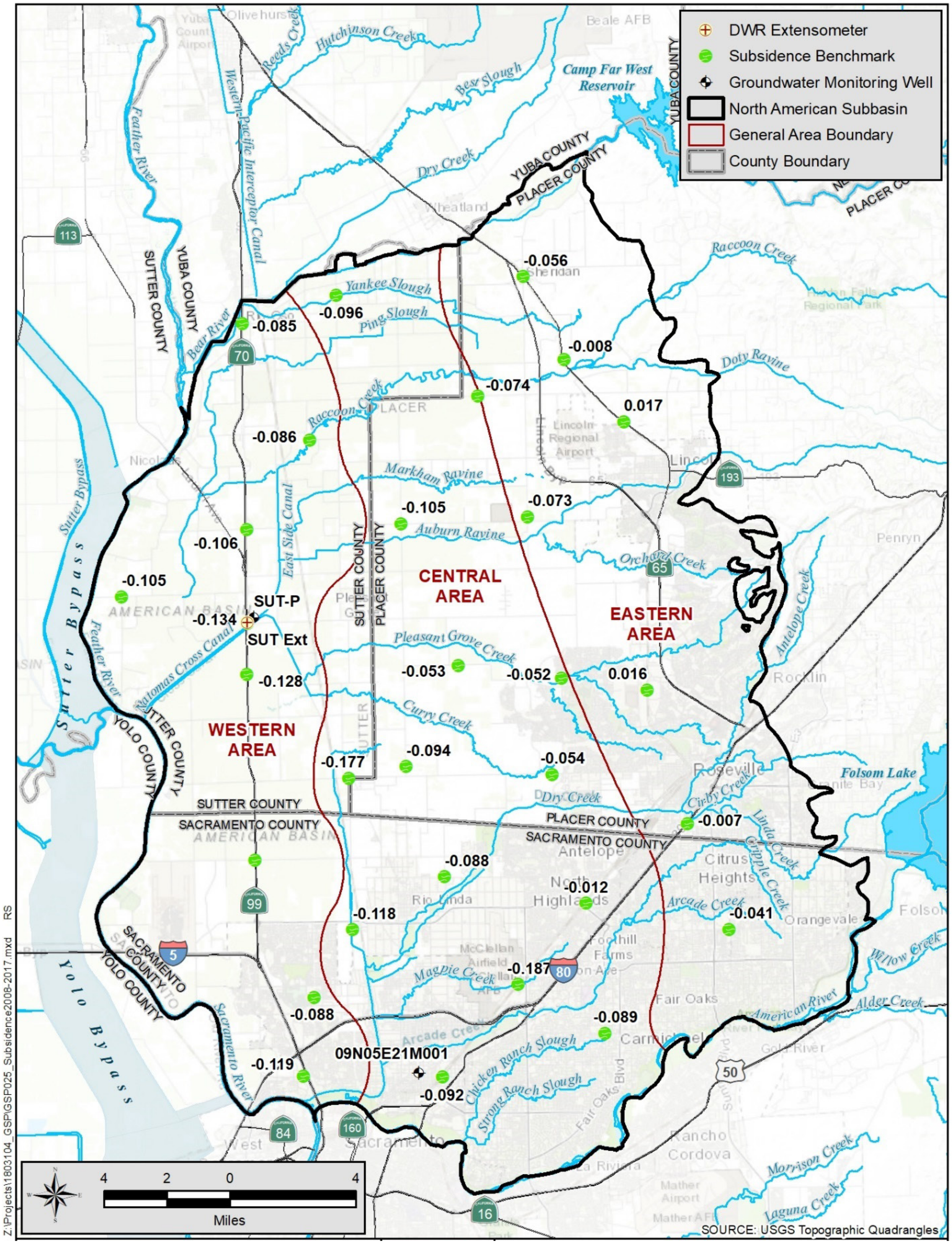


Figure 7-12. Land Subsidence Monitoring Network

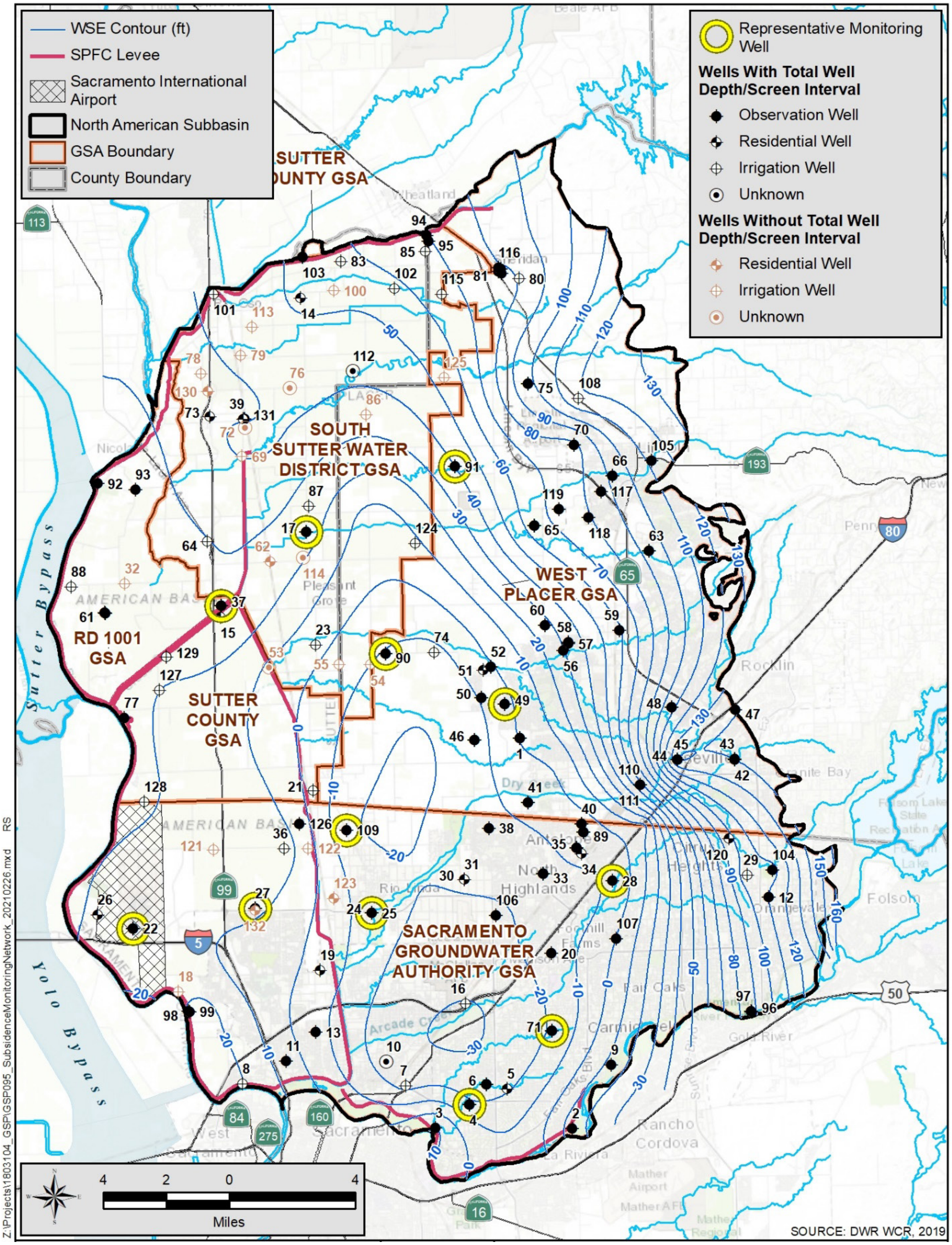


Figure 7-13. Land Subsidence Representative Monitoring Network

Table 7-6. Land Subsidence Representative Monitoring Wells

Map No	CASGEM ID	Local Name	Latitude	Longitude	Screened Interval (ft bgs)	Total Depth (ft bgs)	Well Type	Near Infrastructure	Frequency of Monitoring
4	385947N1213985W001	MW12A	38.59472	-121.39847	200-280	285	O	B80	Monthly
17	388593N1214885W003	AB-2 shallow	38.8593	-121.4885	135-145	155	O		Continuous
22	386782N1215943W002	AB-4 middle-deep	38.6782	-121.5943	795-805	815	O	SIA, I5, L	Continuous
24	386836N1214536W001	SGA_MW02	38.68362	-121.45363	100-110	110	O		Monthly
27	386864N1215222W003	AB-3 shallow	38.6864	-121.5222	190-210	220	O	Hwy 99, L	Continuous
28	386964N1213120W001	Twin Creeks Park	38.6964	-121.31203	183-193	193	O	I80	Monthly
37	388260N1215394W001	SUT-P4	38.826	-121.5394	880-890	890	O	Hwy 70, L	Continuous
49	387786N1213737W002	WPMW-1B	38.7786	-121.3737	460-480	480	O		Monthly
71	386280N1213493W001	WCMSS	38.62799	-121.34925	130-150	170	O	I80	Monthly
90	388026N1214432W004	WPMW-12B	38.80264	-121.44322	508-528	550	O		Monthly
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	132-152	162	O		Monthly
109	387218N1214677W001	SGA_MW01	38.72178	-121.46771	100-110	110	O		Monthly

Notes: O = monitoring well; B80 = Business 80; SIA = Sacramento International Airport; I5 = Interstate 5; I80 = Interstate 80; Hwy 99 = Highway 99; Hwy 70 = Highway 70; L = Levees

The GSAs intend to use these representative monitoring wells in the Subbasin to track the potential for subsidence. Should groundwater levels indicate levels have gone below the historical lows, the GSAs would then implement land surveys of the nearest surrounding benchmarks as shown on **Figure 7-12**.

The GSAs will review annual satellite-based (InSAR) subsidence results when it is made available. This program is currently funded by DWR. Subsidence will also be tracked on a semi-annual basis at the SUT-Ext and compare the subsidence to SUT-P4. Its location is shown on **Figure 7-12**.

7.8.3 Land Subsidence Monitoring Frequency

Groundwater levels in the representative monitoring wells will be made either on a monthly or daily basis. Continuous measuring stations will be downloaded in the Spring and Fall of each year. The groundwater levels will be plotted annually with benchmark survey results or from other sources to assess subsidence.

7.8.4 Land Subsidence Monitoring Spatial Density

Figure 7-13 provides the distribution of the 12 representative groundwater level monitoring wells. The density of the stations is 2 wells per 100 square miles.

A groundwater level well monitoring density goal ranges from 0.2 to 10 wells per 100 square miles (DWR, 2016a). The monitoring well density goals can also be based on the amount of groundwater use. For basins were groundwater pumping more than 10,000 AFY per 100 square miles, four wells per 100 square miles is recommended. Professional judgement will be essential to determining an adequate level of monitoring cones of depression, significant recharge areas, and specific projects. Based on professional judgement the subsidence network has sufficient density.

7.8.5 Data Gaps

At this time there are no data gaps. As necessary, the subsidence monitoring network may be adjusted.

7.9 Surface Water Depletion

Temporal changes in river flows volumes from gaging stations cannot be used to assess surface water depletion due to the relatively small volumes of groundwater gains and losses in comparison to the volume of water in the rivers. The uncertainty in the accuracy of the volume increases due to the complex nature of merging rivers, ungagged small tributaries, wastewater discharges, and tail water return.

As described and illustrated in **Section 5.11 – Interconnected Surface Water**, groundwater levels in monitoring wells in the aquifer near rivers and creeks correlate to changes in elevations of surface water at river gages. Increasing the depth to groundwater will increase groundwater gradient away from the rivers and increase the amount of surface water depletions. Therefore, use of groundwater levels and gradients as a proxy for surface water depletion is appropriate.

As describe in **Section 5.3 – Historic Groundwater Levels**, groundwater levels near the rivers have been stable along the Bear, Feather and Sacramento rivers since the early 1900s. Changes have occurred in the groundwater levels along the American River and portions of the Sacramento River near its confluence with the American River indicating surface water depletion along these portions increased between 1950 and 1990. Since 1990, levels have stabilized and risen reducing the depletion.

7.9.1 Monitoring Network

The Subbasin has monitoring wells placed near river and creek stage gages to assess if the groundwater gradient changes outside of its historic range, indicating greater surface water depletion. The monitoring wells have a short period of record due to most wells being recently constructed. **Figure 7-1** shows the locations of the monitoring wells.

7.9.2 Surface Water Representative Monitoring Locations

Twenty-four shallow monitoring wells are located along the American, Bear, Feather and Sacramento rivers and various creeks and also near surface water gages to track surface water/groundwater interaction in the Subbasin. All wells have construction details. Eighteen wells are less than 80 feet while the other six wells are deeper but still reflect the unconfined aquifer conditions in the Subbasin. **Table 7-3** provides the well construction details and attributes. **Figure 7-14** shows the surface water depletion monitoring wells which in most cases are paired with river or creek gaging stations. At all gage and monitoring well locations, except Bear River Near Wheatland (BRW) gage, observations of water surface/groundwater elevations trend closely during high flow/stage events in the rivers, demonstrating a hydrologic connection between the groundwater in the shallow portion of the aquifer and surface water. The wells are suitable for monitoring surface water depletion.

Table 7-7 lists the river stage gages that will be used as part of the representative monitoring network, the type and frequency of the measurements, responsible monitoring agency along with the associated monitoring wells. **Table 7-8** list the wells that can be used to assess gradients from the surface water and also those wells where only levels will be used to assess surface water depletion.

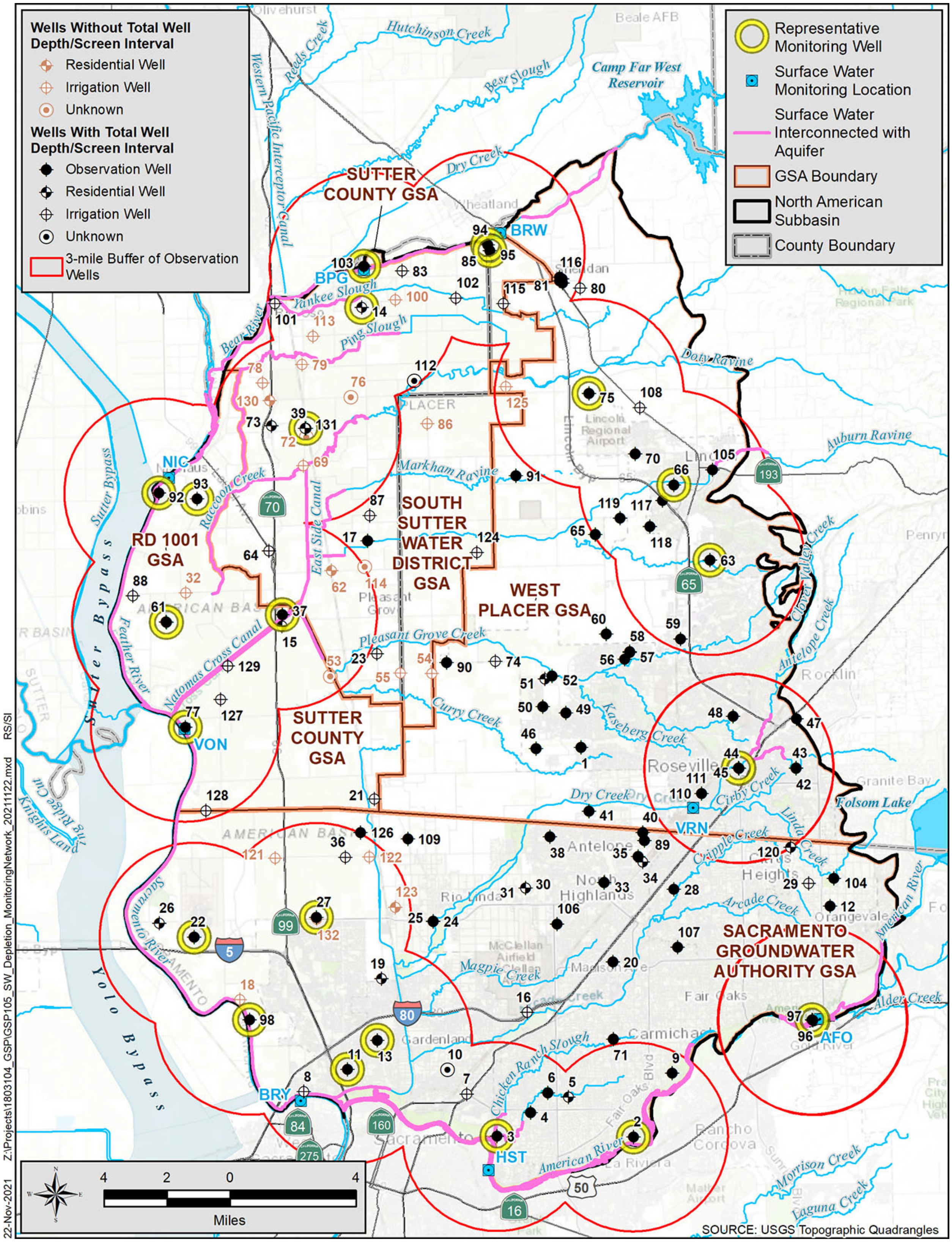


Figure 7-14 Surface Water Depletion Monitoring Network

Table 7-7. Surface Water Gaging Stations

Abbreviation	Name	Operating Agency	Type	Frequency of Measurements	Associated Representative Monitoring Wells (Map No.)
AFO	American River at Fair Oaks	USGS	River Stage (feet [ft]), Flow River Discharge (cubic feet per second [cfs])	15 minutes	96, 97
HST	American River at H Street Bridge	CA Dept of Water Resources/Operations and Maintenance	River Stage (ft)	Hourly	3
BPG	Bear River at Pleasant Grove Road	CA Dept of Water Resources/North Region Office	River Stage (ft), Flow River Discharge (cfs)	Hourly	103
BRY	Sacramento River at Bryce Maintenance Yard	CA Dept of Water Resources/North Region Office	River Stage (ft)	Hourly	98, 99
VRN	Dry Creek @ Vernon St.	City of Roseville	River Stage (ft)	Hourly	44, 45
NIC	Feather River at Nicolaus	CA Dept of Water Resources/Flood Management	River Stage (ft)	Hourly	92, 93
BRW	Bear River Near Wheatland	USGS and DWR	River Stage (ft), Flow River Discharge (cfs)	15 minutes	94, 95
VON	Sacramento River at Verona	DWR & USGS	River Stage (ft), Flow River Discharge (cfs)	Hourly	77

Table 7-8. Paired Monitoring Wells and Gages for Gradients

Map No. or Gage Name	CASGEM ID	Local Name	Latitude	Longitude	River or Creek
Gradient Wells and Gages					
AFO			38.63546	-121.228	Am
96		1516	38.63487	-121.232	Am
97		1518	38.63513	-121.232	Am
BRY		Sacramento River At BRYTE	38.602	-121.533	Sac
11	386160N1215054W001	Bannon Creek Park	38.61603	-121.505	Am
13	386292N1214877W001	Chuckwagon Park	38.62921	-121.488	Am
BPG			38.9841	-121.488	Br
103	389857N1214880W004	BR-1A	38.9857	-121.488	Br
14	389669N1214897W001	13N04E23A002M	38.9669	-121.49	Br
BRW			38.99993	-121.407	Br
94	389950N1214148W002	RDMW-103	38.99461	-121.415	Br
95	389919N1214141W002	RDMW-104	38.99195	-121.414	Br
NIC			38.88984	-121.605	Fr
61	388235N1216079W001	Sutter County MW-5A	38.82324	-121.608	Fr
37	388260N1215394W004	SUT-P1	38.826	-121.539	Fr
NIC			38.88984	-121.605	Fr
92		RDMW-101	38.88294	-121.611	Fr
93		RDMW-102	38.87987	-121.589	Fr
VON			38.77416	-121.598	Sac
77		SREL-1-27-F1	38.77491	-121.598	Sac
22	386782N1215943W004	AB-4 shallow	38.6782	-121.594	Sac
27	386864N1215222W003	AB-3 shallow	38.6864	-121.522	Sac
VRN			38.734	-121.301	Dry
44	387515N1212725W001	WPMW-10A	38.75149	-121.273	Dry
45	387517N1212727W001	WPMW-9A	38.75167	-121.273	Dry
Groundwater Levels Only					
2	385828N1213385W001	SGA_MW06	38.58281	-121.338	Am
3	385841N1214185W001	SGA_MW04	38.58414	-121.419	Am
63	388476N1212872W001	WPMW-3A	38.84761	-121.287	Or
66	388826N1213078W002	MW 5-2	38.88258	-121.308	Ab
75	389255N1213566W003	MW 2-3	38.92547	-121.357	Ra
98		URS71000-700+00C	38.6397	-121.562	Sac
105	388893N1212847W001	MW 4	38.88928	-121.285	Ab

Notes:
Ab = Auburn Ravine
Am = American River
Br = Bear River
Dry = Dry Creek
Fr = Feather River
Or = Orchard Creek
Ra = Raccoon Creek
Sac = Sacramento River

7.9.3 Monitoring Frequency

The stage in the rivers and creeks are monitored on a minimum of 15-minute intervals. The measurements are reported either to the CDEC) database or to the city of Roseville, where the measurements are archived.

Groundwater levels in the monitoring wells are being monitored with transducers that obtain measurements at the same frequency of measurements as the gaging stations, but no less than once every 15 minutes. Groundwater levels will be measured, using water level sounders twice per year, in the Spring (March) and Fall (October) of each year to confirm the accuracy of the transducers. **Table 7-3** provides the frequency of measurements (designated as continuous because they are outfitted with transducers) in groundwater monitoring wells which will correspond with the frequency of measurements at the surface water gaging stations listed in **Table 7-7**.

The frequency of the groundwater measurements may be reduced to daily after further assessment of the data.

7.10 Groundwater Well Monitoring Spatial Density

No specific density of monitoring well spatial density guidance has been provided by DWR for wells associated with surface water depletion. Using a radius of 3-miles (*see* **Figure 7-14**) which is equal to about five wells per 100 square miles illustrates the Subbasin has sufficient density along the rivers.

7.10.1 Data Gaps

Two monitoring wells noted under **Section 7.4.6** as gaps for chronic lowering of groundwater levels would improve the surface water monitoring network.

7.11 Monitoring Protocols

The following technical protocols provide guidance based upon existing professional standards and are commonly adopted in various groundwater-related programs. The protocols provide clear techniques to yield quality data for use in the various components of this GSP. The following monitoring protocol were developed using DWR's Best Management Practices for Monitoring Protocols, Standards and Sites (DWR, 2016b) with additions from other existing programs.

7.11.1 Groundwater Levels

The following monitoring protocols were developed for the CASGEM monitoring programs by the GSAs and will be used to measure groundwater levels in the monitoring wells using a water level sounder or pressure transducers.

7.11.1.1 Water Level Sounders

Groundwater level measurements must be collected with consistency and with sufficient additional data that those who use the data understand its usefulness and limitations. Field notes which document the data collection are therefore required.

To assure that the same well is being measured each time, the monitoring entity will create a Well Identification Sheet, which will be used to track the monitoring at each well site. The following information will be recorded on the Well Identification Sheet: well number, date of survey, latitude and longitude, reference point (RP) elevation and description, location description and map, well type and use, well completion type, and, if available, total depth, screened intervals, and well completion report number. A close-up photo of the well showing the access port for measuring groundwater levels and a photo of the well from a distance should be included for confirmation that the correct well is being monitored and that measurements are made consistently at the same locations.

The following data is collected on standard forms in the field to establish a dependable groundwater level measurement:

- Name of person collecting data and agency association
- Well name/identification
- Date and time of measurement
- Type of equipment used to measure the depth to water
- RP used at each well
- Nearby conditions which confirm (or not) that measurement is static water level and are noted by a Questionable Measurement Code
- Measurement from the RP to the water surface (RPWS)
- Weather and other conditions that may affect the ability to obtain a good measurement
- If a measurement cannot be made information is provided using a No Measurement Code (NM)

Additional steps are taken in the field to:

- Ensure the safety of staff collecting the data
- Ensure the integrity of the data collection process
- Maintain hygienic conditions in the wells
- Maintain good relations with property owners

Groundwater level measurements will be made using the following protocol (DWR, 2016b):

- Depth to groundwater will be measured from an established RP on the well casing. The RP will be identified with a permanent marker, paint spot, or a notch in the lip of the well casing. If no mark is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing.
- The sampler will remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a pressure release is evident, the measurement will be delayed for a short period of time to allow the water level to equilibrate.
- Measurements of depth to groundwater and land surface will be measured and reported in feet to an accuracy of at least 0.01 feet and the method of measurement will be noted on the record (i.e., electric sounder, steel tape, acoustic sounder).
- The sampler will replace any well caps or plugs and lock any well buildings or covers after taking a measurement.
- The water level probe should be cleaned after measuring each well.
- All data will be entered into the North American Subbasin data management system (DMS) as soon as possible. Care will be taken to avoid data entry mistakes and the entries will be checked by a second person for accuracy.

By following these monitoring protocols, the GSAs ensure that its groundwater level measurements are appropriate for use in conjunction with other groundwater level data from other groundwater management entities. Monitoring protocols shall be reviewed at least every 5 years as part of the periodic evaluation and update of this Plan and modified as necessary.

7.11.1.2 Pressure Transducers

Groundwater levels may be measured using pressure transducers. When relying on pressure transducers and data loggers, manual measurements of groundwater levels will be taken during installation to synchronize the transducer system and, periodically (semi-annually), to ensure monitoring equipment does not allow a “drift” in the actual values.

The following protocols from DWR *Monitoring Protocols* BMP, 2016 will be followed when installing a pressure transducer in a monitoring well and during routine monitoring and downloads:

- The sampler will use an electronic sounder or chalked steel tape to measure the depth to groundwater level from the RP. The groundwater elevation will be calculated by subtracting the depth to groundwater from the RP elevation. These values will be used as references to synchronize the transducer system in the monitoring well.

- The sampler will record the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and other pertinent information in the log.
- The sampler will record whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented cables are acceptable if the transducer data are properly corrected for natural fluctuations in barometric pressure, which requires commensurate logging of barometric pressures.
- Transducers will be able to record groundwater levels with an accuracy of at least 0.1 feet. Various factors will be considered in the selection of the transducer system, including battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers.
- Follow manufacturer specifications for installation, calibration, battery life, correction procedure (for non-vented cables), and anticipated life expectancy to ensure optimal use of the equipment.
- Secure the cable to the wellhead with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker to allow estimates of future cable slippage.
- The transducer data will be checked periodically against hand-measured groundwater levels to monitor electronic drift or cable movement. This check will not occur during routine site visits, but at least annually.
- The data will be downloaded regularly to ensure data are not lost and entered into the DMS following the QA/QC program established for the GSP. Data from non-vented cables will be corrected for atmospheric barometric pressure changes, as appropriate. After ensuring the transducer data have been downloaded and stored in the DMS, the data will be deleted from the data logger to ensure that adequate data logger memory remains for future measurements.

7.11.2 Water Quality

Water quality samples will be collected from PWS, ILRP wells, shallow monitoring wells and sentry wells. The samples will be collected by various agencies.

All designated water quality monitoring wells are part of public water supply systems. The state of California requires that public water systems maintain a level of water quality monitoring that ensures the public is provided with a safe, reliable drinking water supply. Specifically, system operators must collect and analyze samples from their producing wells to determine the concentration of a broad range of constituents on a scheduled basis as detailed in Title 22 of the California Code of Regulations. The sampling events are carried out under detailed sampling plans which comply with state requirements. Wells are typically pumped for about 15 minutes prior to acquiring water quality samples to ensure the wells are adequately purged.

All public water system operators have been trained for water quality sampling to obtain certifications. PWS wells are required to be pumped for a minimum of 15 minutes prior to collection of samples, the samples are collected from dedicated sampling ports near the well head, the samples will be collected directly into laboratory prepared bottles, cooled to 4° degrees Celsius and then transported (shipped) to a state Environmental Laboratory Accreditation Program (ELAP) certified laboratory under standard chain of custody.

Water quality samples collected from selected ILRP wells will be performed using protocol described in their Water Quality Trends Monitoring Programs.

Water quality samples collected from dedicated monitoring wells will be collected using the following protocol obtained from DWR's Groundwater Monitoring Protocols, Standards, and Sites BMP, 2016 and as modified for the well types to be sampled:

- Prior to sampling, the sampler must contact the laboratory to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.
- Each well has a unique identifier as contained in **Table 7-4** and will be used to record field measurements and on the sample bottles.
- Laboratory bottles labels will be filled out prior to collection of the samples. The labels are to include: the well name, sampler initials, date, and time of collection of the samples, preservative used, and the type of analysis to be performed.
- The groundwater elevation in the well will be measured prior to being purging of the wells using following appropriate protocols described above in the groundwater level measuring protocols.
- The sampler must decontaminate sampling equipment between sampling locations or wells to avoid cross-contamination between samples. The sampler should clean the sampling port and/or sampling equipment and the sampling port and/or sampling equipment must be free of any contaminants.
- In the NASb most sentry wells are not equipped with sampling pumps and therefore a temporary sampling pump will be installed to purge the wells. The purge time will be calculated using the well construction details and the depth to water. Three well volumes will be purged prior to collection of a sample.
- While purging the wells: pH, temperature, and electrical conductivity (EC) will be monitored at select intervals using a calibrated multi-parameter meter and noted on the field groundwater sampling records.
- In the case of wells with dedicated pumps, samples will be collected at or near the wellhead. Samples should not be collected from storage tanks, at the end of long pipe runs, or after any water treatment.

- All samples will be collected from the pump discharge or sampling port directly into laboratory prepared bottles, cooled to 4 degrees Celsius and then transported (shipped) to an ELAP certified laboratory under standard chain of custody.
- All analyses will be performed by a California State certified ELAP laboratory.

7.12 Data Reporting

All of the groundwater level measurements collected will either be reported to CASGEM and or stored in the DMS developed for the Subbasin. Water quality data will be reported to the GAMA database.

A DMS has been developed for the Subbasin that access publicly available data (DWR, CASGEM, GAMA, and USGS databases) and to store historic and future local data including water supply information. All data is recorded in standard units for water volumes and flow and depths and elevations (NAVD88). All measurement locations are geographic referenced.

The data will be analyzed and reported in annual reports and shared with Stakeholders. The data will be used to provide annual updates and to support revisions to the groundwater model.

7.13 Monitoring Network Improvements

An assessment of the existing monitoring network and representative monitoring wells shows the monitoring network is sufficient for assessment of the sustainability indicators.

Monitoring well network improvements, to be completed within the next 5-years, include:

- Two additional dedicated shallow monitoring wells are needed near high priority GDEs close to the Sacramento River (near the Sutter and Sacramento counties lines) and near the junction of the Bear and Feather rivers (along Ping Slough). Alternatively, surface water observation stations may be established along Ping Slough at road crossings as groundwater and surface water are interconnected in this area.
- Construct a new monitoring well near in the vicinity of monitoring well 112 to improve the monitoring network for chronic lowering of groundwater levels.

This page left intentionally blank

8. Sustainable Management Criteria

This section describes the criteria and the approach by which the NASb GSAs established what are collectively referred to as the Sustainable Management Criteria (SMC). As required by SGMA GSP regulations, this section describes the groundwater conditions that constitute SMC and the process by which the NASb GSAs characterize each element of the SMC.

The SMC include a sustainability goal for the entire NASb and for each sustainability indicator, as wells as locally defined undesirable results, minimum thresholds (MTs), and measurable objectives (MOs) with interim milestones. The sustainability goal and measurable objectives define conditions within the NASb that the GSAs plan to achieve while the minimum thresholds define what constitutes NASb wide undesirable results that GSAs hope to avoid. Defining SMC requires sound data, significant analysis, meticulous planning, and effective coordination and communication.

Provided within this section are the qualitative and quantitative defined conditions that make up each element of the SMC, an explanation of how each element of the SMC were developed, and how each element influences all beneficial uses and users of groundwater.

8.1 Sustainability Goal

As required by the SGMA regulations, the NASb GSAs developed a sustainability goal for the North American Subbasin which is to:

Manage groundwater resources sustainably for beneficial uses and users to support the lasting health of the Subbasin's community, economy, and environment. This will be achieved through:

- The monitoring and management of established SMC;
- Continued expansion of conjunctive management of groundwater and surface water;
- Proactively working with local well permitting and land use planning agencies on effective groundwater policies and practices;
- Continued GSA coordination and stakeholder engagement; and
- Continued improvement of our understanding of the Subbasin.

8.1.1 Supporting Sustainability Goal Information

The sustainability goal was developed by the NASb GSAs based on knowledge gained from actively managing groundwater in the NASb for decades.

Measures implemented to manage the NASb within the Sustainable Yield. To support the sustainability goal, the GSAs will continue to implement measures that will result in sustainable groundwater elevations over time. This includes continued and expanded conjunctive use practices.

Measures to be implemented in the Subbasin to ensure its sustainability include:

- Continued integrated management and adaptive management of water resources.
- Routine monitoring and analysis of groundwater levels and quality along with a comparison to established minimum thresholds and measurable objectives.
- Regular meetings with GSAs to discuss monitoring findings and, as necessary, adaptively adjust management activities to address and resolve adverse trends effecting groundwater conditions.
- Ongoing communication and engagement with stakeholders to build on understanding of how groundwater management activities potentially effect beneficial uses and users (*see* **Section 11 – Notice and Communication**).
- Implementation of projects and management actions (*see* **Section 9 - Projects and Management Actions**), as necessary, based on physical measurements of groundwater conditions at representative monitoring wells.

Information from Basin Setting and Groundwater Conditions used to establish Sustainability Goal. The GSAs established the sustainability goal through a comprehensive understanding of groundwater conditions based on technical information as previously documented in **Section 4 – Hydrogeologic Setting and Section 5 – Groundwater Conditions**. This understanding of the Subbasin setting and groundwater conditions provides a strong foundation for evaluating the sustainability indicators[2] through the SMC and by tracking progress through a detailed monitoring network. The process is defined below.

The process of defining the SMC, specifically minimum thresholds and undesirable results, is heavily dependent on evaluating the applicable sustainability indicators through the specific regulatory sections in three separate parts of the GSP regulations. These three sections include the specific sustainability indicator in the Groundwater Conditions section of the Basin Setting

[2] Sustainability indicators are defined and described in greater detail in sections 8.2 and 8.3.

sub article (§354.16), the minimum thresholds section of the SMC sub article (§354.28), and the monitoring network section of the Monitoring Network sub article (§354.34).

There are specific and separate instructions for the GSA to follow for each of the six sustainability indicators, which is carried through in three separate sub articles of the GSP regulations (i.e., the Basin Setting, SMC, and Monitoring Network). The specific information and purpose of these requirements for each sustainability indicator is illustrated in **Figure 8-1** and described below.

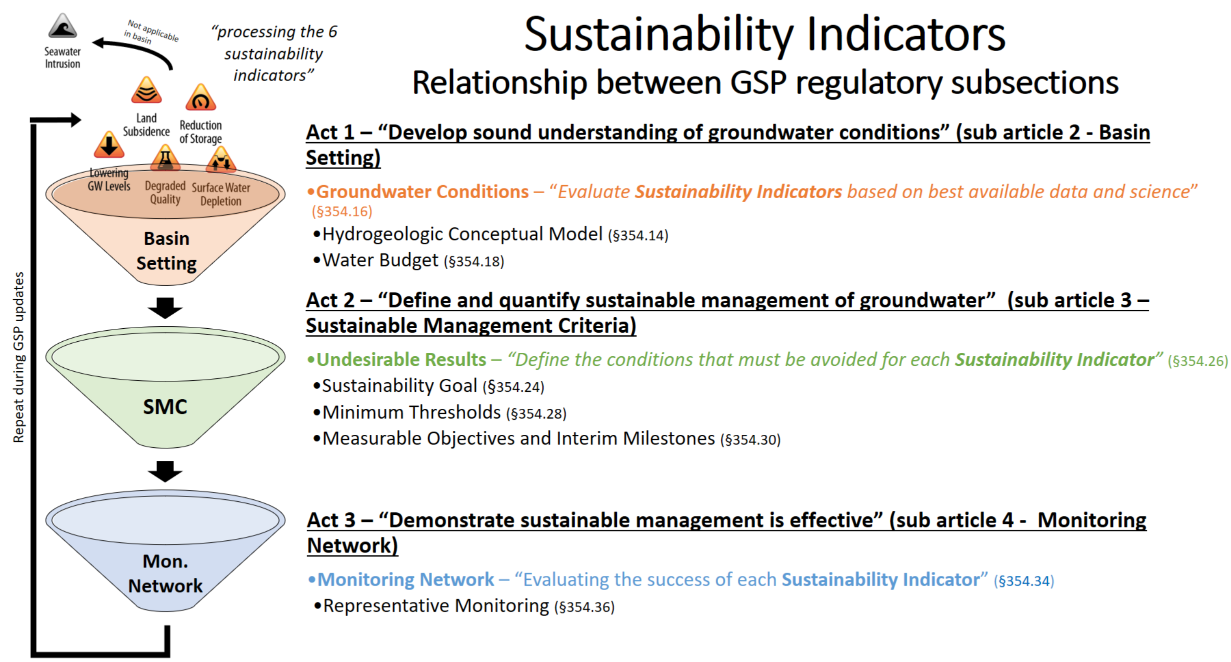


Figure 8-1. Processing of Sustainability Indicators

As illustrated in **Figure 8-1**, the NASb GSAs followed the process of carrying the applicable sustainability indicators for the NASb basin through this process. This process is also referred to as the "three act play" in reference to specific instructions provided for each of the six sustainability indicators that are located in each of three of the GSP regulation sub articles. The general intent of these instructions and how it resulted in NASb GSP development is paraphrased below.

- Basin Setting (GSP regulations - sub article 2) "Act 1" - Within the subsection Groundwater Conditions (§354.16), the current and historical conditions for each sustainability indicator must be evaluated based on best available data and science. This evaluation provides a baseline for each sustainability indicator in the basin and is foundational for the next GSP regulation requirement that applies to each sustainability indicator, the SMC. For the NASb GSP, this foundational baseline information can specifically be found in **Section 5 (Groundwater Conditions)**, but also **Section 4 (Hydrogeologic Setting)** and **Section 6 (Water Budget)**.

- SMC (GSP regulations - sub article 3) “Act 2” – Within the subsection Minimum Thresholds (§354.28), the GSA shall define and quantify the condition that must be avoided for each sustainability indicator. This is done at a site-specific scale through the use of minimum thresholds, and then again defined for each sustainability indictor at a basin scale through the quantifiable definition of undesirable results. These defined conditions provide the State, stakeholders, and GSAs clarity as to what constitutes sustainable groundwater management in the NASb. For the NASb GSP, this information can specifically be found in this section on the SMC.
- Monitoring Network (GSP regulations - sub article 4) “Act 3” - Within the subsection Monitoring Network (§354.34), the GSA shall demonstrate that sustainable groundwater management is effective. Essentially, the GSP defines specific monitoring locations and metrics to adequately evaluate success for each sustainability indicator. For the NASb GSP, this information is in **Section 7 - Monitoring Networks**.

Activities to achieve the sustainability goal for the next 20 years and beyond. The NASb GSAs believe the sustainability goal is currently being met, based on the absence of undesirable results, and plan to continue and expand on activities to maintain the sustainability goal for the next 20 years and beyond. Through the use of empirical data and modeling, the GSAs have evaluated: current groundwater conditions; projected groundwater conditions based on planned land use changes; and projected conditions as a result of planned land use changes with climate change. This evaluation indicates that by managing to the Subbasin’s SMC and through implementing planned projects and management actions, the NASb will remain sustainable as defined by the absence of undesirable results.

8.2 Process of Developing SMC

As provided in **Section 8.1**, the sustainability goal defines and summarizes the conditions in this GSP that constitute sustainable groundwater management for the NASb at the highest level. The remaining process of developing the SMCs is focused on the next levels of defined conditions in the NASb, including establishing undesirable results, minimum thresholds and measurable objectives. Remaining SGMA terminology as depicted on **Figure 8-2** such as *Sustainable Yield* is defined in **Section 6 - Water Budgets**.

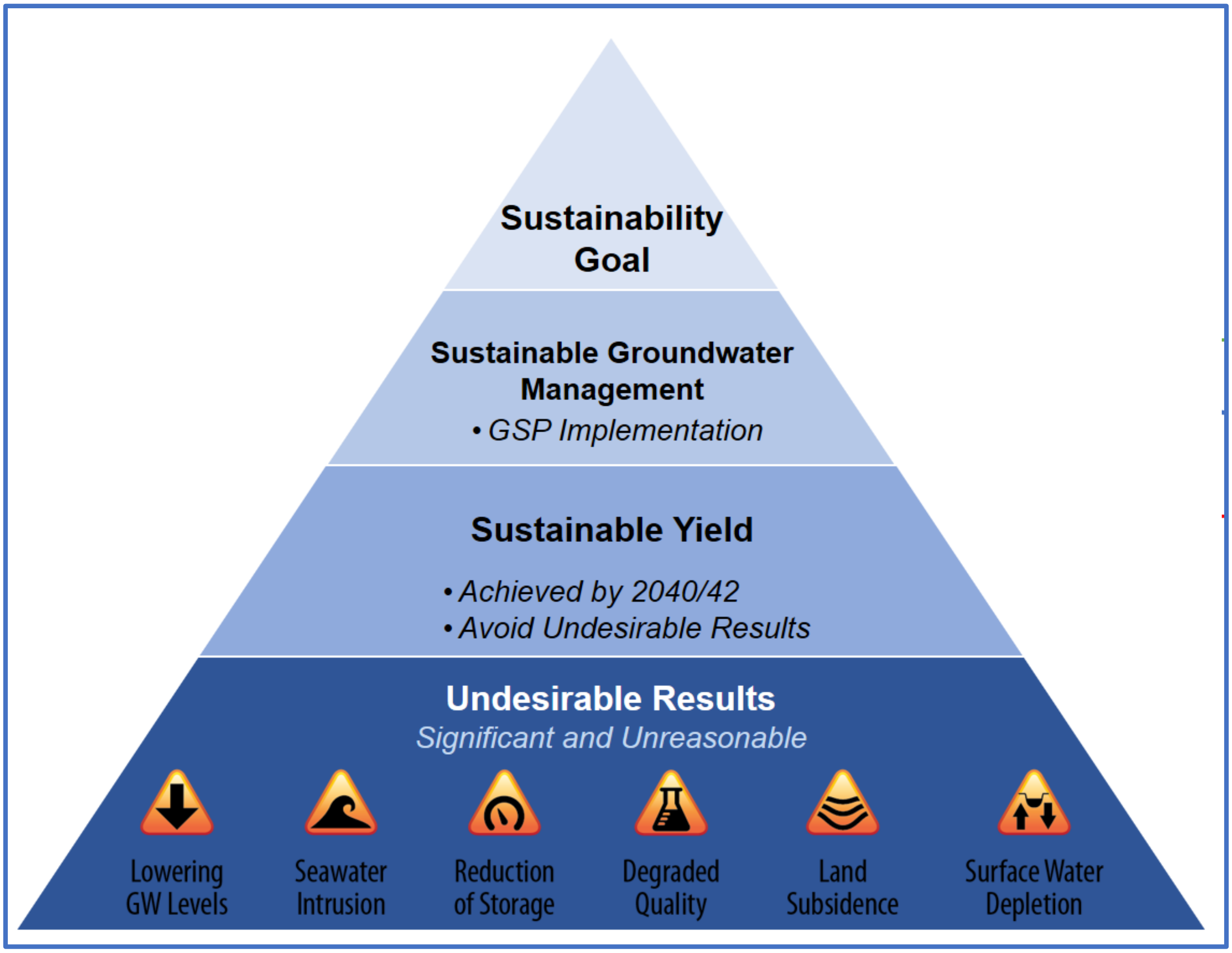


Figure 8-2. Depiction of Key SGMA Compliance Elements

This SMC section of the GSP was developed based on the application of technical information as is documented in:

- Section 4 – Hydrogeologic Setting
- Section 5 – Groundwater Conditions
- Section 6 – Water Budget
- Section 7 – Monitoring Network

The NASb GSAs completed a process during SMC development based on a comprehensive and strong foundational technical understanding of each applicable sustainability indicator. This process then included the development of proposed values that quantified Subbasin conditions that considered beneficial uses and users of groundwater. This process is summarized and illustrated on **Figure 8-3**.

- **Applicability of Sustainability Indicators.** Initially GSAs were required to complete the somewhat simple determination of which sustainability indicators were applicable in the NASb. Sustainability indicators are the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, become undesirable results. As described in **Section 4 – Hydrogeologic Setting** and **Section 5 – Groundwater Conditions** of this GSP, seawater intrusion is not an applicable sustainability indicator in the NASb. A specific description of how undesirable results, minimum thresholds, and measurable objectives were established for the five applicable sustainability indicators is provided in **Section 8.3**.

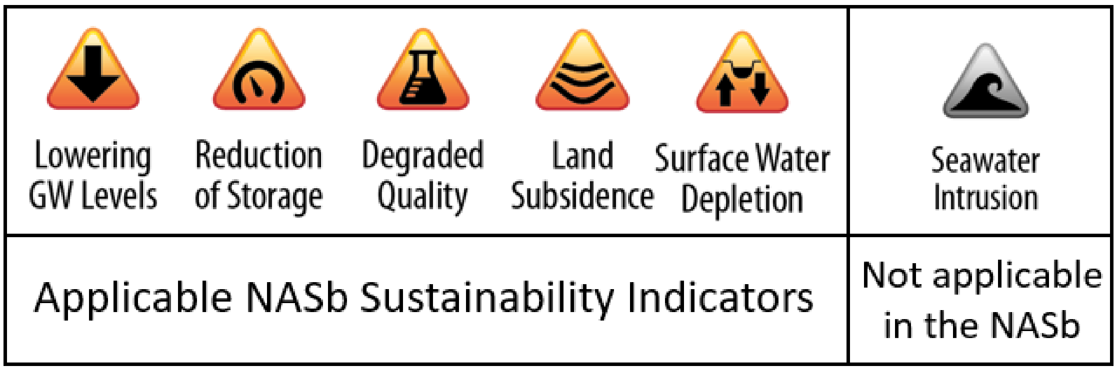


Figure 8-3. NASb Applicable Sustainability Indicators

- **Development of Measurable Objectives (MOs), Minimum Thresholds (MTs) and Undesirable Results.** This process consisted of developing proposed values for the key State regulatory required metrics that define conditions within the NASb that GSAs plan to achieve and also the conditions that GSAs plan to avoid. These include determining the MOs, MTs, and undesirable results for the NASb for each applicable sustainability indicator. **Figure 8-4** illustrates the relationship between the MOs and MTs. The GSAs used consistent methodology in development of the quantitative values for each of these as defined in subsequent sections below. These metrics include:
  - For the MOs, GSAs focused on developing target water levels and water quality that represent optimum water level and quality conditions in the NASb.
  - For the MTs, water levels and water quality values were set that if exceeded, could result in negative effects to beneficial uses and users in the NASb.
  - For the undesirable results, GSAs focused on defining for each sustainability indicator what combination of minimum threshold exceedances may constitute significant and unreasonable groundwater conditions that in turn would mean the NASb groundwater use is unsustainable.

Prior to discussing the proposed values for MOs, MTs, and URs for each sustainability indicator with stakeholders, the GSAs provided stakeholders background information on the status of each indicator in the NASb. This information was provided both in the form of draft GSP technical sections **(Sections 1 through 5)** and summarized in written form and included in presentations at public meetings. Discussion during these public meetings facilitated additional information sharing and clarity for the GSAs. Once GSAs felt that they had an understanding of stakeholder input on the material provided to the public, the GSAs were able to advance the proposed MTs, MOs and undesirable results values for each of the sustainability indicators as provided in the sections below:

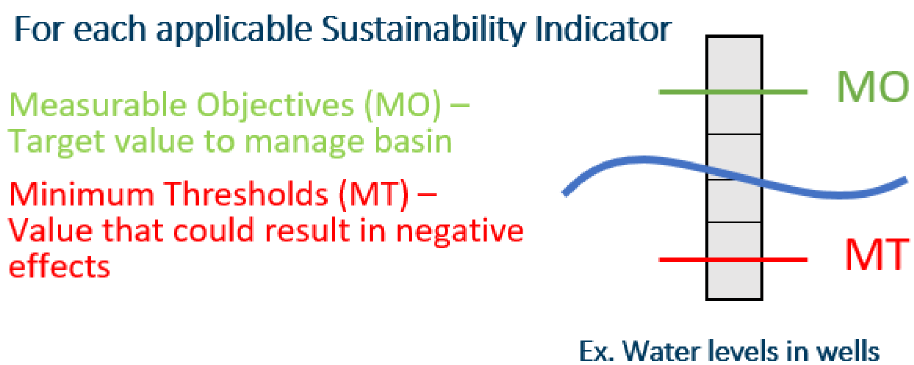


Figure 8-4. MO and MT Relationship

- **Consideration of beneficial uses and users.** This process consisted of identifying all the beneficial uses and users in the NASb and then evaluating the proposed MOs, MTs and undesirable results values based the interests of each beneficial uses and users of groundwater. These beneficial uses and users are listed below:
  - Agricultural
  - Domestic
  - Municipal
  - Public Water Systems
  - Environmental
  - Federal Government
  - Tribes
  - Disadvantaged Communities (DACs)
  - Surface Water Users
  - Parks
  - State Government
  - Local Land Use Planning Agencies
  - Conservancies

Stakeholders provided feedback individually, during public meetings or workshops, or as written comments, which enabled GSAs to fine-tune the quantitative values used for MOs, MTs, and undesirable results as defined below in this section. This approach was taken so that the SMCs would have a strong level of support among stakeholders and the GSAs responsible for implementing this GSP.

8.3 Sustainability Indicators

Sustainability indicators are the effects caused by groundwater conditions occurring throughout the Subbasin that, when significant and unreasonable, become undesirable results. Undesirable results are defined in the SGMA as one or more of the following effects:

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

2. *Significant and unreasonable reduction of groundwater storage*

3. *Significant and unreasonable seawater intrusion*

4. *Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies*

5. *Significant and unreasonable land subsidence that substantially interferes with surface land uses*

6. *Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water*

SGMA requires that GSAs demonstrate sustainability through the avoidance of undesirable results. The presence of significant and unreasonable effects for any of these indicators, if left uncorrected, could result in State intervention in the management of groundwater in the Subbasin.

8.3.1 NASb SMC Approach - Sustainability Indicator Grouping

The following sections of the SMC are grouped by sustainability indicator to not only retain an organized approach but to also ensure all of the GSP regulation requirements regarding SMC have been addressed. Each subsection of the NASb GSP follows a consistent format that contains the information required by Section §354.22 et. seq of the SGMA regulations and outlined in the Sustainable Management Criteria BMP (DWR, 2017). Each Sustainable Management Criteria section includes a description of:

- How locally defined significant and unreasonable conditions were developed.

- How undesirable results were developed, including:

- The criteria defining when and where the effects of the groundwater conditions cause undesirable results based on a quantitative description of the combination of minimum threshold exceedances (§354.26 (b)(2)).
- The potential causes of undesirable results (§354.26 (b)(1)).
- The effects of these undesirable results on the beneficial users and uses (§354.26 (b)(3)).

- How minimum thresholds were developed, including:
  - The information and criteria used to develop minimum thresholds (§354.28 (b)(1)).
  - The relationship between minimum thresholds and the relationship of these minimum thresholds to other sustainability indicators (§354.28 (b)(2)).
  - The effect of minimum thresholds on neighboring basins (§354.28 (b)(3)).
  - The effect of minimum thresholds on beneficial uses and users (§354.28 (b)(4))
  - How minimum thresholds relate to relevant Federal, State, or local standards (§354.28 (b)(5)).
  - The method for quantitatively measuring minimum thresholds (§354.28 (b)(6)).
- How measurable objectives were developed, including:
  - The methodology for setting measurable objectives (§354.30).
  - Interim milestones (§354.30 (a), §354.30 (e), §354.34 (g)(3)).

8.4 Sustainability Indicator #1 - Chronic Lowering of Groundwater Levels

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #1 – chronic lowering of groundwater levels.

8.4.1 Undesirable Results – Chronic Lowering of Groundwater Levels

Chronic lowering of groundwater levels is considered significant and unreasonable when:

- *20% or more of all NASb representative monitoring sites have minimum threshold exceedances for 2 consecutive Fall measurements (8 out of 41 wells).*

The NASb GSAs believe that this criterion would constitute an undesirable result, because it would indicate that about 20% of the area of the Subbasin would be experiencing an MT exceedance (based on relatively even spacing of the representative monitoring wells). As described further below, MTs were established by detailed modeling of expected future conditions that was then compared to beneficial uses and users to ensure that potential negative impacts would be avoided.

The use of 20% of the wells would help early detection of potential impacts of a regional nature. This is based on past experience in the Subbasin. For example, cones of depression emerged over time in both the agricultural areas in the northern part of the NASb and in urban areas in the southern part of the NASb (*refer to* **Section 5.3 – Historic Groundwater Contours**). These cones of depression represented overdraft conditions in relatively small portions of the subbasin that were significant enough for local agencies to take actions to correct them. For years, these local agency groundwater management activities have led to the stabilization and even some recovery of groundwater levels in the South Sutter Water District area since the mid-1960s and in Sacramento County since the mid-1990s.

Overall, the GSAs intend that groundwater elevations remain sustainable over time, which includes allowing for certain planned and managed areas of declining groundwater levels to support the future needs of the region. However, exceedances of MTs at more than 20% of the representative monitoring sites could be an indication that undesirable results are emerging from conditions that exceed the currently assumed future conditions, which could impact beneficial uses and users.

8.4.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for chronic lowering of groundwater levels is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of:

- Domestic and irrigation wells going dry (i.e., cost to deepen existing or construct new wells).
- Municipal wells decrease in capacity or go dry.
- Increased costs associated with lowering or replacement of pumps.
- Surface water is depleted such that creek flows are significantly reduced over time.
- Groundwater supported vegetation die or cannot repopulate, thereby reducing or eliminating GDEs.
- Significant increase in subsurface inflow from adjacent subbasins could impede adjacent basins from meeting their sustainability goals.
- Delaying contamination cleanup by potentially mobilizing existing plumes at existing remediation sites.

8.4.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for chronic lowering of groundwater level results are:

- A significant increase in NASb pumping distribution and volumes, most likely due to changing land use practices such as an increase or concentration of new agricultural and/or municipal pumping.
- A significant reduction in natural recharge as a result of changing surface water hydrology or land use (conversion to impermeable surfaces such as concrete, asphalt or homes).
- An increase in outside of basin demand for surface water (e.g., exports) that could result decreased surface water available for use in the NASb or decreasing natural recharge.

8.4.1.3 Effects on Beneficial Users and Land Use

If undesirable results occur, the likely effects will be experienced by domestic (i.e., shallow well) users. Shallow domestic wells would tend to be impacted first as groundwater levels decline, and rural residents may be faced with the financial burden of well deepening or replacement. If groundwater levels continued to decline causing a much greater percent of MT exceedances, a significant number of deeper domestic and ultimately agricultural and municipal production wells could be challenged to meet their water demands from groundwater.

The effects of undesirable results could also cause GDEs to be cut off from groundwater. GDEs are “ecological communities or species that depend on groundwater emerging from aquifer or on groundwater occurring near the ground surface” (23 CCR §354.24(m)). Undesirable results could include the disconnection of GDEs from saturated groundwater or reduced base flow to streams that depend on groundwater base flow, thereby impacting riparian ecosystems and aquatic species associated with GDEs.

8.4.2 Minimum Thresholds - Chronic Lowering of Groundwater Levels

The MTs used to support the undesirable results definition of the chronic lowering of groundwater levels are provided within this section.

8.4.2.1 Information and Criteria Used to Establish Minimum Thresholds

The GSP regulations require a description of the information and criteria used for establishing the chronic lowering of groundwater levels MTs (§354.28 (b)(1)). To develop proposed MTs, information was derived from detailed modeling analysis. The GSAs identified what conditions would look like at groundwater elevations at representative monitoring site (RMS) locations throughout the NASb under a scenario that included a 50-year simulation with projected demands, climate change, and an urban conjunctive use program. The scenario is described in

Section 9.2.1 – Project #1 Regional Conjunctive Use Expansion – Phase 1, and the CoSANA model is documented in **Appendix P – Groundwater Model Documentation**. The scenario is intended to provide a reasonable approximation of what groundwater conditions could look like over a 50-year hydrologic sequence if all of the demand, climate, and conjunctive use operations projections were realized.

As described in **Section 6 – Water Budget**, the NASb is currently under its estimated sustainable yield by more than 10 percent. Therefore, the NASb is in position to support additional development and land use changes that will result in increased groundwater use. With these land use changes and projected climate change, some portions of the basin could expect to experience lower groundwater elevations in the future. **Figure 8-5** shows the 50-year simulation projected water level changes from baseline conditions at each groundwater RMS location in the NASb.

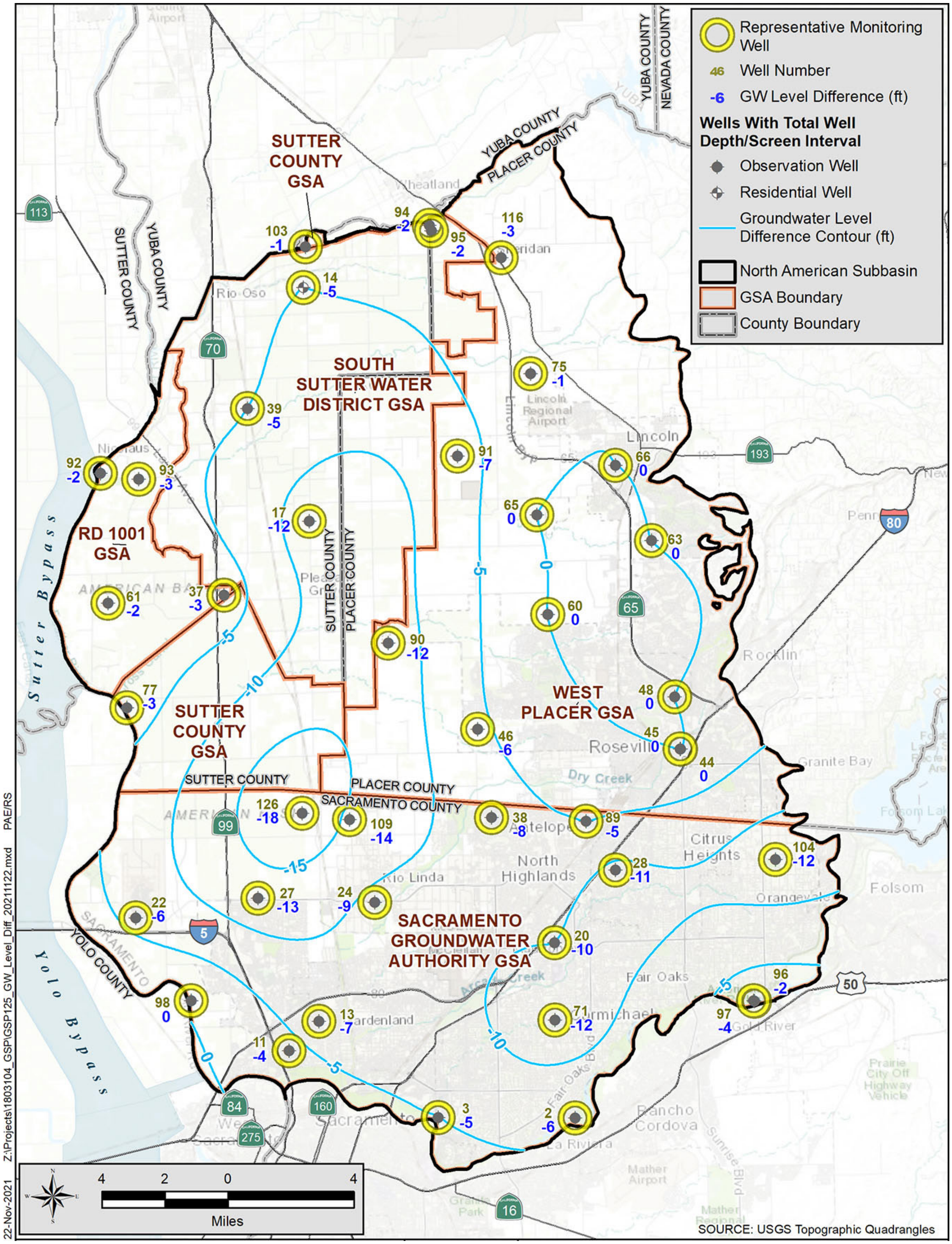


Figure 8-5. Projected Groundwater Elevation Changes at RMS Locations

The elevations in **Figure 8-5** are relative changes to groundwater levels projected at the end of the 50-year groundwater modeling simulation. The methodology used to develop MTs included subtracting the projected groundwater level elevations from baseline elevations. The average of Fall 2014 and Fall 2015 elevations were used for the baseline at each RMS, except in cases where the RMS wells were constructed after that time (data from 2018 through 2020 was used for these recent wells). The NASb GSAs believe this baseline approach is appropriate for the following reasons:

- It is consistent with the conditions present at the time of the passage of SGMA.
- It uses data from the most recent decade, which better reflects current hydrology and regional land use development conditions.
- It represents a period when relatively low levels of groundwater elevations were observed in the basin in which negative effects to beneficial uses and users were not reported or observed.
- As described in **Sections 3.13 and 5.2 through 5.4**, conjunctive use programs in the NASb have been implemented that have resulted in improved groundwater elevations relative to their historical lows in many parts of the subbasin (also see **Figure 5-3**). Using average 2014/2015 levels as the baseline for establishing MTs recognizes the benefit of those conjunctive use programs.

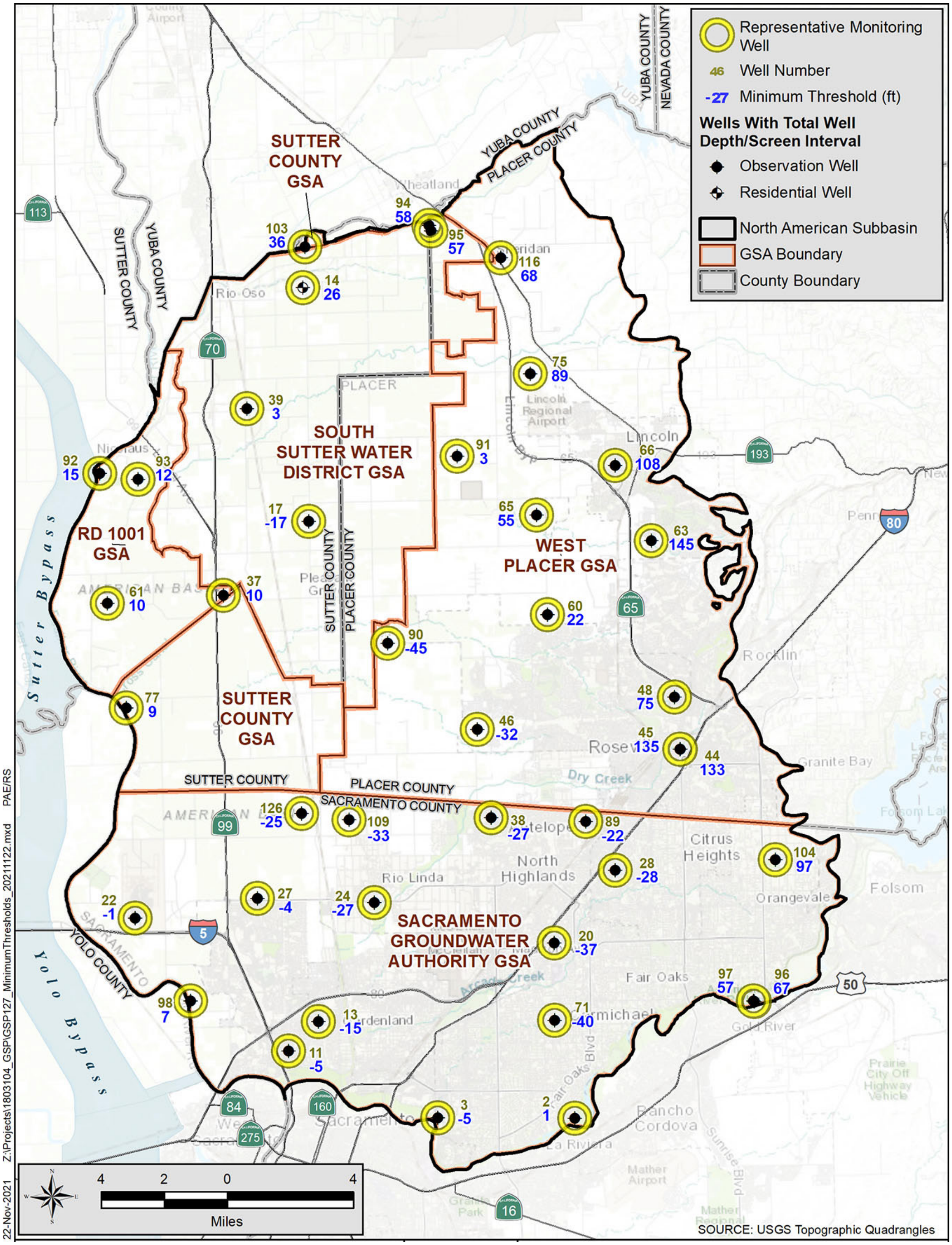
The final MT was then calculated by subtracting the relative change resulting from the 50-year modeled projections at each RMS (as shown in **Figure 8-5**) from the average Fall baseline. Following the calculations of the MTs, the resulting values were evaluated relative to beneficial uses and users and adjacent subbasins (see **Sections 8.4.2.4 and 8.4.2.5** below) to determine whether significant and unreasonable undesirable results would be experienced from those future groundwater elevations.

8.4.2.2 Chronic Lowering of Groundwater Levels Minimum Threshold

Table 8-1 shows the Fall baseline groundwater elevation, the model projected change from baseline, and the final selected MT at each RMS. The final MTs at the RMS locations for chronic lowering of groundwater are shown on **Figure 8-6**. Hydrographs for each RMS showing actual groundwater elevations in comparison to the average Fall condition baseline and model adjusted projected MTs are in **Appendix Q – SMC Hydrographs**.

Table 8-1. Chronic Lowering of Groundwater Level Minimum Thresholds

Representative Monitoring Site		Fall Baseline (ft msl)	Model Projected Water Level Change (ft)	Selected MT (ft msl)
Map No.	Local Name			
2	SGA_MW06	7	-6	1
3	SGA_MW04	0	-5	-5
11	Bannon Creek Park	-1	-4	-5
13	Chuckwagon Park	-8	-7	-15
14	13N04E23A002M	31	-5	26
17	AB-2 shallow	-5	-12	-17
20	SGA_MW05	-27	-10	-37
22	AB-4 shallow	5	-6	-1
24	SGA_MW02	-18	-9	-27
27	AB-3 shallow	9	-13	-4
28	Twin Creeks Park	-17	-11	-28
37	SUT-P1	13	-3	10
38	Lone Oak Park	-19	-8	-27
39	AB-1 shallow	8	-5	3
44	WPMW-10A	133	0	133
45	WPMW-9A	135	0	135
46	SVMW West - 1A	-26	-6	-32
48	WPMW-4A	75	0	75
60	WPMW-2A	22	0	22
61	Sutter County MW-5A	12	-2	10
63	WPMW-3A	145	0	145
65	MW 1-3	49	0	49
66	MW 5-1	108	0	108
71	WCMSS	-28	-12	-40
75	MW 2-3	90	-1	89
77	SREL-1-27-F1	12	-3	9
89	Roseview Park - 315	-17	-5	-22
90	WPMW-12A	-33	-12	-45
91	WPMW-11A	10	-7	3
92	RDMW-101	17	-2	15
93	RDMW-102	15	-3	12
94	RDMW-103	60	-2	58
95	RDMW-104	59	-2	57
96	1516	69	-2	67
97	1518	61	-4	57
98	URS71000-700+00C	7	0	7
103	BR-1B	37	-1	36
104	SGA_MW08	109	-12	97
109	SGA_MW01	-19	-14	-33
116	Old Well #2	71	-3	68
126	DeWit	-7	-18	-25



22-Nov-2021 Z:\Projects\1803104_GSP\GSP127_MinimumThresholds_20211122.mxd PAE/RS

Figure 8-6. Projected Groundwater Elevation MTs at RMS Locations

As described in the groundwater storage, land subsidence, and depletion of interconnected surface water sustainability indicator sections below, groundwater levels were used as a reasonable proxy for defining quantitative thresholds per GSP regulations (§354.28 (d)).

8.4.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

Assessing the relationship between the MTs for each sustainability indicator is a requirement of the GSP regulations (§354.28 (b)(2)). MTs are often established for multiple sustainability indicators at a single RMS. If the same RMS was used for multiple sustainability indicators that use groundwater elevation as a metric, the shallowest (or most protective) groundwater elevation will be used to evaluate potential negative effects at that location.

The relationship between the MT for chronic lowering of groundwater levels and those for other sustainability indicators are discussed below.

Reduction of groundwater in storage. There are different metrics identified in the GSP regulations for reduction of groundwater in storage (volume of groundwater extracted). However, as supported in the GSP regulations (§354.28 (d)), groundwater levels can serve as a reasonable proxy for defining quantitative thresholds for other sustainability indicators. For this reason, since the reduction of groundwater in storage MTs are dependent on avoiding undesirable results pursuant to the NASb's other sustainability indicators, maintaining the MTs for chronic lowering of groundwater levels equates to preventing an undesirable reduction of groundwater in storage.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

Degraded groundwater quality. The MTs are not expected to have a significant impact on groundwater quality. As shown in **Figure 8-5**, the areas of greatest drawdown are in the vicinity of the junction between Sacramento, Sutter, and Placer counties and trending to the north and south. To the north, there are no known areas of contaminants that could be mobilized from these changes in water levels. On the Sacramento County side of the junction, contamination at the former McClellan Air Force Base is actively managed and is expected to be largely remediated in the next two decades; there is very little risk of mobilization of the contaminant plume based on a study by the SGA as discussed in **Section 5.8.3**. Also as shown in **Figure 8-5**, despite some projected declines in groundwater elevations, these are not appreciable in the Subbasin over a 50-year period. This would not be expected to alter conditions in the aquifer to such a degree that significant mobilization or geochemical reactions related to the presence naturally-occurring constituents (e.g., arsenic) would be of concern.

Land subsidence. The MTs are not expected to have a significant impact on land subsidence. **Section 5.10 – Land Subsidence** documents that land subsidence has been negligible in the NASb since the 1990s. The historical rate of subsidence has been approximately 0.01 feet per 1 foot of groundwater level decline. The maximum MT decline is projected at 18 feet, which would equate to approximately 0.18 feet of subsidence over the next 50 years.

Depletion of interconnected surface water. There are different metrics identified in the GSP regulations for depletion of interconnected surface water (rate or volume of surface water depletion caused by groundwater use). As supported by the GSP regulations (354.28 (d)), groundwater levels can serve as a reasonable proxy for defining quantitative thresholds for this sustainability indicator. The NASb GSAs believe that the use of groundwater levels as a proxy is appropriate because:

- The relationship between groundwater elevations and surface water flows has been analyzed and well-established during preparation of this GSP (see **Section 5.11 – Interconnected Surface Water**) and has been analyzed extensively associated with flood control planning efforts in the region (see Luhdorff and Scalmanini 2009).
- An appropriate surface water depletion monitoring network has been established in the NASb (see **Section 7.9 – Surface Water Depletion**).

Similar to the reduction of storage, since depletion of interconnected surface water is dependent on avoiding undesirable results for the NASb's other sustainability indicators, maintaining the MT for chronic lowering of groundwater levels equates to preventing a significant and unreasonable undesirable result with respect to depletion of interconnected surface water. The highest projected future change in gradient associated with the MTs is along the Sacramento River (*see* **Figure 8-5**). As part of the modeling analysis, a review of additional seepage associated with the increased gradient away from the Sacramento River and changes to diversions from the river associated with land use changes reveals that there is an expected net increase in flows in the river. This is described further under **Section 8.9** below. Additional discussion of seepage associated with other interconnected surface waters is also discussed under **Section 8.9** below.

8.4.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The NASb shares boundaries with four groundwater subbasins: the South Yuba Subbasin to the north; the Sutter Subbasin to the northwest; the Yolo Subbasin to the southwest; and the South American Subbasin to the south. The NASb MTs would have negligible effect on adjacent subbasins. This is demonstrated by the modeling conducted to establish the MTs. The first line of evidence is in the limited lowering of average groundwater levels at the boundaries, which range from 0 to 6 feet (see Figure 8-3). These changes in groundwater levels ultimately translate to groundwater gradients, which drive groundwater flow across the boundaries. **Table 8-2** shows the subsurface flows under current and projected conditions used to establish the MTs. The difference in boundary flows associated with implementing the MTs is negligible. Representatives of the NASb met and discussed the boundary conditions with representatives from each subbasin, and the agencies agree that the proposed MTs will not impact their ability to sustainably manage their respective subbasins. This coordination is documented in **Section 11 – Notices and Communications**.

Table 8-2. Groundwater Flow with Neighboring Subbasins

Subsurface Groundwater Flow Across Boundaries with Neighboring Subbasins	Current Conditions (AFY)	Projected with Climate Change and Project Implementation (AFY)	Future Scenario Difference from Current Conditions (AFY)
Inflows			
South American Subbasin	16,600	18,000	1,400
Sutter Subbasin	1,400	2,100	700
Yolo Subbasin	9,000	11,600	2,600
Yuba Subbasin	6,700	7,600	900
Outflows			
South American Subbasin	9,700	11,800	2,100
Sutter Subbasin	2,000	1,400	(600)
Yolo Subbasin	500	400	(100)
Yuba Subbasin	100	100	-
Net Boundary Flows			
South American Subbasin	6,900	6,200	(700)
Sutter Subbasin	(600)	700	1,300
Yolo Subbasin	8,500	11,200	2,700
Yuba Subbasin	6,600	7,500	900

8.4.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The potential effects of MTs to specific applicable beneficial uses and users of groundwater in the NASb are described below.

Rural residential land uses and users. The chronic lowering of groundwater level MTs is protective of domestic well users' ability to access groundwater. As documented in **Appendix B**, domestic well construction was analyzed in the vicinity of each RMS location with a projected decline of 5 feet or more. The evaluation looked at the total depth and first open interval 1,331 potentially existing domestic wells. Note that there are an estimated 2,412 domestic wells NASb-wide. Based on the analysis, no domestic wells of up to 50 years old would go dry (e.g., drop below their total depth). Of wells that are greater than 50 years old, only 2 percent (26 wells) could potentially drop below their total depth; many of these may no longer in use. In terms of maintaining groundwater levels above their first open interval, domestic users are also protected. Of wells that are up to 50 years old, less than 1 percent (9 wells) could potentially drop below the first open interval. Of wells greater than 50 years old, less than 5 percent (65 wells) would potentially drop below their first open interval. Again, many of the wells are over 50 years old and may longer be in use. Confirmation of the status of these domestic wells is a management action in this GSP (see **Section 9.2.6**). MTs could result in slightly higher energy costs associated with greater pumping lifts in limited areas.

Agricultural land uses and users. Similar to rural residential users and users, MTs for chronic lowering of groundwater levels protect agricultural users of groundwater by protecting their ability to meet their typical demands. Most agricultural wells are constructed to deeper depths than domestic wells as shown on **Figure 7-6**. As MTs are set higher to protect other users like rural residences and GDEs, they will also be protective of agricultural beneficial uses of groundwater unless declines continue or are not stabilized. MT exceedances could also increase agricultural land users' energy costs associated with greater pumping lifts.

Urban land uses and users. The MTs for chronic lowering of groundwater levels are set so that all users, including municipal groundwater pumpers can still meet their typical water demands. Similar to the agricultural users, municipal wells are typically deeper, and as MTs are set higher to protect other users such as rural residential and GDEs, if MTs for chronic lowering of groundwater level are exceeded in many areas the exceedance will likely not limit urban beneficial use of groundwater unless declines continue or are not stabilized. MT exceedances could also increase urban land users' energy costs associated with greater pumping lifts.

Ecological land uses and users. The chronic lowering of groundwater level MTs protect Avoid undesirable results with respect to GDEs in the NASb. As described in **Appendix O**, a comparison of existing GDE areas under current conditions compared to conditions at the Subbasin MTs results in only a 2 percent decrease in vegetation and less than a 1 percent decrease in wetland areas. Of those potentially impacted areas, more than 70 percent of the vegetation was classified as low priority (meaning that neither critical species nor diverse vegetation was present) and all of the wetland areas that are potentially impacted were classified as low priority. The MTs are also protective of aquatic ecosystems, which is discussed further under **Section 8.9** below.

8.4.2.6 Relevant State, Federal, and Local Standards

No federal, state, or local standards exist for chronic lowering of groundwater elevations.

8.4.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater levels in RMS wells will be directly measured to determine where groundwater elevations are in relation to MTs and MOs. Groundwater level monitoring will be conducted in accordance with the monitoring protocols outlined in **Section 7.10 – Monitoring Protocols**. Many RMS wells are equipped with continuous data loggers to observe data in between the semi-annual MT and MO monitoring.

After the initial detection of an MT exceedance, the GSAs will:

- Take confirmation measurements.
- If the exceedance is confirmed, initiate an investigation to assess the cause of the exceedance.
- Identify if there are impacts as a result of the MT exceedance and possible mitigation measures, if impacts are noted.

8.4.3 Measurable Objectives – Chronic Lowering of Groundwater Levels

The MOs used to define preferred sustainable groundwater level conditions in the NASb are provided within this section.

8.4.3.1 Measurable Objectives

Groundwater level MOs were set above the MTs to allow for groundwater use for beneficial uses and users in the NASb. The MOs were established based on the approximate average historical Spring groundwater levels from 2010 through 2019 to reflect current conditions and because at these levels there were no reported negative impacts on beneficial uses and users. **Table 8-3** provides a listing of the selected MOs at each RMS.

8.4.3.2 Interim Milestones

Groundwater levels were established as interim milestones at all RMS on a 5-year frequency for the next 20 years as documented in **Table 8-3**. Groundwater levels in the NASb are currently above MTs at all RMS. Minor groundwater level declines in parts of the Subbasin are projected over the next 20 years based on modeling simulations. The 20-year interim milestone groundwater elevation coincides with the MO for each RMS. All of the values provided in **Table 8-3** will be periodically reevaluated as empirical data from monitoring is analyzed. For this reason, the values identified in **Table 8-3** will be evaluated and modified in accordance with the GSP regulatory requirements. The MOs at the RMS locations for chronic lowering of groundwater are shown on **Figure 8-7**.

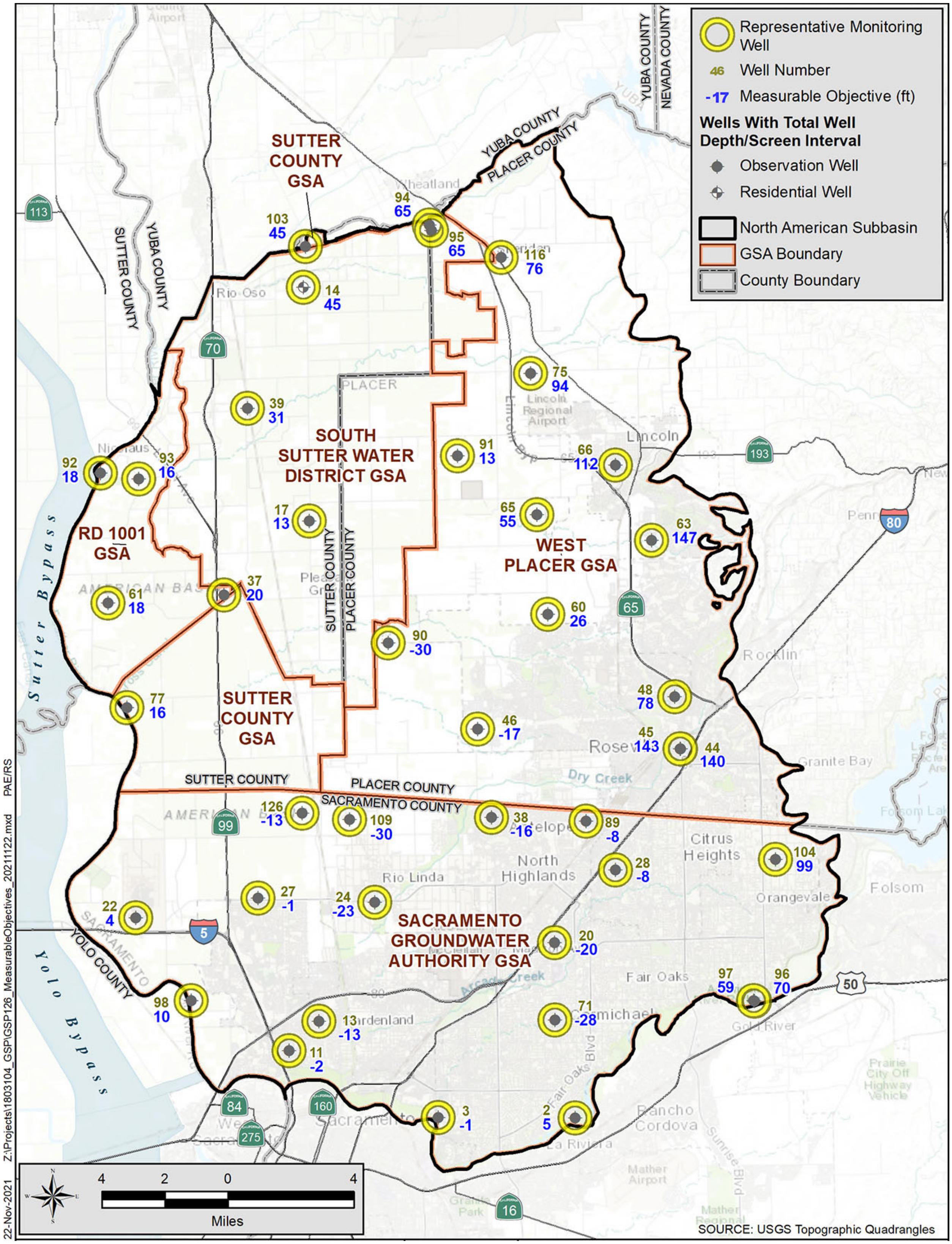


Figure 8-7. Projected Groundwater Elevation MOs at RMS Locations

Table 8-3. Chronic Lowering of Groundwater Level Measurable Objectives and Interim Milestones

Representative Monitoring Site		Selected MO (ft msl)	Interim Milestones (ft msl)			
Map No.	Local Name		Year 5 (ft msl)	Year 10 (ft msl)	Year 15 (ft msl)	Year 20 (ft msl)
2	SGA_MW06	5	9	7	6	5
3	SGA_MW04	-1	3	1	-1	-1
11	Bannon Creek Park	-2	1	0	-2	-2
13	Chuckwagon Park	-13	-8	-10	-12	-13
14	13N04E23A002M	45	49	47	46	45
17	AB-2 shallow	13	21	18	14	13
20	SGA_MW05	-25	-18	-21	-24	-25
22	AB-4 shallow	4	8	6	5	4
24	SGA_MW02	-23	-17	-19	-22	-23
27	AB-3 shallow	-1	8	4	0	-1
28	Twin Creeks Park	-19	-11	-15	-18	-19
37	SUT-P1	20	22	21	20	20
38	Lone Oak Park	-21	-15	-18	-20	-21
39	AB-1 shallow	31	35	33	32	31
44	WPMW-10A	140	140	140	140	140
45	WPMW-9A	143	143	143	143	143
46	SVMW West - 1A	-22	-18	-20	-21	-22
48	WPMW-4A	78	78	78	78	78
60	WPMW-2A	26	26	26	26	26
61	Sutter County MW-5A	18	19	19	18	18
63	WPMW-3A	147	147	147	147	147
65	MW 1-3	55	55	55	55	55
66	MW 5-1	112	112	112	112	112
71	WCMSS	-32	-24	-27	-31	-32
75	MW 2-3	94	95	94	94	94
77	SREL-1-27-F1	16	18	17	16	16
89	Roseview Park - 315	-13	-10	-11	-13	-13
90	WPMW-12A	-30	-22	-25	-29	-30
91	WPMW-11A	13	18	16	14	13
92	RDMW-101	18	19	19	18	18
93	RDMW-102	16	18	17	16	16
94	RDMW-103	65	66	66	65	65
95	RDMW-104	65	66	66	65	65
96	1516	70	71	71	70	70
97	1518	59	62	61	59	59
98	URS71000-700+00C	10	10	10	10	10
103	BR-1B	45	45	45	45	45
104	SGA_MW08	99	107	104	100	99
109	SGA_MW01	-30	-20	-24	-29	-30
116	Old Well #2	76	78	77	76	76
126	DeWit	-13	0	-6	-11	-13

8.5 Sustainability Indicator #2 - Reduction of Storage

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #2 – reduction of storage. Because chronic lowering of groundwater levels can be directly correlated to reduction of storage, groundwater levels will be used as a suitable proxy for reduction of storage.

Using the same modeling scenario for Sustainability Indicator #1 described above, results showed the basin's future projected inflows are balanced with projected outflows (*see* **Table 8-4)**. This would indicate that using the same MTs and MOs as the chronic lowering of groundwater levels MTs and MOs would also result in meeting this sustainability indicator.

Table 8-4. Projected Groundwater Change in Storage

Groundwater Budget Component	Current Conditions (AFY)	Projected with Climate Change and Project Implementation (AFY)
Inflows		
Deep Percolation	183,500	161,000
Stream Seepage	134,500	160,700
GW Injection (from ASR Operations)	200	2,100
Other Recharge	16,700	16,400
Subsurface Inflow	49,900	55,600
Total Inflow	***384,700***	***395,800***
Outflows		
Groundwater Outflow to Streams	53,000	42,400
Groundwater Pumping	303,300	338,500
Subsurface Outflow	13,600	14,900
Other Flows	-	100
Total Outflow	**369,900**	**395,800**
Change in Groundwater Storage	**14,900**	**-**

8.5.1 Undesirable Results – Reduction of Storage

The reduction of storage is considered significant and unreasonable when the following occurs:

- *20% or more of all NASb representative monitoring sites have minimum threshold exceedances for 2 consecutive Fall measurements (8 out of 41).*

8.5.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for reduction of storage are the same as used for chronic lowering of groundwater levels.

8.5.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for reduction of storage are the same as for chronic lowering of groundwater levels.

8.5.1.3 Effects on Beneficial Users and Land Use

The effects on beneficial users and land use are the same as used for chronic lowering of groundwater levels.

8.5.2 Minimum Thresholds – Reduction of Storage

8.5.2.1 Reduction of Storage Minimum Threshold

The GSAs used groundwater levels, which can serve as a reasonable proxy for defining quantitative thresholds for this sustainability indicator as supported in the GSP regulations (§354.28 (d)).

8.5.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

The information and criteria used are the same as used for chronic lowering of groundwater levels.

8.5.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between MTs for each sustainability indicator is the same as used for chronic lowering of groundwater levels.

8.5.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The effects of MTs on adjacent subbasins is the same as used for chronic lowering of groundwater levels.

8.5.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The effects of MTs on beneficial uses and users is the same as used for chronic lowering of groundwater levels.

8.5.2.6 Relevant State, Federal, and Local Standards

No federal, state, or local standards exist for reduction of storage.

8.5.2.7 Method for Quantitative Measurement of Minimum Threshold

The method for quantitative measurement is the same as used for chronic lowering of groundwater levels.

8.5.3 Measurable Objectives – Reduction of Storage

The measurable objectives used to define reduction of storage conditions in the NASb are provided within this section.

8.5.3.1 Measurable Objectives

MOs for reduction in storage are the same as used for chronic lowering of groundwater levels.

8.5.3.2 Interim Milestones

The interim milestones for MOs for reduction in storage are the same as used for chronic lowering of groundwater levels.

8.6 Sustainability Indicator #3 - Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator because the nearest occurrence of saline water intrusion into waterways, the Sacramento-San Joaquin River Delta, is about 40 miles west of the Subbasin boundary. The location of the saline front in the rivers has been maintained in the Delta in a similar location for nearly 80 years due to construction and operation of dams tributary to the Delta. Seawater intrusion is unlikely to occur during the planning horizon of this GSP.

8.7 Sustainability Indicator #4 - Degraded Water Quality

Although the concentration of constituents varies widely over the NASb and with depth at any given location, the quality of groundwater in the NASb has been suitable for nearly all beneficial uses and users. As described in **Section 5 – Groundwater Conditions**, there are some areas of elevated total dissolved solids (TDS), arsenic (As), hexavalent chromium (CrVI), iron (Fe), and manganese (Mn). Additionally, while not having any concentrations exceeding water quality standards, nitrates are an element of concern in the Subbasin. For the most part, constituent trends have remained stable and concentrations have not significantly changed over many decades, with the exception of nitrate, which has an upward trend in about 20 percent of the wells sampled (*refer to* **Table 5-4**). With scattered to very few possibly increasing trends in As, CrVI, Fe, and Mn observed to date and no significant changes in the planned use or management activities in the Subbasin, the NASb is not setting SMCs for these constituents. Rather, the GSAs will continue to monitor these constituents to observe if consistent increasing trends emerge. Because increases in TDS and nitrate can be associated with human activities, and, therefore, subject to some form of management if needed, the NASb is establishing SMC for these two constituents.

It is also worth noting that in the Sacramento County portion of the NASb, there are well-documented larger areas of contamination as described in **Section 5.8.3**. As also described in that section, the NASb has analyzed expanded groundwater use around the plumes relative to the ongoing remediation operations and found that the plumes have effective capture. Representatives of the NASb have also maintained active coordination with regulators and responsible parties to address effective remediation of these contaminants. For that reason, there are no SMC for the contaminants in groundwater.

Based on the above information, degraded water quality is considered significant and unreasonable in the NASb when either of the following occur:

For public water system wells

- *The basin wide average total dissolved solids (TDS) concentrations of <u>all</u> public water system wells exceeds 400 mg/l.*

OR

- *The basin wide average nitrate (as N) concentration of <u>all</u> public water system wells exceeds 8 mg/l.*

For the shallow aquifer (i.e. domestic and self-supplied) wells

- *25% of the representative monitoring sites (RMS)[3] total dissolved solids (TDS) or nitrate (as N) concentrations exceed state maximum contaminant levels (MCLs).*

---

[3] Representative monitoring sites (RMSs) are interchangeably referred to as representative monitoring wells (RMWs)

8.7.1.1 Criteria for Defining Undesirable Results

The criteria used to define undesirable results for degraded water quality is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of:

- Groundwater that fails to meet state drinking water standards for domestic and self-supplied wells which are located predominantly in the shallow aquifer.
- Groundwater that fails to meet state drinking water standards for public water systems (i.e., municipal wells).
- Groundwater exceeding agricultural water quality goals for TDS resulting in lesser crop yields.

8.7.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for degraded water quality are:

- Changes in NASb pumping distribution and volumes. This would be most likely due to changing land use practices such as an increase or concentration of new agricultural and/or municipal pumping. This pumping could alter hydraulic gradients and cause movement of poor-quality groundwater towards municipal or domestic wells, causing concentrations to exceed state drinking water standards or agricultural water quality goals.
- Changing land use practices that contaminate the quality of the groundwater basin or cause an increase in recharge of poor-quality water. Groundwater quality could become degraded by increasing the salt content (i.e., lowering of groundwater levels increases and changes in pressure allows saline water from underlying marine sediments to intrude into freshwater aquifers).

8.7.1.3 Effects on Beneficial Users and Land Use

If undesirable results were to occur, the effect may be groundwater quality that does not meet state drinking water standards or agricultural water quality goals. This would result in either potentially expensive treatment or may trigger increased use of an alternative water supply (e.g., surface water) to meet demands. An alternative water supply may be economically or physically infeasible for certain beneficial users.

This undesirable result does not apply to groundwater quality changes that are outside the control of the GSAs. Multiple federal, state, and local regulatory requirements regarding the protection of groundwater quality exist that will be enforced by these agencies.

8.7.2 Minimum Thresholds – Degraded Water Quality

The MTs used to support the undesirable results definition of the degradation of water quality are provide within this section.

8.7.2.1 Degraded Water Quality Minimum Threshold

The MTs are state drinking water standards for constituents of concern monitored in all public water system wells (i.e., municipal wells) and in the RMS locations for domestic/self-supplied wells for degraded groundwater quality. These MTs include:

- *Individual well total dissolved solids (TDS) concentrations that exceed the state secondary recommended maximum contaminant level (MCL).*
- *Individual well nitrate (as N) concentrations that exceed the state primary maximum contaminant level (MCL).*

As defined by the State Water Resources Control Board (SWRCB) the MCL for nitrate (as N) is a primary MCL and for TDS is a secondary aesthetic "taste and odor" MCL. State regulations allow public water systems to serve water that exceeds secondary aesthetic MCL standards under certain conditions and there are no public health goals for secondary MCLs, whereas primary MCL standards are more strictly observed.

8.7.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

Information used to establish the degraded groundwater quality MTs included:

- Historical and current groundwater quality data from municipal and monitoring wells in the NASb.
- Federal and State drinking water standards.
- Agricultural water quality goals.
- Depths, location, and geologic information from well logs throughout the NASb.
- Evaluation and organization of different well type construction data (i.e., domestic, municipal, and irrigation).

The criteria used to establish MTs consisted of analyzing the historical and current groundwater quality data as discussed in **Section 5 – Groundwater Conditions**. Based on a review of the information identified above, the GSAs determined that state drinking water standards are the most appropriate values to define as the MTs.

For public water system, or municipal wells, the SWRCB Division of Drinking Water (DDW) requires all active municipal wells be periodically sampled and analyzed in accordance with California Water Code Title 22 constituent standards. Results from this analysis is provided directly to the Division of Drinking Water through the Electronic Data Transfer site.

For domestic/self-supplied wells, special care was taken to evaluate the density and known well construction details of domestic wells by section in the NASb. As illustrated on **Figure 7-10**, RMSs were strategically located in areas throughout the Subbasin where the greatest density of domestic/self-supplied wells occur, along with additional wells to provide regional coverage in areas with lesser densities.

8.7.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The NASb projects and management actions (*refer to* **Section 9 – Projects and Management Actions**) are focused on ensuring the sustainability of the Subbasin from chronic lowering of groundwater levels, reduction of storage, land subsidence, and depletions of interconnected streams. The NASb groundwater quality generally meets all beneficial uses and users and is currently sustainable. From a GSP project and management action perspective, there are no projects and management actions in the NASb GSP focused on groundwater quality and, therefore, no direct relationship to other sustainability indicators. However, the prevention of migration of poorer quality groundwater, as a result largely of chronic lowering of groundwater levels, is the main relationship between the degraded water quality and other sustainability indicators.

In theory the degraded water quality MT could influence the **chronic lowering of groundwater levels, reduction of groundwater in storage, land subsidence,** and **depletion of interconnected surface water** MTs in a positive way, if groundwater pumping is reduced as a result of domestic and municipal users being unable to pump groundwater to meet demands. However, GSAs will be managing the groundwater to avoid this theoretical situation, so that groundwater can continue to be used for beneficial uses.

The metric of using state standards has been applied to define MTs for the degraded groundwater quality sustainability indicator. The remaining sustainability indicators' minimum thresholds are based on other metrics (i.e. all others use groundwater). For this reason, there is no conflict between the degraded groundwater quality and other MTs.

8.7.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The anticipated negative effects of exceeding the degraded groundwater quality MTs to each of the neighboring basins is very negligible to potentially nonexistent. If NASb degraded groundwater quality MTs were to be exceeded, it would likely be a result of significant groundwater level declines within the NASb that would result in potentially changing the direction or increasing the slope of the hydraulic gradient of groundwater from adjacent basins towards the NASb. This could result in a potential of increased rate and volume of subsurface flow into the NASb. For this reason, any groundwater quality degradation would likely be contained within the NASb. However, the flow dynamics associated with groundwater level declines, which may change the direction or increase the gradient across basin boundaries are also possible in the other subbasins, meaning if adjacent subbasin groundwater quality was significantly degraded it could impact the NASb.

8.7.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

Degraded groundwater quality minimum thresholds (if exceeded) may have effects on beneficial uses and users of groundwater in the NASb.

Rural residential land uses and users. The degraded groundwater quality MTs protect domestic users of groundwater in the basin as the MTs coincide with state drinking water standards. If the MT was exceeded for nitrate (as N) water would not meet primary MCL state standards. If the MT was exceeded for TDS, water would not meet secondary aesthetic MCL state standards. However, for TDS, domestic users would still be able to use groundwater in excess of the taste and odor thresholds.

Agricultural land uses and users. The degraded groundwater quality MTs generally benefit agricultural water users of groundwater in the basin as the MTs for the agricultural water quality goal of 450 mg/L to obtain 90 percent crop production for TDS is close to the drinking water standard of 500 mg/L. For this reason, groundwater quality approaching the MT will likely not negatively affect known agricultural land uses.

Urban land uses and users. The degraded groundwater quality MTs protect urban water users of groundwater in the basin as the MT coincides with state drinking water standards. Preventing groundwater used for drinking water from exceeding the state drinking water standards provides adequate water quality of groundwater for municipal uses.

Ecological land uses and users. The groundwater quality MTs would benefit ecological users by preventing poor quality groundwater from migrating to GDEs.

8.7.2.6 Relevant State, Federal, and Local Standards

The degraded groundwater quality MTs specifically incorporate state drinking water standards.

8.7.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater samples will be taken in accordance with the monitoring network description provided in **Section 7 – Monitoring Networks**. Results from these samples will enable GSAs to make a direct correlation between current groundwater quality concentrations and state water quality standards.

The GSAs also intend to monitor groundwater quality with the use of “Sentry Wells”. A Sentry Well is <u>not</u> an RMS as defined by the GSP regulations for degraded water quality. The GSAs have identified Sentry Wells for the specific purpose of providing early warning of groundwater quality changes (spatially or vertically) due to shifting changes in groundwater use in the NASb. The GSAs will sample, analyze, and report on water quality concentrations for TDS and nitrate (as N) at Sentry Wells to determine if water quality changes related to groundwater level changes that could result in MT exceedances could occur.

Many constituents that are routinely sampled and analyzed from groundwater wells (e.g., general minerals and metals) are often observed to have significant fluctuations in concentrations over time. Due to these fluctuations, multiple groundwater samples need to be collected over many years to establish trends and a true and accurate understanding of groundwater quality conditions. It is good practice to sample at the same time of year when collecting and analyzing groundwater quality samples from wells. TDS concentrations from groundwater samples are often more susceptible than many other constituents to fluctuating concentrations over time.

Furthermore, although the GSAs will strive to collect samples in accordance with best management practices, the practice of obtaining water quality samples in the field is done so in an uncontrolled environment and, therefore, can lead to erroneous data. For this reason, if MT exceedances are reported, GSAs may resample to verify measurements to ensure accurate readings are reported. Data determined to be erroneous by the GSA and not representative of actual conditions will not be used for the purposes of defining sustainability.

8.7.3 Measurable Objectives – Degraded Water Quality

The MOs used to define optimal water quality conditions in the NASb are provided within this section.

8.7.3.1 Measurable Objectives

The MO for public water system wells will be 300 mg/l for TDS and 3 mg/l for nitrate (as N). These MO concentrations are slightly higher than average concentrations observed in public supply wells from more than 300 samples of TDS and nitrate (as N) as summarized on **Table 8-5**. Slightly higher average MO concentrations were established based on the understanding that projected groundwater levels might be slightly lower in 2042, possibly increasing concentrations. A list of known public system wells and a summary of water quality detections is provided in **Appendix L – Summary of Water Quality Detections**. The average values for TDS and nitrate (as N) have been calculated based on the most recent sample result from each well as summarized in **Table 8-5**.

Table 8-5. Measurable Objective (Public Supply Well – Average Nitrate and TDS Concentrations)

Public Supply Well Statistic	Nitrate (as N)		TDS	
Units	mg/l		mg/l	
Date Range	4/9/1987	10/1/2019	4/9/1987	9/12/2019
Minimum Concentrations[1]	0		0	
Maximum Concentrations	10		720	
Maximum Contaminant Level (MCL)	10		500	
Number of reported concentrations observed above MCL during date range	0		3	
Number of wells with analytical results during date range	354		313	
Average concentrations reported during date range[2]	**1.8**		**258.4**	
Measurable Objective (Estimated concentration based on projected groundwater levels in year 2042)	**3**		**300**	

[1] For purposes of averaging concentration, less than the reporting limit is calculated as 0.
[2] Concentrations are calculated based on the average of the most recent sample result from each well.

The MOs for the domestic/self-supplied wells is approximately 10 percent higher than recent concentrations for Nitrate (as N) and TDS reported at each RMS as illustrated in **Table 8-6**. Similar to the methodology used to establish MO concentrations for public supply wells, the MOs for domestic/self-supplied wells are slightly higher than average concentrations observed in RMS as summarized on **Table 8-6**. Slightly higher average MO concentrations were established based on the understanding that projected groundwater levels might be slightly lower in 2042 possibly increasing concentrations. If an RMS does not have groundwater quality data during this period, an MO will be established prior to the next 5-year GSP update.

Table 8-6. Measurable Objective (Domestic/Self-supplied – RMS Nitrate and TDS Concentrations)

Map No.	Local Name	TDS (Secondary MCL = 500 mg/L)			Nitrate (Primary MCL = 10 mg/L)			Interim Milestones (mg/l)
		Reported Concentration (mg/L)	Selected MTs (mg/L)	Selected MOs (mg/L)	Reported Concentration (mg/L)	Selected MTs (mg/L)	Selected MOs (mg/L)	Year 5, 10, 15, & 20 (mg/L)
17	AB-2 shallow	200	500	220	ND	10	ND	ND
20	SGA_MW05	274	500	300	1.5	10	1.7	1.7
24	SGA_MW02	270	500	300	4.1	10	4.5	4.5
27	AB-3 shallow	150	500	170	ND	10	ND	ND
37	SUT-P1	110	500	120	ND	10	ND	ND
39	AB-1 shallow	140	500	150	ND	10	ND	ND
46	SVMWWest1A	unknown	500	TBD	unknown	10	TBD	TBD
80	Cemetery (IRLP)	268	500	290	unknown	10	TBD	TBD
89	Roseview Park - 315	190	500	210	unknown	10	TBD	TBD
90	WPMW-12A	210	500	230	0.58	10	0.64	0.64
91	WPMW-11A	220	500	240	1.0	10	1.1	1.1
99	Main Well	unknown	500	TBD	ND	10	ND	ND
109	SGA_MW01	330	500	360	0.9	10	1.0	1.0
133	LW-1	200	500	220	3.6	10	4.0	4.0
177	Well 22 - Northrop	110	500	120	ND	10	ND	ND
298	Tinker Road Well	220	500	240	3.87	10	4.26	4.26

8.7.3.2 Interim Milestones

Groundwater quality in the NASb is currently below the respective MTs for public supply wells and domestic/self-supplied wells, with no change in quality expected from projects and management actions implemented to maintain sustainability. Since the MOs effectively represent current conditions, interim milestones for the RMS wells are set as the same concentrations as MOs shown on **Table 8-6**.

8.8 Sustainability Indicator #5 - Land Subsidence

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #5 – land subsidence.

8.8.1 Undesirable Results – Land Subsidence

As described in **Section 5.10 – Land Subsidence**, past land surface subsidence has been very limited and has been gradual through time. As a result, no significant impacts have been documented in the NASb from subsidence. Additionally, the geologic setting (*see* **Section 4.9 - Geologic Sections**) does not indicate the presence of thick, laterally extensive clay deposits that generally create conditions for subsidence to occur. Based on these conditions, significant and unreasonable land surface subsidence could occur when:

The rate of inelastic subsidence exceeds 0.5 feet over a five-year period over an area covering approximately five or more square miles.

8.8.1.1 Criteria for Defining Undesirable Results

Based on past limited subsidence documented in the Subbasin, there have been no undesirable results encountered. Based on the hydrogeologic setting (*see* **Section 4 – Hydrogeologic Setting**) and projected conditions (*see* **Section 6.4.3 – Projected Water Budget**), the Subbasin would not expect to experience undesirable results associated with subsidence. Therefore, the criteria used would indicate exceeding past rates of subsidence. The area of five square miles was selected because it represents one percent of the total area of the Subbasin. An area covering less than that would be a highly localized phenomenon (or potentially based on erroneous data) that would not impact overall basin sustainability.

8.8.1.2 Potential Causes of Undesirable Results

Potential causes that may create these undesirable results could be from groundwater pumping causing groundwater levels to drop below historic lows which may result in inelastic land subsidence.

8.8.1.3 *Effects on Beneficial Users and Land Use*

As stated above, historically the Subbasin has not experienced undesirable results based on existing land subsidence data. For this reason, the extent and magnitude of how an undesirable result for land subsidence might impact beneficial users of groundwater and land uses can only be theorized. Therefore, should undesirable results for subsidence due to groundwater extractions occur, possible impacts to beneficial users' land use could include:

- Shifting of land gradients causing problems for crops that rely on precise irrigation depths (e.g., rice).
- Damage to pipelines and wells.
- Shifting of grades to sewer and storm drains preventing proper drainage.
- Damage to pavement on local roads and highways or structural damage to buildings.
- Lowering of levee crowns adjacent to rivers increasing flood risk.

8.8.2 Minimum Thresholds – Land Subsidence

8.8.2.1 *Land Subsidence Minimum Thresholds*

Groundwater levels are being used as a proxy for minimum thresholds. At each groundwater level RMS, either the minimum recorded low water level elevation or the projected low groundwater elevation, whichever is lower, is being used. In the case of historical lows, subsidence would not be expected until the level exceeded the minimum threshold. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (*refer to* **Section 5.10 – Land Subsidence**). As the maximum projected long-term drawdown within the Subbasin is about 18 feet, that would equate to approximately 0.18 feet of subsidence. That would not result in a demonstrable impact in the Subbasin (i.e., no infrastructure damage or loss of surface water conveyance capacity would be expected). **Table 8-7** shows the RMS locations used for land subsidence. The table also shows the MT as determined by the modeled projected conditions, for chronic lowering of groundwater levels and the minimum measured groundwater elevation near each location. Where the minimum elevation is lower than the modeled MT, the lower value is used for the subsidence MT.

Table 8-7. Minimum Thresholds for Land Subsidence RMS

Map No.	Local Name	Model Projected MT (ft msl)	Subsidence Historic Low Groundwater Levels	Selected MT (ft MSL)
2	SGA_MW06	**1**	**7**	**1**
3	SGA_MW04	**-5**	**-2**	**-5**
11	Bannon Creek Park	**-5**	**-2**	**-5**
13	Chuckwagon Park	**-15**	**-10**	**-15**
14	13N04E23A002M	**26**	**15**	**15**
17	AB-2 shallow	**-17**	**-21**	**-21**
20	SGA_MW05	**-37**	**-35**	**-37**
22	AB-4 shallow	**-1**	**4**	**-1**
24	SGA_MW02	**-27**	**-19**	**-27**
27	AB-3 shallow	**-4**	**5**	**-4**
28	Twin Creeks Park	**-28**	**-15**	**-28**
37	SUT-P1	**10**	**8**	**8**
38	Lone Oak Park	**-27**	**-19**	**-27**
39	AB-1 shallow	**3**	**-5**	**-5**
44	WPMW-10A	**133**	**133**	**133**
45	WPMW-9A	**135**	**131**	**131**
46	SVMW West - 1A	**-32**	**-28**	**-32**
48	WPMW-4A	**75**	**72**	**72**
60	WPMW-2A	**22**	**21**	**21**
61	Sutter County MW-5A	**10**	**-1**	**-1**
63	WPMW-3A	**145**	**146**	**145**
65	MW 1-3	**49**	**38**	**38**
66	MW 5-1	**108**	**104**	**104**
71	WCMSS	**-40**	**-26**	**-40**
75	MW 2-3	**89**	**86**	**86**
77	SREL-1-27-F1	**9**	**13**	**9**
89	Roseview Park - 315	**-22**	**-17**	**-22**
90	WPMW-12A	**-45**	**-65**	**-65**
91	WPMW-11A	**3**	**-18**	**-18**
92	RDMW-101	**15**	**14**	**14**
93	RDMW-102	**12**	**8**	**8**
94	RDMW-103	**58**	**36**	**36**
95	RDMW-104	**57**	**36**	**36**
96	1516	**67**	**69**	**67**
97	1518	**57**	**61**	**57**
98	URS71000-700+00C	**7**	**6**	**6**
103	BR-1B	**36**	**36**	**36**
104	SGA_MW08	**97**	**107**	**97**
109	SGA_MW01	**-33**	**-20**	**-33**
116	Old Well #2	**68**	**72**	**68**
126	DeWit	**-25**	**12**	**-25**

The Department of Water Resources (DWR) is advancing statewide understanding of land subsidence through the use of InSAR technology[4]. DWR has recently extended the use of InSAR technology first utilized in the San Joaquin Valley to evaluate the extent of subsidence to the Sacramento Valley. As data from InSAR has only recently become available, the GSAs did not have the time to thoroughly evaluate the use of InSAR collected data at the time of the preparation of this GSP in comparison to the process described above relating to understanding land subsidence in the NASb. For this reason, the NASb GSAs are establishing MTs using the accepted practice of utilizing historic land subsidence data and correlating it to groundwater levels. However, the NASb GSAs may incorporate DWR-provided InSAR data into how the GSAs evaluate compliance with the SMC.

8.8.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

Information used in establishing thresholds and objectives includes multiple lines of directly measured subsidence (*refer to* **Section 5.10 – Land Subsidence**), direct measurements of historic water levels (see **Section 5.2 – Groundwater Levels and Appendices G through I**), and modeled simulation of projected groundwater elevations based on future land use changes and future climate conditions (see **Section 8.4.2.2**).

8.8.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between land subsidence MTs for other sustainability indicators are discussed below.

Chronic lowering of groundwater levels. These are closely related in that the subsidence MTs will be measured at the same locations as for groundwater levels. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater levels are declining below their groundwater level MT, even though subsidence would likely not be occurring.

Reduction of groundwater in storage. These are closely related in that the subsidence MTs will be measured at the same locations as for groundwater levels. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater in storage is being reduced, with some minor projected subsidence.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

---

[4] InSAR (Interferometric Synthetic Aperture Radar) is a technique for mapping land subsidence with very precise accuracy using radar images of the Earth's surface that are collected from orbiting satellites.

Degraded groundwater quality. There is no relationship between subsidence and groundwater quality.

Depletion of interconnected surface water. These are closely related in that the subsidence MTs will be measured at the same locations as for interconnected surface water groundwater level locations. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater levels are declining that induces additional seepage of surface water, even though subsidence would likely not be occurring.

8.8.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The MTs are not expected to effect adjacent subbasins because they are established at historical or projected low groundwater levels in the representative groundwater level monitoring network, whichever is lower. In the case of historical lows, subsidence would not be expected until the level exceeded the MT. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (see **Section 5.10 – Land Subsidence**). As the maximum projected long-term drawdown at RMS locations to an adjacent subbasin is about 6 feet, that would equate to approximately 0.06 feet of subsidence. That would not result in a demonstrable impact on an adjacent subbasins.

8.8.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The MTs are not expected to effect beneficial uses and users because they are established at historical or projected low groundwater levels in the representative groundwater level monitoring network, whichever is lower. In the case of historical lows, subsidence would not be expected until the level exceeded the MT. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (see Section 5.10). As the maximum projected long-term drawdown within the subbasin is about 18 feet, that would equate to approximately 0.18 feet of subsidence. That would not result in a demonstrable impact on a beneficial user in the subbasin (i.e., no infrastructure damage or loss of surface water conveyance capacity would be expected).

8.8.2.6 Relevant State, Federal, and Local Standards

There are no established state, federal, or local standards for subsidence-related thresholds.

8.8.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater levels are being used as a proxy for MTs. While many of the groundwater elevation monitoring network wells are equipped with pressure transducers to collect at least daily water levels, the minimum standard for quantitative water elevation measurements will be through a manually collected field measurement taken twice annually (Fall and Spring). The Fall water level measurement will be used to compare against the MT.

8.8.3 Measurable Objectives – Land Subsidence

8.8.3.1 Measurable Objectives

Given the well-established relationship between groundwater levels and subsidence, groundwater levels are used as a proxy for MOs for land subsidence. Because the MOs established for chronic lowering of groundwater levels and reduction of groundwater in storage represent the desired state for a sustainable groundwater basin, those same values apply to land subsidence as shown in **Table 8-7**.

8.8.3.2 Interim Milestones

Because the MO interim milestones established for chronic lowering of groundwater levels and reduction of groundwater in storage represent the desired state for a sustainable groundwater basin, those same values apply to land subsidence as shown in **Table 8-7**.

8.9 Sustainability Indicator #6 - Depletion of Surface Water

The following description addresses SGMA GSP regulatory requirements related to sustainability indicator #6 – depletion of surface water. Because the depletion of interconnected surface water is directly related to the gradient between the surface water system at the groundwater interface and the groundwater Subbasin, groundwater levels are a suitable proxy for this sustainability indicator. Because surface water is not interconnected with the groundwater Subbasin over its entire area (*see* **Section 5.11**), only a subset (24 wells) of the RMS for groundwater elevations is used, which is shown in **Figure 7-13** in **Section 7.3 – Representative Monitoring Network**. Of those wells, some are monitoring different depths at the same location. As a result, there are 21 locations that will be used for evaluation purposes.

Using the same modeling scenario for Sustainability Indicator #1 described above, the effects on surface water flows resulting from land use changes and coincident additional use of groundwater can be observed. This would indicate that using the same MTs and MOs as those for the chronic lowering of groundwater levels would also result in meeting this sustainability indicator.

The results of the modeled scenario, which is described further in **Section 9.2.1 – Project #1 – Regional Conjunctive Use Extension – Phase 1**, indicate that NASb-wide groundwater extractions are projected to increase from their Current Conditions Baseline (CCBL) by some 40,000 AFY under the Projected Conditions Baseline with Climate Change (PCBL+CC). As shown in **Figure 8-5** above, the most significant drawdown of groundwater elevations under these conditions is near the Sacramento River. A detailed analysis of seepage along the Sacramento River from the modeling results indicates that the river will lose about 5,800 AFY over the 50-year simulation to the groundwater basin. However, as the municipal development occurs near the river, it will take some agricultural land out of production that currently diverts water from the river. As a result, Sacramento River flows will experience a net increase of about 17,200 AFY. This trend has already been observed by NMWC, which is in the area of proposed land use conversion. NMWC has observed surface water deliveries decline from an average of more than 80,000 AFY in the 1990s down to less than 65,000 AFY in the 2010s.

Figure 8-7 depicts the long-term projected changes along the Sacramento River on a monthly basis. Since the new groundwater demand is for public water supply, there is a baseline demand all year long (rather than a typical 6-month growing season). Additionally, some of the new public water supply will come from surface water, so there is a decrease in streamflow from January through March from diversions to meet that demand. The river will see its greatest increase in streamflow from May through August; this would have otherwise been diverted to meet agricultural demand. There is a net decrease in streamflow for the month of September, because there are still relatively high public supply demands in that month due to high air temperature and lack of precipitation. The net change is partially offset by the fact that many agricultural lands have reduced water applications in September. Overall, the projected land use changes would represent a net improvement to Sacramento River flows on an annual basis.

As described in **Section 5.11**, Central Valley Steelhead and Chinook Salmon are known to rely on the Sacramento, Feather, and American rivers, and Central Valley Steelhead are known to enter western Placer County creeks through the Natomas Cross Canal and the westernmost segment of Steelhead Creek. To evaluate whether there would be potential impacts to these aquatic species, additional seepage from each reach of these systems resulting from the modeled scenario described above was evaluated in comparison to total flow in the interconnected reach on a monthly basis. **Table 8-8** shows the projected average monthly flows in each reach, the projected future seepage from each reach to the groundwater system (value is negative when there is a net contribution from groundwater to surface water), and the percentage of surface water flow that seepage represents for any given month. As can be seen in the table, the seepage at all times represents less than 1 percent, generally substantially less, of flow in the rivers and the Natomas Cross Canal. In Steelhead Creek (aka Natomas East Main Drain), additional projected seepage is greater than 2 percent in a few months. However, that occurs in summer months when the fish species would not be migrating. Finally, it is worth noting that at no time do any of these reaches go dry. The Cross Canal and Steelhead Creek are constantly fed by urban runoff and wastewater treatment plants, and that condition is projected to increase with future development.

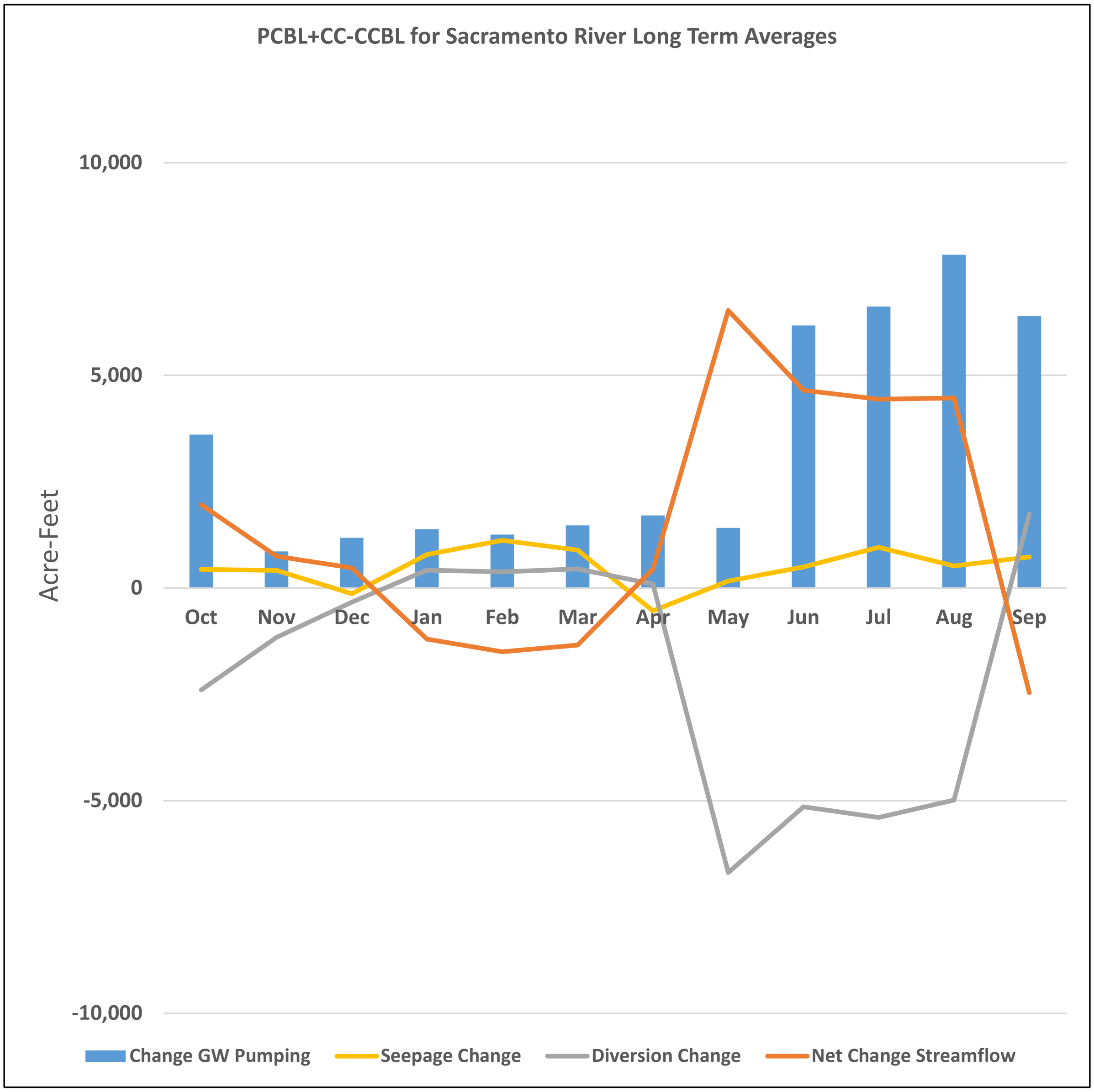


Figure 8-7. Projected Long-Term Average Annual Water Budget Change along the Sacramento River

Table 8-8. Seepage Changes in Interconnected Surface Waters that Support Critical Aquatic Species

Reach	Flow (acre-feet)	Seepage (acre-feet)	Seepage as Percent of Flow
Feather River			
Oct	166,572	156	0.09%
Nov	195,798	56	0.03%
Dec	354,140	369	0.10%
Jan	623,738	234	0.04%
Feb	814,007	422	0.05%
Mar	979,384	583	0.06%
Apr	449,412	-607	0.14%
May	208,164	-631	0.30%
Jun	212,331	87	0.04%
Jul	354,998	604	0.17%
Aug	274,013	-7	0.00%
Sep	288,837	336	0.12%
Annual Total	4,921,394	1,602	0.03%
Sacramento River			
Oct	509,583	485	0.10%
Nov	638,065	463	0.07%
Dec	1,078,974	-70	0.01%
Jan	1,718,596	862	0.05%
Feb	1,932,039	1,163	0.06%
Mar	2,021,789	871	0.04%
Apr	1,027,100	-493	0.05%
May	593,809	240	0.04%
Jun	559,450	568	0.10%
Jul	843,658	1,020	0.12%
Aug	723,319	574	0.08%
Sep	831,110	784	0.09%
Annual Total	12,477,492	6,467	0.05%
American River			
Oct	70,127	410	0.58%
Nov	92,426	517	0.56%
Dec	166,509	524	0.31%
Jan	305,324	784	0.26%
Feb	352,172	710	0.20%
Mar	378,339	918	0.24%
Apr	207,264	293	0.14%
May	104,031	17	0.02%
Jun	209,435	950	0.45%
Jul	221,909	764	0.34%
Aug	107,981	402	0.37%
Sep	117,452	749	0.64%
Annual Total	2,332,969	7,038	0.30%

Reach	Flow (acre-feet)	Seepage (acre-feet)	Seepage as Percent of Flow
Natomas Cross Canal			
Oct	7,156	41	0.57%
Nov	14,695	47	0.32%
Dec	30,120	40	0.13%
Jan	39,131	40	0.10%
Feb	37,100	49	0.13%
Mar	38,076	45	0.12%
Apr	11,913	31	0.26%
May	6,582	29	0.44%
Jun	5,123	21	0.41%
Jul	6,239	32	0.51%
Aug	5,227	30	0.57%
Sep	4,752	31	0.65%
Annual Total	206,114	436	0.21%
Steelhead Creek			
Oct	7,799	109	1.40%
Nov	13,522	75	0.55%
Dec	20,461	95	0.46%
Jan	26,383	92	0.35%
Feb	24,197	113	0.47%
Mar	24,097	133	0.55%
Apr	9,657	69	0.71%
May	6,465	101	1.56%
Jun	5,400	129	2.39%
Jul	6,194	163	2.63%
Aug	5,626	136	2.42%
Sep	5,510	125	2.27%
Annual Total	155,311	1,340	0.86%

8.9.1 Undesirable Results – Depletion of Surface Water

Depletion of surface water is considered significant and unreasonable when the following occurs:

- *20% or more of the NASb interconnected surface water (ISW) representative monitoring sites (RMS) have minimum threshold exceedances for 2 consecutive Fall measurements (5 out of 21).*

8.9.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for depletion of surface water is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of drawing down of groundwater levels such that a gradient is induced that results in significant and unreasonable depletion of surface water that could impact downstream users, riparian and aquatic habitat and species in the river corridor, or adjacent GDEs dependent on shallow groundwater.

8.9.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for depletion of surface water are increased groundwater extractions that could induce additional seepage from local rivers and tributaries.

8.9.1.3 Effects on Beneficial Users and Land Use

If undesirable results were to occur, this could reduce the availability of surface water for downstream and in-basin diverters, riparian and aquatic habitat and species in the river corridor, or adjacent GDEs. Reduced surface water availability could limit land use if reliable water supply is determined to not be available.

8.9.2 Minimum Thresholds – Depletion of Surface Water

Groundwater levels were used as a proxy metric for this sustainability indicator.

8.9.2.1 Depletion of Surface Water Minimum Threshold

The MTs for depletion of surface water are the same as for chronic lowering of groundwater levels, with the exception that only a subset of the RMS locations are considered interconnected with the surface water system. These are shown in **Table 8-9**.

Table 8-9. MTs, MOs, and Interim Milestones for Depletion of Surface Water

Representative Monitoring Sites (i.e. Wells)		Final Selection		Interim Milestones (ft msl)			
Map No.	Local Name	(ft msl)	(ft msl)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
2	SGA_MW06	5	1	9	7	6	5
3	SGA_MW04	-1	-5	3	1	-1	-1
11	Bannon Creek Park	-2	-5	1	0	-2	-2
13	Chuckwagon Park	-13	-15	-8	-10	-12	-13
14	13N04E23A002M	45	26	49	47	46	45
22	AB-4 shallow	4	-1	8	6	5	4
27	AB-3 shallow	-1	-4	8	4	0	-1
28	Twin Creeks Park	-8	-17	-8	-8	-8	-8
37	SUT-P1	20	10	22	21	20	20
44	WPMW-10A	140	133	140	140	140	140
45	WPMW-9A	143	135	143	143	143	143
61	Sutter County MW-5A	18	10	19	19	18	18
63	WPMW-3A	147	145	147	147	147	147
66	MW 5-1	112	108	112	112	112	112
75	MW 2-3	94	89	95	94	94	94
77	SREL-1-27-F1	16	9	18	17	16	16
92	RDMW-101	18	15	19	19	18	18
93	RDMW-102	16	12	18	17	16	16
94	RDMW-103	65	58	66	66	65	65
95	RDMW-104	65	57	66	66	65	65
96	1516	70	67	71	71	70	70
97	1518	59	57	62	61	59	59
98	URS71000-700+00C	10	7	10	10	10	10
103	BR-1B	45	36	49	47	46	45

8.9.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

The criteria used to define significant and undesirable results for depletion of surface water are the same as used for chronic lowering of groundwater levels, with an additional analysis of changes in streamflow as described above.

8.9.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between depletion of surface water MTs and other sustainability indicators are discussed below:

Chronic lowering of groundwater levels. These are closely related in that the MT values are the same. However, the MTs for depletion of surface water are only applicable at a subset of the overall groundwater level network, because only those locations with likely interconnected surface water are being monitored. Based on modeling results, maintaining groundwater levels above the MTs for surface water depletion will also result in not experiencing chronic lowering of groundwater levels.

Reduction of groundwater in storage. These are closely related in that the MT values are the same. However, the MTs for depletion of surface water are a subset of the overall groundwater level network, because only those locations with likely interconnected surface water are being monitored for that MT. Based on modeling results, maintaining above the MTs for surface water depletion will also result in not experiencing reduction of groundwater in storage.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

Degraded groundwater quality. There would not be expected degradation of groundwater quality as surface water is of generally higher quality.

Land Subsidence. The MTs are not expected to have a significant impact on land subsidence. The rate of subsidence been approximately 0.01 feet per 1 foot of groundwater level decline. The maximum MT decline for the depletion of surface water RMS location is projected at 13 feet, which would equate to approximately 0.13 feet of subsidence.

8.9.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

As described under the chronic lowering of groundwater levels, modeling results demonstrate that there are no significant impacts to adjacent basins from those MTs for the NASb.

8.9.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The MTs for interconnected surface water use the same elevations as the MTs for chronic lowering of groundwater levels. As described under the chronic lowering of groundwater levels, the MTs protect rural residential, agricultural, and urban users, as well as GDEs. Also as described above, there is no net decrease in surface water outflow from the NASb resulting from the use of groundwater or management actions under this GSP, so downstream uses would not be impacted. The MTs would result in minimal increases in seepage and rivers and their tributaries, and there are projected circumstances in which these systems would go dry; therefore, there are no expected significant and unreasonable undesirable results to aquatic species. As an additional protection to migrating fish species, the RD1001 GSA has a planned project on the Natomas Cross Canal to improve flood protection and improve channel habitat (see **Section 9.2.2**).

8.9.2.6 Relevant State, Federal, and Local Standards

No federal, state, or local standards exist for depletion of surface water.

8.9.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater elevations in RMS wells will be directly measured to determine where groundwater levels are in relation to MTs and MOs. Groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in **Section 7 – Monitoring Network**. Many RMS wells are equipped with continuous data loggers to observe data in between the semi-annual MT and MO monitoring.

Because of the sensitivity of the beneficial uses near the interconnected surface water systems, additional data analysis would begin if measurements were nearing an MT exceedance. After the initial detection of an MT exceedance, the GSAs will:

- Take confirmation measurements.
- Assess the groundwater gradients.
- If the exceedance is confirmed, initiate an investigation to assess the cause of the exceedance.
- Identify if there are impacts as a result of the MT exceedance and possible mitigation measures, if impacts are noted.

8.9.3 Measurable Objectives – Depletion of Surface Water

The measurable objectives used to define optimal management of groundwater and surface water conditions in the NASb are provided within this section.

8.9.3.1 Measurable Objectives

The process for establishing depletion of surface water MOs is the same as for chronic lowering of groundwater level MOs. These MOs are shown in **Table 8-9**.

8.9.3.2 Interim Milestones

Interim milestones are shown in **Table 8-9**.

This page left intentionally blank

9. Projects and Management Actions

SGMA requires that a GSP establish a sustainability goal that results in the absence of undesirable results within 20 years, with 2042 being the applicable deadline in the NASb. As described in previous sections of this GSP, the NASb is not experiencing any undesirable results and it does not project to experience any in the 2042 planning horizon. This projection includes planned growth and land use changes. However, the NASb GSAs recognize that some sustainability risk in the form of modest groundwater overdraft of about 3,500 AFY may present itself when climate change is considered in the 50-year planning horizon. To avoid future potential undesirable results related to lowering of groundwater levels and depletion of groundwater storage, additional conjunctive use opportunities in the urban municipal supply distribution systems were identified as a combined project. As a result, urban water purveyors under the Regional Water Authority (RWA) have been planning for the completion of a Federally-recognized groundwater bank, which will increase the use of the Subbasin as a storage reservoir as surface water reservoirs and the snowpack evolve under climate change. Further development of the Sacramento Regional Water Bank is presented as a management action below.

A description of current groundwater management activities, planned projects and management actions, and supplemental projects is provided below. Current groundwater management activities are those that are already ongoing and anticipated to continue. Planned projects and management activities (PMAs) are those that are intended to begin implementation within the first 5-year horizon of this GSP and that the NASb GSAs believe will aid in the achievement of the sustainability goal of the Subbasin, while allowing effective responses to changing conditions in the Subbasin. Supplemental projects are those that are still generally at a feasibility level of planning, so detailed information is not presented in this GSP.

9.1 Current Groundwater Management Activities

The NASb GSAs recognize that groundwater sustainability is not guaranteed without active management. As noted in **Section 5 – Groundwater Conditions**, the northern portion of the NASb experienced significant decline in groundwater levels until surface water was introduced to practice conjunctive use in agricultural areas. In the southern portion of the NASb, groundwater declines continued into the 1990s until a conjunctive use program was introduced into the more urban areas of the Subbasin. These and other PMAs that have brought the NASb to a point of sustainability are ongoing and warrant listing here. Additional information can be found at the referenced sections in this GSP.

- Continued conjunctive use in urban and agricultural areas (*see* **Section 3.13 – Conjunctive Use Programs**)

- Continued demand management through:
    - Temporary conservation measures consistent with water shortage contingency plans in Urban Water Management Plans that allow for water use reductions during periods of constrained supply (*see* **Section 3.10.5 – Urban Water Management Plans**)
    - Urban water use efficiency program (*see* **Section 3.10.6 – Urban Water Use Efficiency Program**)
    - Agricultural specific Efficient Water Management Practices (*see* **Section 3.10.7- Agricultural Water Management Plans**)
- Continued agricultural water reuse (*see* **Section 3.8.4 – Water Reuse**)
- Continued recycled water use (*see* **Section 3.8.3 - Recycled Water**)

9.2 Projects and Management Actions

Two projects and five management activities are described below that will help aid in reaching the NASb sustainability goal. For each PMA, SGMA-required detail is provided.

9.2.1 Project #1 - Regional Conjunctive Use Expansion – Phase 1

For more than two decades, municipal and industrial (M&I) water purveyors in the NASb have expanded conjunctive use operations that arrested past overdraft conditions and have resulted in generally increasing groundwater levels in the urban area. Additionally, M&I water purveyors in the South American Subbasin (SASb) have been expanding conjunctive use for the past decade that has also improved conditions south of the American River. In 2019, the Regional Water Authority completed a Regional Water Reliability Plan (RWRP) that identified additional conjunctive use operations that could be achieved with both existing facilities and with future water facilities improvements to expand upon successful conjunctive use.

Project Description:

This project identified additional conjunctive use that could be implemented in the near-term by reoperating existing water treatment and distribution facilities[5]. The conjunctive use program was closely coordinated with the SASb and was evaluated as part of a single modeling evaluation. The project will provide additional surface water during wet years to reduce existing demand on groundwater. Some additional groundwater would be utilized during dry years, but

[5] One exception is in the Rio Linda/Elverta Community Water District. Future demand projections are associated with the Elverta Specific Plan area, which is conditioned by Sacramento County to essentially implement a conjunctive use program if the development occurs. The model analysis assumed that the new demand would receive surface water in wet years and use groundwater in dry years to assess the long-term effects on the subbasin. If the assumed growth does not occur, the projected demand will not increase.

average annual operations would result in a net decrease of groundwater extraction, resolving the deficit of 3,500 AF of projected overdraft with climate change. Agencies expected to participate by altering their groundwater extraction patterns to increase conjunctive use include California American Water, Citrus Heights Water District, City of Lincoln, City of Sacramento, Golden State Water Company, Rio Linda/Elverta Community Water District, Sacramento County Water Agency, and Sacramento Suburban Water District.

Hydrologic conditions serve as the trigger criteria for implementing the project. For example, when wet conditions existed in 2019, M&I purveyors in the region preferentially used surface water as a percentage of supply. As dry conditions emerged in 2020 and continued into 2021, M&I purveyors have increasingly used groundwater as a percentage of supply.

Measurable Objectives Expected to Benefit: The net reduction in groundwater extraction will benefit the measurable objectives for groundwater levels and, by extension, groundwater storage, and depletion of interconnected surface waters.

Project Status: The project is capable of proceeding immediately as hydrologic conditions warrant. Dry conditions in 2021 necessitate the preferential use of groundwater. Additional surface water use as a percentage of supply would increase when wet conditions return.

Permitting and Regulatory Process: The operations are within existing water rights, contracts, and authorized places of use, so no additional permitting or regulatory requirements are anticipated.

Public Noticing: The operations are within existing water rights, contracts, and authorized places of use, so no additional public noticing requirements are anticipated.

Expected Benefits: The project is expected to reduce long-term average pumping from the M&I area of in the NASb. This will fully mitigate the projected deficit of 3,500 AFY in average annual storage projected under future climate conditions described in **Section 6 – Water Budgets**.

How the Project will be Accomplished: The M&I purveyors involved have a history of working cooperatively together. While the project can already be implemented in the near-term, long-term operations of the conjunctive use program will likely require completion of planning of the Sacramento Regional Water Bank (described below), which will also establish a framework for accounting of the storage and recovery of water from the groundwater subbasin.

Legal Authority: Each of the M&I purveyors have the legal authority to operate the public water systems needed to implement the project.

Estimated Costs and Funding Plan: Because of the complexity of variable water costs among the participants, an estimated operations cost cannot be determined. However, each of the M&I purveyors will fund the shifting of supplies between groundwater and surface water from their existing operations and maintenance programs. Most of the infrastructure needed to implement the program is already in place. The only capital costs may be in some areas that will experience growth, which will primarily be funded through development fees.

Management of Groundwater Extractions and Recharge: The M&I purveyors have demonstrated a past ability to manage extractions and recharge to sustainably manage the Subbasin. Additionally, The Sacramento Regional Water Bank (Management Action #1, described below) will establish when extractions and recharge should occur and a framework for accounting for the storage and recovery of water from the groundwater subbasin.

Project Evaluation: To evaluate the potential effects of proposed projects and management actions in meeting the sustainability goals of the NASb GSP, the regional conjunctive use program has been analyzed using the groundwater model developed jointly for the CoSANA subbasins. The CoSANA model is described in greater detail in the water budget section of GSP **Section 6 – Water Budgets**.

For consistency and to support more accurate effects of project implementation, including subsurface groundwater flow estimates between the subbasins, modeling included projects proposed for both the NASb and SASb. Near-term projects and management actions simulated in the SASb include the portion of the Regional Conjunctive Use Program within that subbasin, Sacramento Regional County Sanitation District's Harvest Water Program, which delivers recycled water for in-lieu recharge and for habitat use, and a groundwater recharge project proposed by Omochumne-Hartnell Water District (OHWD) near the Cosumnes River. Both the Harvest Water Program and the OHWD recharge project are on the opposite side of the SASb from the NASb and, while beneficial to the SASb, are expected to provide very limited benefits to the NASb. Because those two projects have limited effect on the NASb, they are not described further in this GSP.

The analysis below considers the proposed projects using the Projected Conditions Baseline (PCBL) in CoSANA with climate change. The Projected Conditions Baseline applies future land and water use conditions and uses the 50-year hydrologic period of WY 1970-2019, with modifications for the climate change analysis.

Specific assumptions used for the effects of implementing the NASb project modeling scenario include:

- The program is a comprehensive regional conjunctive use program, with participation by both NASb and SASb urban purveyors
- The program will be integrated with the Regional Water Reliability Plan (RWA, 2019)
- Project operations include delivery of wet year surface water supplies to reduce groundwater use and dry year groundwater pump back operations to move water between distribution systems to meet demands

- A summary of the regional conjunctive use scenario assumptions is shown in **Table 9-1**

The results of modeling the projects in both the NASb and SASb are shown on **Figure 9-1.** The figure shows the changes in groundwater level hydrographs in the NASb compared to the PCBL with and without climate change. The benefits of the project are seen primarily in the Sacramento County portions of the NASb, as that is the area where most of the increased conjunctive use occurs. Groundwater levels in these areas are typically improved to approximately 3 to 5 feet above the comparable baseline.

Table 9-1. CoSANA Regional Conjunctive Use Scenario Specifications

Entity	Projected Demand (AFY)	Wet Year Additional SW Supply (AFY)	Wet Year GW Pumping Reduction (AFY)	Long Term (50-Yr) Avg. Annual Pumping Reduction (AFY)	Dry Year GW Pump Back (AFY)
Cal Am - Antelope	5,225	2,174	2,174	739	0
Cal Am - Arden	1,606	0	0	0	0
Cal Am - Lincoln Oaks	6,213	4,681	4,375	1,487	0
Citrus Heights Water District	17,172	719	653	222	0
City of Sacramento - North	62,922	1,000	1,000	340	0
Rio Linda/Elverta CWD	7,745	5,000	5,000	2,400	0
Sac. Suburban WD - North	24,848	2,000	2,000	680	0
Sac. Suburban WD - South	16,456	4,800	4,800	1,632	4,000
City of Lincoln	20,568	1,013	762	259	0
Subtotal NASb	***162,755***	***21,388***	***20,764***	***7,760***	***4,000***
Cal Am - Parkway	16,604	5,351	5,351	1,819	0
Cal Am - Suburban Rosemont	13,227	6,902	6,885	2,341	0
Golden State WC - Cordova	19,752	6,177	6,108	2,077	0
City of Sacramento - South	101,306	1,000	1,000	340	0
Sac County WA - Laguna Vineyard	72,423	1,000	1,000	612	0
Subtotal SASb	***223,312***	***20,431***	***20,344***	***7,189***	***0***

Figure 9-2 shows the cumulative change in storage compared to the PCBL both with and without climate change over the 50-year simulation period. While the PCBL has an average annual change in storage of 5,400 AFY (increasing) without climate change, the PCBL with climate change has an average annual reduction in storage of about 3,500 AFY. Implementing this project results in an average annual change in storage of approximately 0 AFY. Therefore, this project provides an average annual benefit to the subbasin of about 3,500 AFY, in addition to the benefits provided to the surface water bodies and the neighboring subbasins.

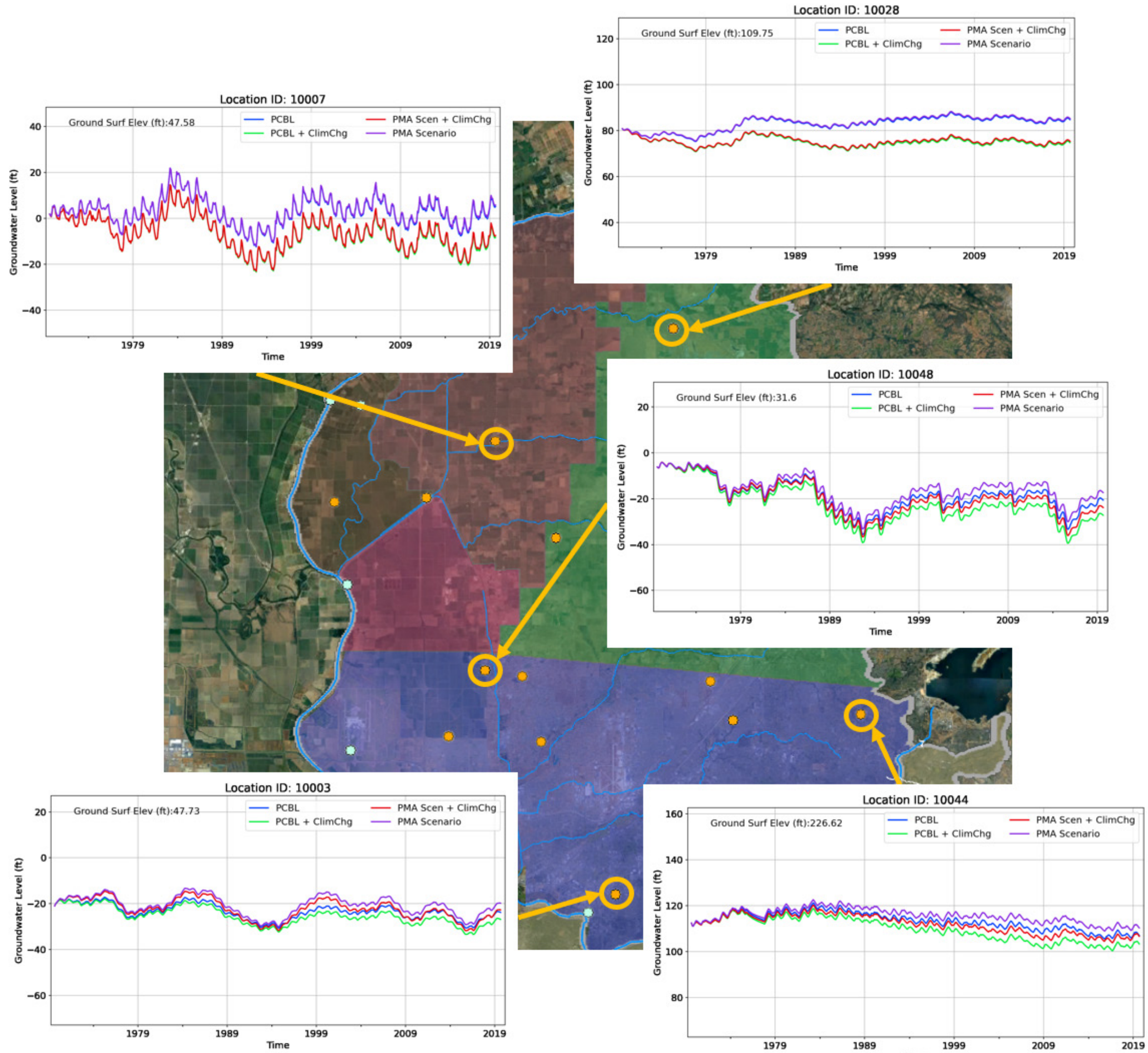


Figure 9-1. Groundwater Level Hydrographs, PMA Scenario and Associated Baselines

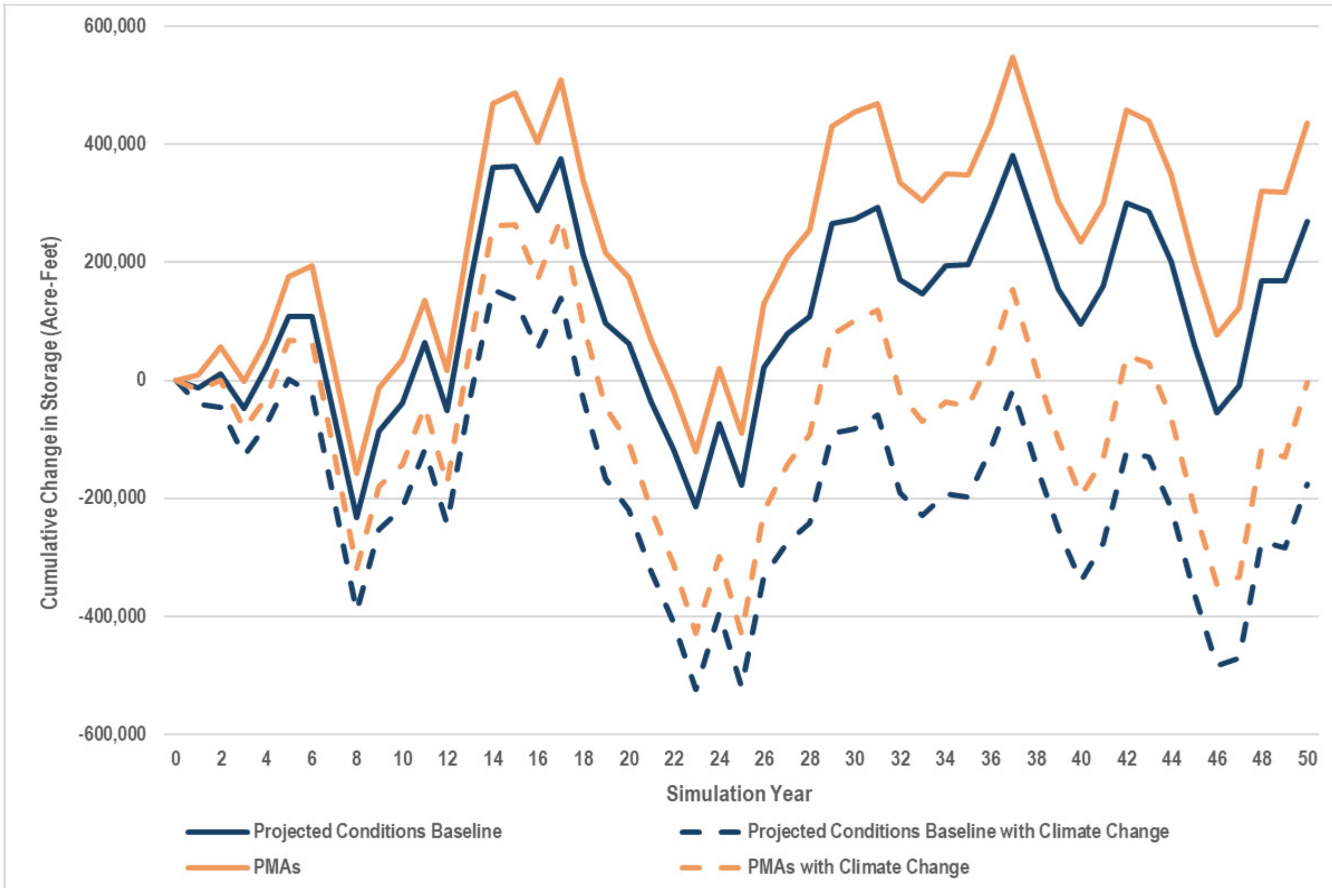


Figure 9-2. Cumulative Storage Change for the PMA Scenarios and Associated Baselines

9.2.2 Project #2 - Natomas Cross Canal Stability Berm and Channel Habitat Enhancements Project

Reclamation District 1001 (RD 1001) is proposing to design and implement the Natomas Cross Canal Stability Berm and Channel Habitat Enhancements Project (NCC SB & CHE Project) that will drastically improve flood protection through strengthening of the Natomas Cross Canal (NCC) north levee and enhance the aquatic and riparian habitat within the NCC channel.

The NCC is a man-made flood control feature, originally constructed in 1912, through use of a dragline excavator to excavate a canal and the placement of spoils to act as levees, offset from the channel on both sides of the canal. The NCC is intended to act as conveyance for numerous small tributaries that were intercepted by the flood control system to outflow into the Sacramento River. Four watersheds, including the Auburn Ravine, the Markham Ravine, Raccoon Creek and the Pleasant Grove Creek converge and flow into the Sacramento River through the NCC. These four watersheds are located north of the American River watershed and northeast of Sacramento, California. The original construction excavated and placed existing materials, predominately composed of variable lean-to-fat clay and silty materials, throughout the levee, which are subject to shrink-swell cycles that result in decreased stability over time. These stability issues were evaluated in 1987 and again in the DWR's Non-Urban Levee Evaluation (NULE) Program (Segment 284).

In addition to embankment stability issues, the NCC north bank levee has also had historical issues with wind-induced wave erosion. This erosion results from high winds pushing waves against levee embankments, resulting in erosion of the embankment material. The NCC north bank levee1 experiences prevailing southern winds during storm events which pushes the wave action towards the north levee. Observations from the most recent flood fight of wind-wave erosion, which occurred during the January 2006 flood event, indicate that the areas most susceptible to damage are those lacking adequate tree cover in the channel. The riparian forest acts as a buffer to break wind-induced wave action before it reaches the north bank levee.

The NCC was listed as the top priority for RD 1001 in the 2014 Feather River Regional Flood Management Plan (FRRFMP), due to "Potential overtopping, recurrent wave wash erosion, slumps, and cracking of the Natomas Cross Canal north levee." The highest priority project for RD 1001, as listed in the FRRFMP, was to "[r]aise, buttress, and provide erosion protection for the Natomas Cross Canal levee."

The primary purpose of the NCC SB & CHE Project will be to construct a stability berm along 11,000 feet of the NCC levee, in areas that have not been previously repaired, and to plant additional riparian vegetation to act as a natural wind-induced wave defense. The project will also enhance local aquatic and riparian habitat through vegetation management; terracing and grading the in-channel geometry, near the NCC and Sacramento River confluence; and reconfigure downstream portions of the NCC into a more meandering channel. This effort will utilize waterside berm plantings of varietal native understory and native plant species; thus, providing a natural wind-wave buffer that will also provide shaded riverine aquatic habitat over an additional 2,400 linear feet, along the channel edge. These habitat enhancements and channel modifications will benefit water quality, improve water flow along the channel, as well as provide more non-natal rearing habitat for juvenile salmon – particularly winter-run salmon and other commercially important fishes (including fall-run Chinook, steelhead, and green sturgeon). In addition, the habitat enhancements and channel modifications will also provide an additional flood control conveyance and natural erosion protection feature. Fish screens will also be installed on existing intakes to protect the fish within their new environment.

Construction of the proposed in-channel habitat improvements will yield a large enough quantity of borrow to construct up to a 11,000 linear feet of stability berm. The NCC SB & CHE Project plans to add riprap, soil, and plants on another 3,600 linear feet of the north NCC levee between RD 1001's main pumping plant, the NCC, and the Sacramento River confluence, to correct channel scour that is encroaching into the levee prism. These features will also provide adequate waterside berm to allow riparian habitat between the levee toe and the channel.

These various improvements the NCC SB & CHE Project will support many of the Central Valley Protection Plan's Conservation Strategy, and at the same time reduce flood risk, provide significant fish and wildlife habitat benefits, maintain the existing high-water quality within the NCC, protect local agricultural, and forested landscapes. These actions and benefits are also consistent with the State of California's planning priorities.

Measurable Objectives Expected to Benefit: This project is not expected to directly benefit a current measurable objective; however, it will improve flood protection and enhance aquatic and riparian habitat within the NCC channel, which are designed to help sensitive aquatic species (a beneficial use and user) to migrate into western Placer County creeks.

Project Status: As of November 2021, the project is currently at 65% design and is preparing submittals for CEQA and National Environmental Policy Act (NEPA) compliance, Central Valley Flood Protection Board encroachment permit, US Army Corps Sections 404 and 408 permissions, ESA consultation, CDFW Section 1600 Lake and Streambed Alteration Agreement, and Section 401 Water Quality Certification. Construction is expected to be completed in 2023.

Permitting and Regulatory Process: The project is preparing applications for regulatory permits as stated above. The operations are within existing water rights, contracts, and authorized places of use, so no additional permitting or regulatory requirements are anticipated.

Public Noticing: Public Noticing will occur for both CEQA and NEPA. The operations are within existing water rights, contracts, and authorized places of use, so no additional public noticing requirements are anticipated.

Expected Benefits: The project is expected to improve flood protection and enhance riparian habitat within the NCC channel.

How the Project will be Accomplished: RD 1001 has a history of successful project implementation and has a grant in place to fund the project. The RD also exists to operate and maintain flood control and drainage features and project operations and maintenance will fit within existing RD activities.

Legal Authority: RD 1001 has the legal authority to implement and operate the project as proposed.

Estimated Costs and Funding Plan: Project costs are estimated at $6,042,500. RD 1001 has a grant agreement in place with DWR utilizing funding from the Water Quality, Supply, and Infrastructure Improvement Act of 2014 to fund 100% of the Project pursuant to Water Code, section 79780.

Management of Groundwater Extractions and Recharge: This project is not intended to manage groundwater extractions and recharge.

Project Evaluation: RD 1001 will be implementing a monitoring program prior to, during and following project completion to evaluate the project. Details of this monitoring program are currently under development.

9.2.3 Management Action #1 - Complete Planning for Sacramento Regional Water Bank

Management Action Description: As envisioned, the Sacramento Regional Water Bank (Water Bank) will consist of an institutional and legal framework for operating a sustainable storage and recovery program in the North American and South American subbasins. Participation in the Water Bank will be voluntary, but it is intended to provide an incentive for participants to expand conjunctive use operations in the subbasins that would also allow for future groundwater substitution transfers, which can provide funding to maintain, replace and improve water supply infrastructure. The primary goal of the Water Bank is to manage the groundwater subbasins sustainably and to enhance climate change resilience through expanded conjunctive use, while protecting all beneficial uses and users in the subbasins. To achieve this, banking and recovery operations will need to be developed and evaluated using the regional CoSANA model, which will assist in accounting for stored water including losses through groundwater outflow from the subbasins over time. A fundamental principle of the Water Bank is that water must be stored before it can be recovered and losses must be accounted for, so that operations will contribute to enhancement of subbasin conditions; operations of the Water Bank will not operate in a deficit manner. It should be noted that a groundwater bank is already operating in the NASb in that the SGA GSA has accounted for actions to increase conjunctive use since 2012. The planning for the Sacramento Regional Water Bank will expand upon the program by seeking Federal recognition and will assess existing accounting consistent with SGMA requirements. Operations of the Water Bank will require monitoring and mitigation specifically designed to aid in the protection of beneficial users of groundwater in the Subbasin.

Measurable Objectives Expected to Benefit: The net increase in storage in the NASb will benefit the measurable objectives for chronic lowering of groundwater levels and, by extension, groundwater storage by raising groundwater levels and reducing depletion of interconnected surface waters.

Project Status: As of mid-2021, the planning for the project has entered its second and final phase. With development of GSPs and ongoing drought conditions in 2021, the majority of the planning effort is expected to commence in 2022 and take up to two years to complete.

Permitting and Regulatory Process: Initial operations of the Water Bank include the use of existing water rights and contracts within the existing public water supply distribution system of the subbasins. For these existing water rights, where appropriate the Water Bank would rely on the Department of Water Resources and United States Bureau of Reclamation (USBR) Water Transfer White Paper (2019) for transfer criteria and the State Water Board to approve temporary transfer of post-1914 water rights to enable groundwater substitution transfers for recovery operations. Most groundwater substitution transfers occurring in Sacramento County would also require a county permit. A county permit is not required in Placer or Sutter counties. GSA approval of substitution transfers is required in all counties. Additionally, the Water Bank will seek to be able to store and recover Central Valley Project (CVP) contract water for those agencies with federal contracts. For the federal component, the Water Bank would comply with the USBR Groundwater Banking Guidelines for CVP Water (2019). Operations of the Water Bank that result in groundwater substitution transfers would require concurrence of the GSAs in which such activities would occur in each year that a transfer is proposed.

Public Noticing: Completion of the Water Bank will include CEQA and NEPA environmental documentation and analysis and will be appropriately publicly noticed. In addition, RWA as the project lead to complete Water Bank planning, has conducted extensive stakeholder outreach for the project and will continue to provide notice and input opportunities to local stakeholder interests as the Water Bank is developed. Among other means, RWA will provide notice to GSAs and caucuses of the Sacramento Water Forum.

Expected Benefits and Evaluation: The 2019 RWA RWRP identified the potential to increase surface water use in the existing interconnected urban distribution systems in the region by up to about 60,000 AF as a means of storing water in the Water Bank. In dry years, the RWRP estimated the ability to increase groundwater extraction by about 60,000 AF to recover stored water. The operations would be roughly split in half between the NASb and the South American Subbasin. With system improvements (described under Supplemental PMA below), the RWRP estimated that both storage and recovery could be increased to about 90,000 AF in any given year, after completion of Phase 2 (refer to **Section 9.3 – Supplemental Projects**). Operations will be determined during the development of the Water Bank and evaluated using the CoSANA model used to develop the GSP. The evaluation will include determination of the volumes of water that will need to remain in storage in the subbasins to sustainably manage the Subbasin. Evaluation will include an analysis of future climate that will include consideration of the risks of changing hydrology and temperatures.

How the Project will be Accomplished: Development of the Water Bank is being coordinated by RWA. RWA has developed a scope of work to complete planning and has launched a Sacramento Regional Water Bank Program to complete the effort. The participants will work cooperatively to develop and operate the Water Bank in a way that results in improved groundwater subbasin sustainability. Most of the current participants have worked together since the 1990s through the Sacramento Water Forum, so they have demonstrated their intent and ability to achieve outcomes that benefit the region's community and environment.

Legal Authority: The Water Bank participants possess the water rights and contracts and have the legal authority to operate the water systems required to store and recover water under the program.

Estimated Costs and Funding Plan: Estimated remaining planning costs are about $2.5 million. Of this, local participants have committed $1.4 million through the Water Bank Program under RWA, and USBR is providing $1.1 million in technical funding support for the Water Bank, which will include a feasibility determination.

Management of Groundwater Extractions and Recharge: The Water Bank itself provides in part an institutional framework for the management of the storage and recovery of water. It includes an accounting to track storage and recoverable volumes of water and requires an extensive monitoring and mitigation program. Participants will agree to restrict operations as needed to maintain proper accounting balances overall, while adjusting operations in real-time if monitoring exceeds parameters that will be established during Water Bank planning.

9.2.4 Management Action #2 - Explore Improvements with NASb Well Permitting Programs

Management Action Description: This management action will consist of exploring potential revisions to Placer, Sacramento, and Sutter counties' and the City of Roseville's well permitting programs. Areas of improvement to explore include:

- Minimum screen depth requirements to limit high-capacity wells from impacting shallow aquifers directly connected to surface water or groundwater that may support GDEs.
- Minimum spacing requirements for high-capacity wells to limit impacts to existing groundwater wells in the NASb.
- Consultations for new wells to be constructed near groundwater level representative monitoring wells to optimize effective future monitoring for the NASb.

The project will require development of technical information to support proposed modifications to existing well programs.

Measurable Objectives Expected to Benefit: This project is expected to benefit the water level objective associated with interconnected surface water by limiting direct connection of wells to rivers, canals, and creeks.

Project Status: The project is expected to commence upon submittal of the NASb GSP. Technical analysis and coordination with the respective well permitting programs are expected to take about two years to complete.

Permitting and Regulatory Process: Each well permitting agency would determine the necessary and appropriate permitting and regulatory requirements from any modifications that may result from this management action.

Public Noticing: Each well permitting agency is a public agency and will determine the necessary public noticing requirements from any modifications that may result from this management action. The GSAs will notice interested parties when the management action commences and will provide regular updates on any progress through nasbgroundwater.org.

Expected Benefits and Evaluation: The management action is intended to protect the most sensitive of the beneficial uses and users of the NASb, including, interconnected surface water, shallow domestic well owners, and GDEs. Benefits are expected to be evaluated using groundwater drawdown software and potentially field testing of drawdown and recovery.

How the Project will be Accomplished: The NASb GSAs intend to work cooperatively with their respective well permitting agencies by proactively communicating the management needs of the beneficial uses and users of the subbasin and performing an appropriate technical analysis.

Legal Authority: The counties and city have land use management and planning authority granted through the State of California. This power allows cities and counties to establish land use and zoning laws that govern development. The well permitting agencies are authorized under California Water Code Section 13801.

Estimated Costs and Funding Plan: Costs to the local well permitting agencies to modify existing Code or Ordinances is unknown. The NASb GSAs have estimated $25,000 to conduct an analysis of well drawdowns and pumping spheres of influence at various capacities in an alluvial system. This will help inform recommended minimum screen depths in areas most sensitive to drawdown (e.g., interconnected surface water, GDEs) and to recommend spacing requirements for future wells to avoid impacts to existing groundwater users. The GSAs have committed to funding this activity in the Implementation Agreement in this GSP (*refer to* **Appendix A – MOA and Fiscal Budget**).

Management of Groundwater Extractions and Recharge: This management action is not intended to limit groundwater extraction. Rather, it is intended to put into place prudent practices to limit mostly localized impacts to beneficial uses and users in the Subbasin.

9.2.5 Management Action #3 - Proactive Coordination with Land Use Agencies

Management Action Description: This management action will help aid GSAs and land use planners and decision makers coordinate land use planning and GSP implementation consistent with the requirements under the SGMA. This GSP relied heavily on existing information from land use planning decisions that have already been made. The technical analysis performed for this GSP indicates that those planned land use practices have maintained sustainable conditions in the Subbasin. However, the analysis indicates that the system is only just in balance with current land use and approved development along with implemented GSP projects. Significant changes in land use from these assumptions could represent a potential risk to the Subbasin's sustainability. Therefore, the NASb GSAs desire to coordinate with respective city or county land use planning agencies so they are aware of GSP analysis and implementation as General Plans or other land use permitting updated occur in the future. Areas for coordination include:

- Sharing groundwater modeling results specific to the areas covered by the respective land use planning agencies.
- Sharing of annual GSP implementation reports with monitoring results that are relevant to the area of each land use planning agency.
- Holding an annual meeting with each land use planning agency to share information on trends, upcoming projects, and upcoming planning efforts (e.g., General Plan update).

Measurable Objectives Expected to Benefit: This management action is not expected to directly benefit a current measurable objective because the objectives were established based on the land use planning decisions that have already been made. Rather, the intent of the action is to aid in coordinated land use planning so land use decisions do not impede the GSAs' ability to sustainably manage the Subbasin.

Project Status: The project is expected to commence upon submittal of the NASb GSP and will be an ongoing annual activity.

Permitting and Regulatory Process: There are no permitting or regulatory processes required for this coordination.

Public Noticing: There is no public noticing requirement for this coordination. Land use planning agencies will follow their respective public noticing requirements for future land use planning and General Plan updates.

Expected Benefits and Evaluation: The expected benefit is that the Subbasin will continue to be managed sustainably and locally to promote continued healthy economic growth in the region.

How the Project will be Accomplished: The project will be accomplished by regular, cooperative coordination between NASb GSAs and local land use planning agencies.

Legal Authority: GSAs have legal authority to share information proactively with land use planning agencies. Land use planning agencies will maintain their authority for ultimately making land use planning decisions.

Estimated Costs and Funding Plan: There is no expected direct cost for this management action. The GSAs will participate with their in-kind time for meetings.

Management of Groundwater Extractions and Recharge: This management action is not intended to limit groundwater extraction. Rather, it is intended to proactively work with local land use planning agencies so the Subbasin continues to be sustainable into the future.

9.2.6 Management Action #4 - Domestic/Shallow Well – Data Collection and Communication Program

Management Action Description: This program will focus on the collection, sharing, and distribution of water level and water quality data and information for GSAs and domestic well owners to make informed decisions regarding land owners design and construction of wells and GSAs the management of groundwater. The ultimate goal of this program will be to safeguard land owners use of domestic/shallow wells for their deminimus supply while enabling other beneficial users of groundwater in the basin to maintain use of this resource.

The analysis of domestic wells consisted of detailed review of known construction information of every known well completion report (WCR) from DWR. While the NASb GSAs' analysis and established SMC was done carefully with the best available data and information to consider these beneficial users of groundwater, we recognize that DWR has not historically received full compliance in submission of WCRs. This is particularly likely in the case of well abandonment or destruction. Additionally, the NASb GSAs believe that one of the best ways to protect shallow well owners is through knowledge and information gained through two-way communication. This program is expected to include:

- Using assessor parcel number (APN) data provided by DWR, send direct mailings to high concentration areas of domestic and other shallow wells to confirm the presence of a well.
- Establish a group of willing, voluntary domestic well owners interested in monitoring groundwater conditions in their local areas.
- Provide regular information to interested domestic well owners and to NASb well permitting agencies on groundwater elevation and groundwater quality conditions to help protect existing owners and allow proposed new well owners to make informed decisions when constructing new wells.

Measurable Objectives Expected to Benefit: This management action is not expected to directly benefit a current measurable objective because the objectives were established based on the land use planning decisions that have already been made. Rather, the intent of the action is to aid in the management of groundwater levels to allow for current and continued use of groundwater for existing and prospective shallow well owners.

Project Status: The project is expected to commence upon submittal of the NASb GSP.

Permitting and Regulatory Process: There are no permitting or regulatory processes required for this coordination.

Public Noticing: There is no public noticing requirement for this coordination. However, the NASb GSAs will use direct mailings and other electronic means (NASb website, social media, etc.) to reach out to domestic and other shallow well owners.

Expected Benefits and Evaluation: The expected benefit is that the subbasin will continue to be managed sustainably and locally to protect shallow and domestic well users.

How the Project will be Accomplished: The project will be accomplished by regular, cooperative coordination between NASb GSAs, local well owners, and local well permitting agencies.

Legal Authority: GSAs have legal authority to share information proactively with well owners and well permitting agencies.

Estimated Costs and Funding Plan: The NASb GSAs have budgeted $25,000 in direct expenses for this management action. The GSAs will also participate with their in-kind time in implementing the program.

Management of Groundwater Extractions and Recharge: This management action is not intended to limit groundwater extraction. Rather, it is intended to proactively work with local well owners and well permitting agencies to protect shallow uses of groundwater in the NASb.

9.2.7 Management Action #5 - GDE Assessment Program

Management Action Description: This management action will improve the NASb GSAs' understanding of GDEs in the NASb to informing potential future protective measures for this beneficial use of groundwater. As described in **Appendix O** of the GSP, the GSAs used a conservative approach by using the 30-foot depth to water interval to identify potential GDEs, and up to an 80-foot depth to water interval to identify potential Valley Oak that could be supported by groundwater. To further inform the understanding of potential GDEs and their relative health, the program will include:

- Using the Normalized Difference Vegetation Index (NDVI) during implementation of the GSP to track vegetative health and confirm the likelihood that the vegetation is groundwater-supported. We will achieve this by monitoring a year-to-year index for longer-term. For the first part of the program, we will also review intra-year data to confirm whether the vegetation is more likely supported by surface water or groundwater.

- Continue to monitor flows in small tributary systems to better understand the source of flow in these channels (e.g., urban runoff, treated wastewater discharges, groundwater baseflow).

Measurable Objectives Expected to Benefit: This management action is not expected to directly benefit a current measurable objective because the objectives were established based on the land use planning decisions that have already been made. Rather, the intent of the action is to aid in the management of groundwater in the Subbasin through the improved understanding and monitoring of GDEs.

Project Status: The project is expected to commence upon submittal of the NASb GSP.

Permitting and Regulatory Process: There are no permitting or regulatory processes required for this coordination.

Public Noticing: There is no public noticing requirement for this program.

Expected Benefits and Evaluation: The expected benefit is that the subbasin will demonstrate that GDEs are protected under the adopted SMC.

How the Project will be Accomplished: The project will be accomplished by developing the methodology and completing the NDVI analysis and by regular monitoring of flows in NASb tributary areas associated with GDEs.

Legal Authority: GSAs have legal authority to conduct the NDVI monitoring and surface water monitoring.

Estimated Costs and Funding Plan: for the GSAs have budgeted up to $55,000 this management action. The GSAs will also participate with their in-kind time contributions for monitoring.

Management of Groundwater Extractions and Recharge: This management action is not intended to limit groundwater extraction.

9.3 Supplemental Projects

Groundwater management is a continuous ongoing process in the NASb whether SGMA is mandating sustainable management or not. The NASb GSAs have additional projects that are at a feasibility level and over the next several years many will likely be ready for implementation. **Table 9-2** provides a list of these supplemental projects that are in an ongoing planning process.

Table 9-2. Supplemental Projects

Supplemental Project No.	Project Sponsor	Project Description	Potential Benefit (AFY)	Potential Capital Cost ($ million)
1	Regional Water Authority	Expansion of the Sacramento Regional Water Bank – Phase 2 - implementation of the expanded conjunctive use program by constructing various system interties and booster pumps to increase in-lieu recharge; install aquifer storage and recovery (ASR) for direct recharge; install additional production wells to recover groundwater in dry years. The recharge potential and cost are “up to” amounts because the program is fully scalable.	30,000	250
2	Placer County Water Agency	RiverArc – a new treatment plant and pipeline would be constructed to bring Sacramento River water for municipal and industrial water supplies. Improves water supply security by having a water source from a different watershed and expands in-lieu conjunctive use by offsetting existing groundwater demands.	30,000	1,400
3	South Sutter Water District	Water System Conveyance System Improvements – enlarging of district laterals to allow greater surface water deliveries during wet years and a reduction of groundwater pumping to achieve in-lieu recharge.	TBD	TBD
4	Natomas Mutual Water Company	Service Area Expansion – annexation of about 2,300 acres and supplying the area with surface water reducing groundwater pumping. This area has previously been solely dependent on groundwater.	4,600	TBD
5	City of Lincoln	Conjunctive Use – expand use of recycled water to offset existing groundwater demand.	1,000	TBD
6	Placer County	Sustainable Agricultural Groundwater Recharge Program – this program will fund construction of recharge facilities in western Placer County. A funding mechanism has been established through developer fees.	TBD	TBD

10. Plan Implementation

This section describes in general how the NASb GSAs will implement our GSP. Successful implementation requires committed human resources, sufficient and sustained funding, and specific actions to be undertaken in appropriate timeframes.

10.1 Plan Implementation Staffing

The NASb GSAs have entered into an MOA for the implementation of this GSP, which will include management of the Subbasin along with projects and management actions. The GSAs have designated the SGA GSA as the lead agency with DWR and as the GSA Coordinator. The role of the coordinator includes ensuring that all required submittals to the State are provided in a timely fashion, that the GSAs meet and coordinate on a regular basis for successful GSP implementation and coordinate activities and findings with adjacent subbasins. SGA has been an ongoing groundwater management agency with permanent staffing since 1998, so it is well-positioned to serve in this role. The GSAs have designated the West Placer GSA as the GSA Administrator. The administrator will serve in an important coordination and documentation role for the GSAs as well as to ensure that effective outreach continues during GSP implementation. Placer County has assigned a senior-level planner to serve in this role. Each GSA is committed to actively serving on the GSA Committee and will provide either in-kind staffing or consulting support services to implement the GSP. **Appendix A** provides a copy of the GSP Implementation MOA.

10.2 Implementation Costs and Funding

Table 10-1 provides an estimate of the shared common expenses over the first five years of GSP implementation, which is subject to change. Note that these expenses do not include the in-kind time that each GSA will contribute or other expenses related to groundwater management that each GSA may perform that is unique to its area. The estimate also does include expenses that other agencies will provide for projects and management actions. For example, the conjunctive use expansion expenses will be borne by participating agencies developing the Sacramento Regional Water Bank. Finally, the budget below does not include the small number of new monitoring wells needed that were identified as potential data gaps. At this time, the NASb GSAs are pursuing assistance through the DWR Technical Support Services Program (TSS) to construct new monitoring wells that were identified as data gaps. The TSS will fund the construction of monitoring wells at no cost to GSAs, other than for local in-kind assistance in completing the project. In the event that support is not provided, the GSP Implementation MOA includes a 20 percent contingency budget of the total estimated budget that could be used for that purpose.

Table 10-1 also provides the funding contributions of each GSA to cover the five-year budget. The NASb GSAs have agreed to use their relative geographic areas within the NASb to determine the funding distribution for the first five years of implementation.

Table 10-1. Five-year Budget and Funding Sources

Budget Item Description/Year	2022	2023	2024	2025	2026
Regulatory Requirements					
Groundwater Level Monitoring	$7,300	$7,500	$7,700	$7,900	$8,100
Biennial Water Quality Monitoring	$0	$25,000	$0	$25,000	$0
Annual Reports	$65,000	$50,000	$40,000	$40,000	$40,000
5-Year GSP Assessment/Update	$0	$0	$0	$125,000	$125,000
Modeling Support and Update	$20,000	$20,000	$20,000	$150,000	$90,000
Data Management System Maintenance and Upgrades	$10,000	$10,000	$10,000	$10,000	$10,000
Program Management and Administrative Expenses					
NASb GSA Coordination Meetings	$3,800	$3,800	$3,800	$3,800	$3,800
Public Outreach	$1,000	$1,000	$1,000	$1,000	$1,000
Website Maintenance	$4,000	$4,500	$5,000	$5,500	$6,000
GIS Mapping Support	$3,800	$4,000	$4,200	$4,400	$5,000
Lead Agency Administration	$6,200	$6,500	$6,900	$14,800	$16,000
Projects and Management Actions					
Well Permit/Construction Practices	$12,500	$12,500			
Domestic/Shallow Well – Data/Communication Program	$12,500	$12,500			
GDE Assessment Program	$20,000	$10,000	$10,000	$ 7,500	$ 7,500
Total Shared Costs					
Annual Estimated Cost	**$166,100**	**$167,300**	**$108,600**	**$394,900**	**$312,400**
5-year Total Cost					$1,149,300
Average Annual 5-year Cost	$229,860	$229,860	$229,860	$229,860	$229,860
Estimated Average Annual Contribution by GSAs					
SGA	$83,171	$83,171	$83,171	$83,171	$83,171
West Placer	$76,912	$76,912	$76,912	$76,912	$76,912
SSWD	$44,521	$44,521	$44,521	$44,521	$44,521
Sutter County	$13,583	$13,583	$13,583	$13,583	$13,583
RD1001	$11,673	$11,673	$11,673	$11,673	$11,673

10.3 Implementation Activities

Groundwater management is a continuous ongoing process in the NASb. **Table 10-2** provides a partial list of the implementation actions needed for successful management of the Subbasin.

Table 10-2. Summary of Implementation Actions

Monitoring
Groundwater Elevation Monitoring
1. Continue ongoing semi-annual monitoring of the groundwater elevation monitoring network. 2. Conduct confirmation water level monitoring as needed. 3. Download transducer data semi-annually.
Groundwater Quality Monitoring
1. Download public supply well water quality monitoring data for TDS and Nitrates from the State DDW by December 31 of each year for MT and MO evaluation. 2. Download data for Arsenic, Hexavalent Chromium, Iron, and Manganese from DDW as it becomes available for individual public supply wells and observe for trends. If future upward trends emerge for these constituents, assess if establishing sustainable management criteria for them would be beneficial. 3. Collect water quality samples in the shallow water quality monitoring network in the Fall of odd numbered years (e.g., 2023).
Subsidence Monitoring
1. No current action required unless water level MT exceedances are occurring or if optional DWR InSAR monitoring indicates a potential undesirable result.
Other Monitoring
1. Collect additional monitoring data (e.g., surface water stages) from CDEC on an as-needed basis (e.g., during preparation of Annual Report).
Data Management
1. Upload groundwater elevation data on an ongoing basis to CASGEM (or other applicable State SGMA database) within one month after semi-annual monitoring. 2. Upload water quality data from shallow monitoring well network by December 31 of each year that it is collected. 3. Update NASb Data Management System with appropriate data by December 31 of each year.
Data Analysis
Sustainability Indicators
1. Review all representative groundwater levels in comparison to MOs and MTs by December 31 each year for potential emergence of undesirable results. 2. Calculate the public water supply wells TDS and N rolling averages to determine if the Subbasin in meeting MOs and MTs by January 31 each year. 3. Review shallow monitoring network TDS and N data to determine if the Subbasin in meeting MOs and MTs by January 31 of each year following its collection.
Annual Report
1. Complete the recurring Annual Report for review by GSAs by February 28 each year and submit to DWR by April 1 each year.
CoSANA Groundwater Model
1. In 2025, a comprehensive assessment and update of the CoSANA model will begin. This will be coordinated with the South American and Cosumnes subbasins. Update to the model will include the use of the most updated urban water supplier demand projections, the latest climate change projections (using multiple future projection scenarios), consideration of an extreme scenario, consideration of the model recommendations in Section 6 of the CoSANA model report included in Appendix P of the GSP.
Coordination and Outreach
1. Continue quarterly meetings of the NASb GSAs.

2. Hold at least one public meeting each year in which basin conditions will be presented and upcoming year activities will be described. The meeting will be scheduled when the Annual Report has been completed each year. 3. Meet with each adjacent subbasin at least annually. The meeting will be scheduled as the Annual Report is being prepared, so that any observations about potential concerns near common boundaries can be discussed. 4. Meet with County and City land use planning staff of respective counties once each year to share the results of the Annual Report and discuss any upcoming anticipated changes to land use designations or General Plans. The meetings will be scheduled shortly after the Annual Report is submitted. 5. Continue quarterly meetings of the Regional Contamination Issues Committee to identify and report on potential emerging issues of contamination or constituents of concern. The committee is facilitated by SGA staff and includes State and Federal regulatory agencies, local water agencies, responsible parties, and members of the public.
Other Management Activities
1. Fill the data gaps noted in the monitoring well network by December 31, 2024. 2. Track implementation of urban area conjunctive use program as part of Annual Report preparation. Identify if there are barriers to its planned expansion. 3. Work with the Regional Water Authority in its development of the Sacramento Regional Water Bank to ensure that it is consistent with achieving the sustainability goal of the NASb. 4. Begin technical work on well construction practices (e.g., depth and spacing) to protect the most sensitive beneficial uses and users of groundwater in the NASb. Work will commence in early 2022 and be completed by the end of 2023. This will require a cooperative effort with local permitting agencies. 5. Commence shallow/domestic well analysis in early 2022 and conclude by early 2024. 6. Commence GDE assessment management action in early 2022 and conclude major assessment by early 2024. Continue annual monitoring of GDE health. 7. Track progress on supplemental projects on an annual basis. Update progress and any information on newly proposed supplemental projects in the Annual Report.

11. Notice and Communications

This section describes the NASb GSA noticing and communication with stakeholders and interested parties during the development and then during implementation of this GSP. The regulatory requirements and additional State guidance were provided in DWR's GSP Guidance Document: Stakeholder Communication and Engagement (DWR 2018). Under the requirements of the SGMA, GSAs must consider interests of all beneficial uses and users of groundwater. Furthermore, the GSP Regulations require that GSAs document the opportunities provided for public engagement and active involvement of diverse social, cultural, and economic elements of the population within the Subbasin during develop of this GSP.

11.1 Public Engagement and Active Involvement

Early in the GSP development process, each GSA developed a Communication and Engagement Plan, or C&E Plan, that described how stakeholders would be engaged through outreach, education, and opportunities for input during development of the GSP. The C&E Plans included key elements such as:

- Goals and Desired Outcomes
- Stakeholder Identification
- Venues for Engaging
- Implementation Timeline

The GSAs established and maintained an Interested Parties list to receive notices regarding plan preparation. To comply with this section, the GSAs maintain an email notification database. The public is regularly informed through engagement activities on how they can request to be placed on the list and receive notifications. Currently the Interest Parties list has over 330 subscribers.

The GSAs used a variety of methods to communicate with the public and encourage participation throughout GSA formation and GSP development as outlined in the C&E Plans and summarized below. When COVID-19 restrictions went into effect in 2020, some adjustments had to be made, such as switching from in-person public meetings to virtual meetings, pursuant to Executive Order N-25-20. Other than that, the C&E Plans were implemented as written and included the following engagement methods:

- Notifications – The GSAs used multiple methods to keep stakeholders informed of the GSP development process and aware of opportunities to engage. These methods included email blasts, website postings, social media, mailers and other printed information such as a SGMA brochure for distribution at public counters and outreach events and postcard mailers announcing the public comment period. A NASb website was developed, which included a communications portal where interested parties could sign up for notifications and from which email notifications could be sent. Ultimately, over 330 parties received GSP updates, public meeting notifications, invitations to comment, and other notices via email.

- Websites –The NASb website (nasbgroundwater.org) served as the main hub for information on the GSP, providing opportunities for the public to sign up for electronic notices, learn about SGMA, the GSAs, the GSP, how to attend events, access and comment on the draft GSP, and contact their GSA representative. In addition, the West Placer GSA formed an independent website (westplacergroundwater.com) to post information on GSP-specific activities. Finally, single-entity GSAs maintained information on SGMA and GSP development on their agency websites.

- Public Meetings – The GSAs held many public meetings during GSP development. These meetings included GSA agency board/council meetings, Agriculture Commission meetings, water agency meetings, and larger, multi-GSA coordinated events to discuss GSP development in depth. Public meetings are discussed in Section 10.3.

- Board, Neighborhood, or Community Meetings – Individual GSAs engaged the public through various other meetings opportunities where appropriate, such as board/council meetings, committee meetings, municipal advisory committees, and others.

- Targeted Engagement – Where appropriate, the GSAs conducted targeted engagement with specific groups. In the NASb, one of the primary beneficial users of groundwater is the agricultural community. Therefore, targeted meetings were held to engage the agricultural community through tailgate meetings and presentations at public venues such as Agriculture Commission meetings. The NASb also has an engaged environmental community. One such group, the Sacramento Water Forum's Environmental Caucus was actively targeted to participate in public meetings and to comment on GSP components.

Stakeholder input received through these methods helped the GSAs guide development of the draft GSP. In the early development, most input was in the form of questions or concerns regarding how the GSP might affect them. As input was received, the GSAs acknowledged the input and/or concerns, answered the questions, and strived to keep the public informed of how their input influenced the GSP development.

11.2 Groundwater Beneficial Uses and Users

SGMA requires the GSAs consider the interests of beneficial users and uses of groundwater in the Subbasin. As a result, the GSP development process needed to consider effects to other stakeholder groups in and around the groundwater Subbasin with overlapping interests including holders of overlying groundwater rights, including, but not limited to, the following:

1. Agricultural users, including farmers, ranchers, and dairy professionals.

2. Domestic well owners.
3. Municipal well operators.
4. Public water systems.
5. Local land use planning agencies.
6. Environmental users of groundwater.
7. Surface water users, if there is a hydrologic connection between surface and groundwater bodies.
8. The federal government, including, but not limited to, the military and managers of federal lands.
9. California Native American tribes.
10. Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems.
11. Entities that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.

Early in GSP development, the GSAs worked to identify the individuals and groups in their areas that would have interest in groundwater. A broad list of potential beneficial uses and users and parties representing those interests is shown in Table 11-1.

The categories referenced above are broad examples; the GSAs considered each of the interest groups named to determine if they were present within the NASb. Below is a discussion of some of the beneficial users and uses of groundwater that were considered and contacted during development of the GSP. More detailed information regarding how they were considered specifically during development of sustainable management criteria is described in **Section 8 – Sustainable Management Criteria.**

11.2.1 Agriculture

Through preliminary stakeholder identification and engagement efforts the agriculture community was identified as a major beneficial user of groundwater in the Subbasin. Although Sacramento County and the southeastern portion of Placer County contain mostly urban areas, the rest of the Subbasin is predominately agriculture and undeveloped land. Permanent crops dominate the western, eastern, and northern edges of the Subbasin and along the rivers, while rice and other non-permanent crops dominate the central and western portions of the Subbasin. While much of the agriculture community relies on surface water to irrigate pastures, orchards, rice fields, and farms, many also pump groundwater to augment their surface water supplies, particularly in dry years. Therefore, the NASb GSAs included the agriculture community in their engagement plans early in GSP development – e.g. included agriculture representatives such as Farm Bureaus, Farm Advisors, and Agriculture Commissioners in their stakeholder lists and identified and added members of the agriculture community to interested parties lists.

In 2016, during the formation of the WPGSA, a stakeholder assessment was conducted for the purposes of guiding communication strategies and tactics associated with the formation process. Agriculture was identified as having a key interest in groundwater, so West Placer GSA agencies immediately engaged these stakeholders, holding 12 interviews with members of the agricultural

Table 11-1. Beneficial Uses and Users

Category of Interest	Parties Representing Interests	Engagement Purpose
General Public	Citizen Groups Community Leaders Municipal Advisory Committees	Inform to improve public awareness of sustainable groundwater management
Land Use	Municipalities (City/County Planning Regional Land Use Agencies	Consult and involve to promote land use policies that support GSPs
Private / Domestic Users	Private / Rural Pumpers Domestic Users	Inform and involve to minimize negative impact to these users
Urban / Agricultural Users	Water Agencies Irrigation Districts Mutual Water Companies Resource Conservation Districts Farm Bureaus	Collaborate to promote sustainable management of groundwater
Industrial Users	Commercial and Industrial Self Suppliers Local Trade Associations or Groups	Inform and involve to avoid negative impact to these users
Environmental	Federal and State Agencies Environmental Groups Wetland Managers Conservation Plans, Districts Resource Conservation Districts Land Trusts School Farm Departments	Inform and involve to avoid negative impact to the environment
Economic Development	Chambers of Commerce Business Groups / Associations Elected Officials State Senators and Assembly Members	Inform and involve to support a stable economy
Human Right to Water	Disadvantaged Communities Small Water/Community Systems Environmental Justice Groups	Inform and involve to provide a safe and secure groundwater supplies to all communities reliant on groundwater
Tribes	Federally Recognized Tribes Other Tribes with Land Interest	Inform, involve and consult with tribal government
Federal Lands	Federal Governments Military	Inform, involve and collaborate to ensure basin sustainability
Integrated Water	Flood Agencies Regional Water Management Groups	Inform, involve and collaborate to improve regional sustainability

community to hear their concerns and input. In addition, the Agricultural Commissioner was brought in as a member of the West Placer GSA technical working group. Throughout development of the GSP, the agricultural community was engaged through email notifications, postcard mailings, updates at Agriculture Commission and Farm Bureau meetings and focused in-person tailgate meetings with local farmers and ranchers. The West Placer GSA will continue to inform and engage the agricultural community throughout the GSP implementation.

Similarly, within the SSWD GSA boundaries agriculture accounts for the vast majority of water use. SSWD is a conjunctive use agricultural water district. Approximately one-third of water used by landowners in the district comes from stored surface water with the remaining two-thirds being pumped groundwater. Throughout the GSP development process, SSWD engaged its stakeholders via newspaper announcements, postcard notifications, and public meetings; both in-person and virtual. The SSWD Board of Directors, all of which are landowners and water users within the SSWD GSA, are updated on GSP activity regularly at monthly board meetings. SSWD will continue to actively engage with stakeholders moving forward.

The other GSAs engaged agricultural users as appropriate for their GSA, and consistent with their C&E plans, through public meetings, board updates, online information, letters, direct mailers, and other methods.

11.2.2 Non-municipal Domestic Well Users

Domestic wells are used to supply groundwater to households in both urban and rural areas, and are scattered through the Subbasin **Figure 3-13** show the density of domestic wells per square mile (outlines of DAC and SDAC communities are also shown on the domestic well density figure). The GSAs reached out to and consulted with domestic users through the activities described in their C&E Plans. Additionally, the monitoring network was developed with consideration of the locations of domestic wells (*refer to* **Section 7.4.2 – Domestic Well Representative Monitoring Network**) and sustainable management criteria were specifically developed to be protective of domestic wells; see **Section 8 – Sustainable Management Criteria** for details.

In Placer County, many of the areas with high domestic well density are in the rural Sheridan and Lincoln areas (domestic users within the City of Lincoln and community of Sheridan are on public water supplies). Outreach to DACs in the more rural areas was done through social media, community meetings, municipal advisory meetings, and direct mailers. In addition, multiple community meetings were held in locations near them – e.g. in rural Lincoln (including at Western Placer Waste Management Authority meeting room and Rural Lincoln Municipal Advisory Committee meetings), downtown Lincoln, and community of Sheridan (Sheridan MAC meetings). The meetings were held during after-work hours (as well as not during the busy farming season) to ensure adequate opportunity to participate. See **Appendix R** for a full list of public meetings. Local community Facebook pages were also utilized to post notices, including Lincoln Country Neighbors and Sheridan Happenings pages. In addition, direct mailers were sent to the rural areas in Lincoln and Sheridan (including the community of Sheridan) announcing the public comment period for the draft GSP.

11.2.3 Small Water Systems

As noted in **Section 3.3.7 – Small Community Water Systems**, there are multiple small community water and non-community non-transient water systems in the Subbasin that are overseen by the counties and the state. Their water supplies are from groundwater. These systems and the local permitting agencies were identified as stakeholders early in the process through direct mailings. Most recently, postcard mailers with information on how to review and comment on or participate in the GSP were sent directly to the small public water system operators.

11.2.4 Environmental Users of Groundwater

As described in **Section 3.7.4 – Environmental**, the Subbasin includes several creeks, streams, ponds and marshes support more than 40 species of native and nonnative fish, including naturally spawning fall-run Chinook salmon, steelhead, and American shad. The banks of the many rivers and streams within the Subbasin provide riparian habitat, both scrub and forest consisting of cottonwood, valley oak, and willow, with occasional white alder, box elder, and Oregon ash. To ensure environmental users, including groundwater dependent ecosystems (GDEs), were adequately considered, a thorough evaluation was performed for GDEs as documented in **Appendix O**.

During this GSP development process, GSA staff engaged environmental interests. GSA staff engaged with the Sacramento Water Forum's Environmental Caucus and met with representatives of the Environmental Council of Sacramento (ECOS) and Habitat 2020, two organizations that have been actively engaged in the NASb GSP, including attending numerous NASb public meetings. Member organizations of ECOS include: 350 Sacramento, Breathe California Sacramento Region, Environmental Democrats of Sacramento, Friends of Stone Lakes National Wildlife Refuge, International Dark-Sky Association, Physicians for Social Responsibility Sacramento Chapter, Sacramento Audubon Society, Sacramento Citizens' Climate Lobby, Sacramento Electric Vehicle Association, Sacramento Housing Alliance, Sacramento Natural Foods Coop, Sacramento Valley Chapter of the California Native Plant Society, Sacramento Vegetarian Society, Save Our Sandhill Cranes, Save the American River Association and Sierra Club Sacramento Group. Member organizations of Habitat 2020 include: Friends of Stone Lakes National Wildlife Refuge, Friends of Swainson's Hawk, International Dark-Sky Association, Sacramento Area Creeks Council, Sacramento Audubon Society, Sacramento Heron and Egret Rescue, Sacramento Valley Chapter of the California Native Plant Society, Save Our Sandhill Cranes, Save the American River Association and Sierra Club Sacramento Group.

In Placer County, WPGSA staff engaged early on with the Administrator of the Placer County Conservation Plan - a multi-component program comprised of a Habitat Conservation Plan / Natural Community Conservation Plan and County Aquatic Resources Plan – to coordinate in the common goal to support long-term conservation and management of natural resources, including groundwater. Both agencies will be collaborating on joint groundwater recharge projects that will be part of the Sustainable Agriculture Groundwater Recharge Project (Supplemental Project) and will utilize joint funding where appropriate to benefit agriculture, GDE's, groundwater levels and the preservation of local habitat. As implementation of both the PCCP and GSP moves forward, these agencies will continue to collaborate.

In Sacramento and Sutter counties, SGA GSA staff have been actively engaged with Natomas Basin Conservancy. The Conservancy is implementing the Natomas Basin Conservancy Habitat Conservation Plan (NBCHCP), which covers approximately 54,000 acres in the Natomas Basin. The purpose of the NBCHCP is to promote biological conservation along with economic development and the continuation of agriculture within the Natomas Basin. Both agriculture and habitat rely on groundwater in the Natomas Basin. The SGA GSA has communicated with the Conservancy on the development of sustainable management criteria and is coordinating on locations for additional groundwater monitoring during GSP implementation.

These groups were added to the Interested Parties notification list and the fact that some of them commented on the draft GSP demonstrates that they were sufficiently informed.

11.2.5 Disadvantaged Communities

As mentioned in **Section 3.6 – Disadvantaged Communities**, there are disadvantaged communities (DACs and SDACs) in the Subbasin that were identified using DWR's DAC mapping tool. **Figure 3-8** shows their locations. Most are located within Placer and Sacramento counties. Those within Sacramento County are located within urban areas, while those in Placer County are primarily in the rural areas around the communities of Sheridan and Lincoln. Those disadvantaged communities in Sacramento County and in the southern portion of Placer County are mostly provided drinking water by water agencies, but some still rely on domestic wells. Water delivered to these customers by water agencies is regularly sampled and tested to ensure it meets or exceeds all state and federal drinking water standards. Outreach to these communities was provided through water agency board meetings, notices, and/or direct mailers and other methods.

In the Sacramento area, the water supply and water quality needs of DACs in the Subbasin are generally served effectively by water agency efforts to provide high-quality water supplies to their entire service area. Customers are represented by the water agencies that serve them and have received information on the GSP process through those agencies. Some DACs or individuals that would be considered disadvantaged reside in very small pockets of the region, served by a small water system. As mentioned above, direct mail outreach was sent to small water system operators.

Most DAC areas in the northern portion of Placer County do not have water service and rely on domestic wells - other than those communities near City of Lincoln, which have water service from the City of Lincoln. The community of Sheridan is also served by a community water system. As mentioned in Section 11.2.2 above, outreach to DACs in the more rural areas was done through social media, community meetings, municipal advisory meetings, and direct mailers. In addition, multiple community meetings were held in locations near them – e.g. in rural Lincoln (including at Western Placer Waste Management Authority meeting room and Rural Lincoln Municipal Advisory Committee meetings), Lincoln City Hall, and community of Sheridan (Sheridan MAC meetings). The meetings were held during after-work hours (as well as not during the busy farming season) to ensure adequate opportunity to participate. An additional in person meeting targeted at area farmers and ranchers was held at the Wise Road Placer County Fire Station in rural Lincoln. See **Appendix R** for a full list of public meetings. Local community Facebook pages were also utilized to post notices, including Lincoln Country Neighbors and Sheridan Happenings pages. In addition, direct mailers were sent to the DAC areas in Lincoln and Sheridan announcing the public comment period for the draft GSP.

Those DACs in the Roseville area of Placer County are served by the City of Roseville Environmental Utilities and were automatically covered by outreach conducted to customers.

11.2.6 Tribes

The United Auburn Indian Community (UAIC) has jurisdiction over land in Placer County southeast of Lincoln and northeast of Sheridan (See Section 3.3). These lands are exempt from SGMA. **Figure 3-2** in **Section 3 – Plan Area** shows the tribal lands in the Subbasin. The West Placer GSA reached out to the UAIC prior to GSP development by coordinating with the Placer County Environmental Coordinator to attend the joint Placer County / UAIC annual meeting. Staff gave an update on SGMA and the GSP development process and offered to attend future UAIC meetings. Staff obtained the contact information of key tribal staff and added them to the Stakeholders and Interested Parties lists, touching base periodically to ensure contact information was up to date (most recently with Anna Starkey, UAIC, in July 2021) and to repeat the standing offer to present at future meetings. To date, the UAIC has received notification of all GSP development activities. The UAIC’s properties in Lincoln and Auburn are provided surface water by Placer County Water Agency.

11.3 List of Public Meetings

The individual GSAs conducted numerous public meetings during GSA formation and throughout GSP development to explain the requirements of SGMA, discuss the GSP regulations and proposed content, and solicit input from the public. This section focuses primarily on the public meetings that were held once key information for the GSP became available, such as the results of the groundwater modeling and water budget, and proposed sustainable management criteria, and projects and management actions.

A full list of public engagement activities, including all public meetings, are included in **Appendix R**. It should be noted that this is not an exhaustive list, as many of the water agency GSAs have standing agenda items to report on SGMA-related updates to their boards or various committees.

11.3.1 Draft GSP

The GSAs conducted public meetings at various times throughout GSP development, culminating in a three-meeting virtual series of coordinated, Subbasin-wide public meetings in spring of 2021 prior to the Public Draft GSP release and one Subbasin-wide public meeting during the Public Draft GSP review period on September 8, 2021. At each meeting, GSA representatives gave a general overview of SGMA and GSP requirements, GSP development and content, as well as an overview of the GSP development timeline, before focusing on the specific meeting topic. Representatives from each GSA in the basin were present to answer questions. Notices were provided through a variety of methods and consistent with C&E Plans, including email blasts to over 330 stakeholders and interested parties. Prior to these meetings, in November 2020, draft GSP Sections 1 through 5 were posted for public comment on the NASb website along with a recorded PowerPoint presentation and a written overview of the sections' contents to guide the reader. Comments to the sections were accepted via the online portal at nasbgroundwater.org or by mail.

Below is a summary of the four basin-wide public meetings in 2021, which were all held via Zoom.

- **Workshop #1 - SGMA and Sustainable Management Criteria (February 10, 2021)** – In this first meeting, the GSAs provided an overview of SGMA, the draft sections (1 through 5) recently completed and released for public review and comment, and the GSAs' efforts to define groundwater levels and other criteria to measure sustainability in the basin. This event had 69 attendees.
- **Workshop #2 - Water Budget (March 10, 2021)** – In this second meeting, the GSAs presented the results of the Subbasin wide groundwater model and groundwater budget, explaining how the water budget will provide stakeholders a good understanding of the Subbasin, assist the GSAs in long range planning as well as fine-tuning of sustainable management criteria, and help determine how much water can be safely pumped from the Subbasin while remaining sustainable. This event had 72 attendees.
- **Workshop #3 - Projects and Management Actions (May 12, 2021)** - In this third meeting, the GSAs discussed refinements to the sustainable management criteria, approach to defining undesirable results, and the proposed projects and management actions that will potentially be included in the GSP and that could be implemented should the Subbasin become unsustainable, or at risk of becoming unsustainable, as indicated by the results of the above-mentioned monitoring of water groundwater conditions. This event had 47 attendees.

The two-hour meetings allotted time for questions and comments from the public. All workshops were recorded, and the videos were posted online at nasbgroundwater.org. Additionally, the Q&A and Chat questions were downloaded, and transcripts were compiled to document verbal comments. Around this time, many of the GSAs brought updates to their boards and councils and at other community venues to inform them of the GSP status, GSP content, and the public review process.

A final public meeting was held on Zoom shortly after the Public Draft GSP was released for public review on August 31, 2021:

- **Workshop #4 – Draft GSP (September 15, 2021)** - In this final meeting, the GSAs gave an overview of the GSP, reviewed updates to the GSP since Workshop #3, and how and when the public may comment on the plan.

11.3.2 GSP Hearings and Adoption

Each GSA, including individual GSA member agencies where required (when GSA is not a JPA), adopted the GSP at a public meeting and after a public hearing, pursuant to California Water Code Section 10728.4.

11.4 GSP Comments and Responses

GSP regulations require GSAs to consider stakeholder input and DWR must, in their evaluations, consider whether GSAs have adequately responded to comments that raise credible technical or policy issues with the GSP. Pursuant to SGMA, the five GSAs solicited and responded to comments from the public on the Public Draft GSP. On numerous occasions prior to and during development of the GSP, information about the GSP was released to the public and comments were solicited. With each release of information, public notices were sent through a variety of methods, consistent with C&E Plans, and public meetings were held. Comments were accepted both electronically via the website, emails and during public meetings. This section discusses comments received during key points in GSP development.

In November 2020, partial drafts of Sections 1 through 5 were released to the public on the NASb website and a 30-day comment period was provided. Comments were accepted online via the comment portal at nasbgroundwater.org and by email. A list of comments and how they were considered can be found in **Appendix S**. Copies of the public letters or emails are also provided in **Appendix S**.

A Public Draft of the GSP, with previous public comments incorporated was prepared and released on the NASb website on August 31, 2021, and a 60-day comment period was provided. The Public Draft GSP was noticed on the website, through social media, mailers, print outreach, and an e-mail blast was sent to over 300 stakeholders and interested parties notifying them of the document availability. Comments were accepted online via the comment portal at nasbgroundwater.org and by email. A list of comments and how they were considered can be found in **Appendix S**. Copies of the public letters or emails are also provided in **Appendix S**.

Prior to adoption, and in accordance with California Water Code Section 10728.4, the GSAs filed a Public Notice of Proposed GSP Adoption to notify cities and counties in the NASb plan area. GSAs must review and consider comments from any city or county that receives notice pursuant to this section and shall consult with a city or county that requests consultation within 30 days of receipt of the notice. No cities or counties requested consultation.

It should be noted that in addition to the formal comment periods mentioned above, input from the public was sought and received in various ways throughout GSP development, including verbally at public meetings. All public outreach informed the public how they could reach their GSA representatives to ask questions or provide input by phone, email, or in writing.

Input from the public on the GSP was handled in three different ways depending on how the information was submitted. It should be noted that most comments during public meetings were in the form of questions or requests for clarification.

- **Verbal Comments** – If the input was received in a broad context, changes to the GSP were made if they were they were specific or relevant to a section of the GSP and if they raised credible technical or policy issues. If received in the form of questions, various portions of the GSP may have been changed to provide better clarification.
- **Website Comments** – If the input was submitted via the website, raised credible technical or policy issues, and provided specific sections, paragraph and line, these comments were downloaded into a table format and a response placed opposite each comment that indicates if the change was made to the GSP. If a similar comment raised the same issue and/or was previously addressed in a different section of the GSP, or if the comment was too general in nature or not required by SGMA, the comment was noted but no changes were made.
- **Written Comments** – If the input was received in letter or email format, the comments were dissected and placed into the table format described for Website Comments, along with if and how the GSP was modified or clarified. If a similar comment raised the same issue and/or was previously addressed in a different section of the GSP, or if the comment was too general in nature, the comment was noted but no changes were made.

As mentioned, **Appendix S** provides a table listing the public comments received on the draft GSP Sections 1 through 5 (November 2020) and those to the Public Draft GSP and how the comments were addressed. Responses focused on those comments that pertained to the GSAs responsibilities and obligations under the SGMA and that raised credible technical or policy issues with the GSP pursuant to GSP regulations (23 CCR 55.4).

11.5 Interbasin Communications and Agreements

During development of this GSP the GSAs reached out to adjacent subbasin GSAs (South American, Sutter, Yolo and Yuba South) to share information, technical approaches, findings and whether implementation of the NASb GSP would adversely affect adjacent subbasins's ability to achieve sustainability. Coordination meetings were held that discussed:

- Groundwater model types and coordination
- Groundwater flow across common boundaries
- Projected land use changes along common boundaries
- Monitoring networks along common boundaries
- Minimum thresholds along common boundaries

Based on this coordination, the NASb GSAs and adjacent subbasin GSAs concluded:

- Current and projected groundwater flow, projected land use changes, and MTs near common boundaries do not appear to impede their respective abilities to achieve each subbasin's sustainability goals.
- The monitoring network along common boundaries is sufficient to detect significant changes that could impact their respective GSPs and that each GSA will actively share monitoring information along common boundaries.
- The GSAs would meet for annual coordination meetings after the completion of each GSP annual report to share information on monitoring results and other implementation activities and to identify and address any emerging trends that may be of concern along common boundaries
- It is currently preferrable to document our coordination through this correspondence rather than through a more formal interbasin agreement. Interbasin letters are provided in **Appendix T**.

As a result of the above coordination, the GSAs shared information to the mutual benefit of each subbasin's GSP development effort and have confirmed that the implementation of each respective GSPs will not adversely impact the attainment of sustainability goals. The GSAs examined findings in each GSP along their respective boundaries and either confirmed consistency or have agreed to work together during GSP implementation to resolve differences, to the extent they merit such effort.

11.6 GSAs Decision Making Process

The Subbasin is managed by five GSAs that have jointly developed this coordinated GSP. A description of each GSA's organization and management structure can be found in **Section 2.1 – GSA Organization and Structure**. All GSAs are comprised of local agencies authorized to exercise powers related to groundwater management under California Water Code Section 10721.

- **Sacramento Groundwater Authority GSA** - This SGA is a Joint-Powers Authority that manages groundwater in Sacramento County north of the American River. The joint-powers agreement signatories chose to manage the basin cooperatively by creating a governing board of directors comprised of representatives of 14 water agencies and other water users within their jurisdiction. GSA decisions must be approved by a majority of this board.
- **Reclamation District 1001 GSA** - The Reclamation District (RD) is a special-purpose district governed by elected board members who own property or work on land in RD 1001. RD 1001 has delegated certain activities regarding the implementation of SGMA to the Pleasant Grove Verona Mutual Water Company through a separate MOA. GSA decisions must be approved by a majority of this board.
- **SSWD GSA** - South Sutter Water District (SSWD) is a public agency governed by an elected board of directors who are landowners within the district. GSA decisions must be approved by majority vote of the SSWD Board.
- **Sutter County GSA** - The Sutter County Board of Supervisors serves as the legislative body for Sutter County and is responsible for GSP preparation and implementation in the County; however, Sutter County has delegated certain activities regarding the implementation of SGMA to the Natomas Central Mutual Water Company through a separate MOA. GSA decisions must be approved by a majority of the Sutter County board.
- **West Placer GSA** - The West Placer GSA has no authority of its own. Placer County, the cities of Roseville and Lincoln, and Placer County Water Agency formed the WPGSA through a MOA (with participation by the California American Water through a separate participation agreement). Each member agency assigned representatives to serve on the technical working group with certain decision-making abilities. However, certain actions, such as approval of the GSP, require the approval of the governing body of each WPGSA member agency.

This section provides a summary of their decision-making processes and key decisions made leading up to adoption of the GSP, including how the public was engaged.

11.6.1 GSA Formation

All five NASb GSAs began coordinating in January 2017 and executed a MOA in April 2019 to fund development of a single GSP for the NASb. During GSA formation, and as the GSAs began to meet to develop this GSP, the GSAs offered numerous opportunities for public engagement:

- GSA Formation Public Notice – Each public agency desiring to form a GSA published a notice of public hearing.
- GSA Formation Public Hearing – Before deciding to become a groundwater sustainability agency, and after publication of notice pursuant, the local agencies each held a public hearing in the county or counties overlying the Subbasin.

In addition to these two mandatory activities, the GSAs engaged the public prior to and during the GSA formation process through various activities such as public workshops and other public venues (e.g. Municipal Advisory Committees, City Councils, County Board of Supervisors, Water Agency Directors, Agricultural Commission and others) to inform groundwater users and other interested parties of GSA formation and SGMA requirements, as well as to identify potential participants and other stakeholders to engage during the GSP development phase.

11.6.2 GSP Initial Notification

GSP regulations require GSAs to submit an Initial Notification to DWR prior to GSP development. SGA, as the lead agency for the NASb, and pursuant to the above-mentioned MOA, filed the Initial Notification on behalf of the five NASb GSAs on September 24, 2018. While there are no formal adoption requirements for Initial Notification, the GSAs notified the public through various methods, including public meetings, of the Initial Notification and opportunity to comment to DWR. The public was engaged during this process via notifications prior to and after filing of the Initial Notification.

11.6.3 GSP Adoption and Submittal to DWR

The GSAs offered numerous opportunities for public engagement, including but not limited to the following key decision points pursuant to California Water Code Section 10728.4:

- Public Notice of Proposed Adoption – *Prior to adopting a GSP, GSAs must provide notice to a city or county within the area of the proposed plan or amendment. Notices were sent on September 1, 2021.*
- GSP Adoption Public Hearing – *A GSA may adopt a Final GSP after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment.*

Following the required notifications and public hearings, and after consideration of public comments, the GSA agencies adopted the GSP at public meetings held in December and January 2021. Specific dates of public hearings can be found in **Appendix R**.

11.6.4 GSP Review and Evaluation

Once the Final GSP is submitted, any person may provide comments to DWR via the SGMA Portal. The GSA's will inform stakeholders of the GSP submittal and DWR's public comment process and online public comment portal during the workshop on September 8, 2021.

11.6.5 GSP Implementation MOA

At the time the GSAs adopt the GSP, they will also agree to the Implementation MOA to fund and coordinate GSP implementation activities, including ongoing outreach and stakeholder engagement. In general, each of the GSAs in the Subbasin will be responsible for sustainably managing their portion of the Subbasin and contributing funds for GSP implementation, including basin-wide management activities, public engagement, annual reports, and five-year GSP updates. Each GSA approved the MOA at a publicly noticed meeting.

11.7 Informing the Public During GSP Implementation

The GSAs plan to continue public outreach and stakeholder engagement through the GSP implementation phase through various activities, including an annual public meeting to release the results of the Annual Report and the status of projects and management actions. As mentioned, the NASb agencies agreed to coordinate and fund GSP implementation activities through a MOA. The MOA also contains provisions for funding and implementing outreach activities, and the GSAs agreed to, at a minimum:

1. Provide for the consideration of all interests of legal users of groundwater within the NASb. To that end, the GSAs intend to update and seek input from the public and other interested stakeholders as part of GSP implementation and overall SGMA compliance.

2. Hold at least one annual NASb public meeting to inform and update stakeholders on NASb activities and basin wide conditions.

3. Develop public outreach materials and maintain and update the public website (nasbgroundwater.org). The website will be used to inform the public about NASb activities and meetings, provide a portal for the public to provide comments to the NASb GSAs, and include information for each GSA.

In addition, the GSP commits to a Domestic/Shallow Well Data Collection and Communication Program that will focus on increased outreach and collection, sharing, and distribution of water level and water quality data and information with domestic well owners, enabling informed decisions regarding land owners' design and construction of wells and GSAs' management of groundwater.

The GSAs will work to ensure DAC areas are notified at least annually through a variety of methods, such as water agency notices, direct mail, social media, and/or community meetings (e.g. annual notices or updates at Municipal Advisory Committee meetings in DAC areas).

The UAIC will continue to be notified of all activities and invited to the NASb annual public meetings.

With adoption of this GSP and the MOA, public involvement will continue through activities in the GSA individual C&E Plans along with Subbasin-wide public meetings. Nothing within the MOA precludes the individual NASb GSAs from holding additional public stakeholder meetings or conducting their own public engagement activities, consistent with their C&E Plans.

In addition, to comply with the statutory requirements for public engagement during implementation of this GSP, the GSAs will engage the public through:

- Public Notices and Meetings
  - Before amending a GSP
  - Prior to imposing or increasing a fee
- Encouraging Active Involvement

The GSAs will continue to maintain and update their Stakeholder and Interested Parties lists.

This page left intentionally blank

12. References

Berkstresser, C.F., Jr. 1973. Base of Fresh Ground-Water – Approximately 3,000 micromhos - in the Sacramento Valley and Sacramento-San Joaquin Delta, California. U.S. https://pubs.er.usgs.gov/publication/wri7340

Bennett, G.L., V, Fram, M.S., and Belitz, Kenneth. 2011. Status of groundwater quality in the Southern, Middle, and Northern Sacramento Valley study units, 2005–08—California GAMA Priority Basin Project. USGS Scientific Investigations Report 2011–5002. https://pubs.usgs.gov/sir/2011/5002/

Bennett, G.L., 2019. Groundwater quality in the Sacramento Metropolitan Shallow Aquifer, California. USGS Open-File Report 2019-1047. https://pubs.er.usgs.gov/publication/ofr20191047

Brown & Caldwell. 2006. Placer County Water Agency Integrated Water Resources Plan. Rancho Cordova, CA. http://www.pcwa.net/

Bryan, K. 1923. Geology and Ground-Water Resources of the Sacramento Valley, California. U.S. Geological Survey Water-Supply Paper 495. https://pubs.er.usgs.gov/publication/wsp495

California Code of Regulations (CCR), Title 23, Division 2, Chapter 1.5, Subchapter 2 Groundwater Sustainability Plans. 2016. https://cawaterlibrary.net/document/california-code-of-regulations-title-23-waters-division-2-department-of-water-resources-chapter-1-5-groundwater-management-subchapter-2-groundwater-sustainability-plans/

California Code of Regulations (CCR), Title 22, Division 4, Chapter 15, Domestic Water Quality and Monitoring, accessed 2021. https://casetext.com/regulation/california-code-of-regulations/title-22-social-security/division-4-environmental-health/chapter-15-domestic-water-quality-and-monitoring-regulations

California Department of Water Resources (DWR), July 1974. Evaluation of Ground Water Resources: Sacramento County. Department of Water Resources Bulletin 118-3. https://www.csus.edu/indiv/h/hornert/Geologic%20maps%20and%20references/DWR_Bull_118-3_text.pdf

California Department of Water Resources (DWR), July 1978. Evaluation of Ground Water Resources: Sacramento Valley. Department of Water Resources Bulletin 118-6.

California Department of Water Resources (DWR), 1981. Bulletin 74-81 Water Well Standards: State of California. https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Standards/Combined-Well-Standards

California Department of Water Resources (DWR), 1991. Bulletin 74-90. California Well Standards. https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Standards/Combined-Well-Standards

California Department of Water Resources (DWR), 1995. Sacramento Delta San Joaquin Atlas. Reprinted July 1995. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/nmfs/spprt_docs/nmfs_exh4_dwr_1995.pdf

California Department of Water Resources (DWR), 1995. *Draft Feasibility Report, American Basin Conjunctive Use Project*. Sacramento, CA.

California Department of Water Resources (DWR), 1997. *Feasibility Report, American Basin Conjunctive Use Project*. Sacramento, CA.

California Department of Water Resources, 2003. "California's Groundwater," Bulletin 118 – Update 2003, North American Subbasin, last update February 27, 2004. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/Statewide-Reports/Bulletin_118_Update_2003.pdf

California Department of Water Resources, 2014. Geology of the Northern Sacramento Valley, California. https://cawaterlibrary.net/document/geology-of-the-northern-sacramento-valley-california/

California Department of Water Resources, 2016a. Best Management Practices for the Sustainable Management of Groundwater, Monitoring Networks and Identification of Data Gaps. https://groundwaterexchange.org/wp-content/uploads/2020/09/BMP-2-Monitoring-Networks-and-Identification-of-Data-Gaps_ay_19.pdf

California Department of Water Resources, 2016b. Best Management Practices for the Sustainable Management of Groundwater, Monitoring Protocols, Standards and Sites. December 2016. https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents

California Department of Water Resources, 2016c. *Best Management Practices for the Sustainable Management of Groundwater: Water Budget*. December. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

California Department of Water Resources, 2017. Best management Practices for the Sustainable Management of Groundwater, Sustainable Management Criteria DRAFT. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf

California Department of Water Resources, 2018a. Disadvantaged Communities Mapping Tool. Accessed May 2021. https://gis.water.ca.gov/app/dacs/

California Department of Water Resources, 2018. 2017 GPS Survey of the Sacramento Valley Subsidence Network. https://scgah2o.saccounty.net/Documents/2017_GPS_Survey_of_the_Sacramento_Valley_Subsidence_Network.pdf

California Department of Water Resources, 2018. Guidance Documentation for Groundwater Sustainability Plan, Stakeholder Communication and Engagement. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Assistance-and-Engagement/Files/Guidance-Doc-for-GSP---Stakeholder-Communication-and-Engagement.pdf

California Department of Water Resources, 2019. SGMA Basin Prioritization, Phase 2. https://gis.water.ca.gov/app/bp-dashboard/final/

California Department of Water Resources, 2019. Well Completion Reports, https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Completion-Reports

California Department of Water Resources. 2020. SGMA Data Viewer https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub

California Department of Water Resources. 2021. California's Groundwater Update 2020, Bulletin 118. CalGW Online datasets, water level trend data (Groundwater Level Estimated Trends Dashboard (arcgis.com))

Central Valley Regional Water Quality Control Board (CVRWQCB). 2007. *The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region, Fourth Edition, Revised October 2007 (with Approved Amendments), The Sacramento River Basin & The San Joaquin River Basin, California Regional Water Quality Control Board Central Valley Region.* http://www.swrcb.ca.gov/rwqcb5/water_issues/basin_plans/ (accessed 10/2008).

Central Valley Region Regional Water Quality Control Board (CVRWQCB). 2018. Water Quality Control Plan for the Sacramento and San Joaquin Rivers. https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

CH2MHill, 2013. Rice Specific - Groundwater Assessment Report. https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/water_quality/coalitions_submittals/california_rice_commission/ground_water/2013_07_rice_gar.pdf

CH2M, 2016. Groundwater Quality Assessment Report on behalf of the Northern California Water Agencies and the Sacramento Valley Water Quality Coalition. https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/water_quality/coalitions_submittals/sacramento_valley/ground_water/2016_0128_sacvalley_gar_rev.pdf

CH2M, 2016. Groundwater Trend Monitoring Workplan and Data Gap Assessment Plan on behalf of the California Rice Commission.

https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/water_quality/coalitions_submittals/california_rice_commission/ground_water/2016_03_rice_gar.pdf

County of Sacramento. Chapter 6.28 Wells and Pumps. https://qcode.us/codes/sacramentocounty/view.php?topic=6-6_28

Davis and Hall, 1959. Davis, S. N., and Hall, F. R., 1959, Water quality of eastern Stanislaus and northern Merced Counties, California: Stanford Univ. Pubs., Geol. Sci., v. 6, no. 1, 112 p. Davis and Hall, 1959. Davis, S. N., and Hall, F. R., 1959, Water quality of eastern Stanislaus and northern Merced Counties, California: Stanford Univ. Pubs., Geol. Sci., v. 6, no. 1, 112 p. https://ngmdb.usgs.gov/Prodesc/proddesc_91644.htm

Department of Water Resources and United States Bureau of Reclamation (USBR) Water Transfer White Paper (2019) https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Water-Transfers/Files/Draft_WTWhitePaper_20191203.pdf

Harwood and Helley, 1987. Late Tectonism of the Sacramento Valley, California, U.S. Geologic Survey Professional Paper 1359. https://pubs.usgs.gov/pp/1359/report.pdf

Helley and Harwood, 1985. Geologic Map of Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California, U.S. Geological Survey, Miscellaneous Field Studies Map MF-1790. https://pubs.usgs.gov/mf/1985/1790/

Howard, Janet L. 1992. Quercus lobata. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). https://www.fs.fed.us/database/feis/plants/tree/quelob/all.html

GEI, March 2018 (GEI SBR). State of the Basin Report 2013 through 2016 West Placer County.

GEI, November 2, 2018. Technical Memorandum, Initial GSP Development Activities.

GEI, June 21, 2019. Technical Memorandum, Brackish Water Affected Areas Study.

GEI, March 11, 2020. Water Quality Sampling.

Kleinfelder, 2019, Piezometer Reading Summary, 2018-2019 Flood Season Natomas Cross Canal Sacramento and American Rivers. Sacramento and Sutter Counties, CA. File No.: 20161893.005A.

Komex H20 Science, Inc, 2005. Summary of Studies Regarding Surface Water-Groundwater Interaction Along the American River Downstream of Nimbus Dam, Sacramento County, California. Technical Memorandum. Prepared for Sacramento Groundwater Authority.

Land IQ, 2017. Draft report-2014 statewide land use mapping. In. Sacramento, California, USA. https://gis.water.ca.gov/app/CADWRLandUseViewer/images/2014%20Statewide%20Land%20Use%20Mapping%20-%20Report%20-%2020170727.pdf

MBK, 2016. South Sutter Water District Agricultural Water Management Plan.

Milby, Barbara J, and George L. Bennett V, and Kenneth Belitz, 2005. Ground-Water Quality Data in the Southern Sacramento Valley, California, 2005—Results from the California GAMA Program. https://pubs.er.usgs.gov/publication/ds285

Milby, Barbara J, and George L. Bennett V, and Kenneth Belitz, 2018. Ground-Water Quality Data in the Southern Sacramento Valley, California, 2005—Results from the California GAMA Program. https://pubs.usgs.gov/ds/285/

Montgomery Watson Harza (MWH), 2002. Sacramento Groundwater Authority Data Management System, Summary of Basin Conditions.

Montgomery Watson Harza (MWH), December 2005. Western Placer County, Groundwater Storage Study Final Report.

Natomas Basin Habitat Conservation Plan, 2003. https://www.natomasbasin.org/helpful-documents/2003-nbhcp-related-documents/

Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset, accessed 2018. https://gis.water.ca.gov/app/NCDatasetViewer/sitedocs/

O'Green, M Saal, H Dahlke, D Doll, R Elkins. 2015. Soil suitability index identifies potential areas for groundwater banking on agricultural lands. http://calag.ucanr.edu/archive/?article=ca.v069n02p75

Olmstead, F.H., and Davis, G.H., 1961, Geologic features and ground-water storage capacity of the Sacramento Valley, California. vi, 241. DOI 10.3133/wsp1497 https://pubs.usgs.gov/wsp/1497/report.pdf

Page, R. W. and Balding 1973. Geology and quality of water in the Modesto-Merced area, San Joaquin Valley, California. Water-Resources Investigations Report 73-6. https://pubs.usgs.gov/wri/1973/0006/report.pdf

Page. 1986. Geology of the Fresh Ground-Water Basin of the Central Valley, California, with Texture Maps and Sections. USGS Professional Paper 1401-C. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C38&as_vis=1&q=Page.+1971&btnG=

Piper, A. M., Gale, H. S., Thomas, H. E., and Robinson, T. W., 1939, Geology and ground-water hydrology of the Mokelumne area, California: U.S. Geol. Survey Water-Supply Paper 780, 230 p. https://pubs.er.usgs.gov/publication/wsp780

Placer County, 1990. Water Well Construction Ordinance. https://www.placer.ca.gov/DocumentCenter/View/8877/County-Water-Well-Construction-Ordinance-PDF

Placer County, 2020. Placer County Conservation Plan. https://www.placer.ca.gov/3362/Placer-County-Conservation-Program

Redwine, L.E., 1984, The Tertiary Princeton Submarine Valley System Beneath the Sacramento Valley, California: American Association of Petroleum Geologists publication Paleogene Submarine Canyons of the Sacramento Valley, California, pp. 53-80. http://archives.datapages.com/data/pacific/data/069/069001/53_ps0690053.htm?q=%2BtextStrip%3Ala+textStrip%3Aluna+textStrip%3Aformation+textStrip%3Amiddle+textStrip%3Amagdalena+textStrip%3Abasin+textStrip%3Acolombia

Regional Water Authority, 2018. American River Basin Integrated Water Management Plan 2018. https://rwah2o.org/programs/integrated-regional-water-management/american-river-basin-irwmp-2018-update/

RMC, 2011. Groundwater Quality Sustainability Report, Integrated Hydrologic Modeling, prepared for Sacramento Groundwater Authority.

Sacramento Groundwater Authority (SGA), October 2011. Groundwater Quality Vulnerability Assessment. Prepared by Kennedy/Jenks Consultants.

Sacramento Groundwater Authority (SGA), 2014. Groundwater Management Plan Sacramento County – North Basin. http://www.sgah2o.org/wp-content/uploads/2016/06/GMP_SGA_2014_Final.pdf

Springhorn, S.T., 2008, Stratigraphic Analysis and Hydrogeologic Characterization of Cenozoic Strata in the Sacramento Valley near the Sutter Buttes: Master of Science Dissertation, California State University, Chico, 2008. https://www.worldcat.org/title/stratigraphic-analysis-and-hydrogeologic-characterization-of-cenozoic-strata-in-the-sacramento-valley-near-the-sutter-buttes/oclc/636057707

Soil Survey Survey Geographic Database (SSURGO), Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. https://websoilsurvey.nrcs.usda.gov/ . Accessed [11/4/2019].

State Water Resources Control Board, 2021. SAFER Drinking Water Systems with Violations Tool. https://www.waterboards.ca.gov/safer/dw_systems_violations_tool.html

State Water Resources Control Board, 2021. Drinking Water Needs Assessment. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

State Water Resources Control Board, 2021. SAFER Aquifer Risk Tool. https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=17825b2b791d4004b547d316af7ac5cb

Sutter County, 2005. County of Sutter Department of Public Works Improvement Standards. 2005, rev. 2010. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKE

wjr0MWthr7yAhWFW80KHWZNBiEQFnoECAMQAQ&url=https%3A%2F%2Fwww.suttercounty.org%2Fhome%2Fshowpublisheddocument%2F2600%2F637554857279900000&usg=AOvVaw0A8jRi6vM4em5_rtL6YahS

U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Interior Region. 2020. American River Basin Study. https://www.pcwa.net/planning/arbs

U.S. Soil Conservation Service, 1987. Soil Survey of Sacramento County, California. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/CA067/0/sacramento.pdf

U.S. Soil Conservation Service, 1980. Soil Survey of Placer County, California, Western Part. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/placerCA1980/placerCA1980.pdf

USBR Groundwater Banking Guidelines for CVP Water (2019). https://www.usbr.gov/mp/waterbanking/docs/groundwater-banking-guidelines-11-2014.pdf

USGS, 2005. Groundwater Quality Data in the Southern Sacramento Valley, California, 2005 – Results from the California Groundwater Ambient Monitoring and Assessment (GAMA) Program.

USGS, accessed 2019. National Water Information System. https://waterdata.usgs.gov/nwis

Water Education Foundation, 2002, The Water Forum Agreement: A model for collaborative problem solving. https://www.watereducation.org/publication/water-forum-agreement-model-collaborative-problem-solving

Water Forum. 2000. Water Forum Agreement. Updated October 2015. https://waterforum.org/wp-content/uploads/2014/08/Water-Forum-Agreement-Update-2015-FINAL-FOR-PRINT2.pdf

This page left intentionally blank

Appendix A: Implementation MOA

NORTH AMERICAN SUBBASIN
GROUNDWATER SUSTAINABILITY PLAN

APPENDIX A
Implementation Memorandum of Agreement

December 2021

MEMORANDUM OF AGREEMENT
REGARDING COORDINATION BETWEEN GROUNDWATER SUSTAINABILITY AGENCIES AND IMPLEMENTATION OF THE GROUNDWATER SUSTAINABILITY PLAN FOR THE NORTH AMERICAN SUBBASIN

THIS MEMORANDUM OF AGREEMENT (MOA or Agreement) is entered into and effective this 11th day of January, 2022 (Effective Date) by and among the City of Lincoln, the City of Roseville, the County of Placer, the County of Sutter, the Natomas Central Mutual Water Company, the Placer County Water Agency, the Reclamation District 1001, the Sacramento Groundwater Authority, and the South Sutter Water District (all hereafter known individually as a "Party" and collectively as "Parties").

RECITALS

Whereas, on August 29, 2014, the California Legislature passed comprehensive groundwater legislation contained in SB 1168, SB 1319, and AB 1739. Collectively, those bills, as subsequently amended in later years, enacted the Sustainable Groundwater Management Act (SGMA). Governor Brown signed the legislation on September 16, 2014 and it became effective on January 1, 2015; and

Whereas, SGMA requires "sustainable groundwater management "for all groundwater basins and requires “sustainable groundwater management” via a Groundwater Sustainability Plan (GSP) for all groundwater basins or subbasins that are designated as high-priority or medium- priority basins by the California Department of Water Resources (DWR) in its' report entitled "California's Groundwater: Bulletin 118”; and

Whereas, the North American Subbasin (NASb) of the Sacramento Valley Groundwater Basin, DWR Basin No. 5-21.64, has been designated as a high priority subbasin in Bulletin 118; and

Whereas, the following Groundwater Sustainability Agencies (GSAs) collectively cover under their respective jurisdictions, the entire NASb; Reclamation District 1001; Sacramento Groundwater Authority; South Sutter Water District; County of Sutter (consisting of the County of Sutter and the Natomas Central Mutual Water Company); and West Placer GSA (consisting of the City of Lincoln, the City of

Roseville, the County of Placer, the Nevada Irrigation District and the Placer County Water Agency); and

Whereas, the Nevada Irrigation District Board of Directors took action on November 10, 2021] to formally withdraw from the West Placer GSA thereby removing them as a Party to this Agreement; and

Whereas, the California American Water Company and the Golden State Water Company are participants, as defined by SGMA, in certain GSAs overlying the NASb; and

Whereas, the GSAs overlying the NASb have jointly prepared a single Groundwater Sustainability Plan (GSP) to cover the entire NASb, and each Party plans to adopt the GSP to ensure continued sustainable management of the basin; and

Whereas, it is the desire of the Parties to coordinate on the development and long-term implementation of the GSP for the NASb; and

Whereas, the Parties seek to memorialize the terms and conditions of the development and long-term coordination of the GSP and long term SGMA coordination through this Memorandum of Agreement.

THEREFORE, in consideration of the mutual promises, covenants and conditions herein set forth, the Parties agree as follows:

I. **DEFINITIONS.** As used in this Agreement, the meaning of the terms hereinafter set forth shall be as follows:

A. **"Agreement"** shall mean this Memorandum of Agreement Regarding Coordination Between Groundwater Sustainability Agencies and Implementation of the Groundwater Sustainability Plan for the North American Subbasin.

B. **"Annual Budget" or “Budget”** means the budget provided for in this Agreement.

C. **“California Public Records Act”** shall mean California Government Code section 6250, *et seq*.

D. **“Contracting Entity”** shall mean the Party appointed from time to time by agreement of a majority of the NASb GSA Representatives in the manner set forth in this Agreement, who is authorized to collect funds annually from the approved budgets from each Party and contract with service providers for common GSP activities, including monitoring, analysis, and reporting, as well as implementation of Projects and Management Actions.

E. **“Coordination Committee”** shall mean, the five-member committee organized to oversee GSP implementation and SGMA compliance for the NASb.

F. **“Data Management System” or “DMS”** shall mean a system that is capable of storing and reporting information relevant to the development or implementation of the GSP and monitoring of the subbasin as defined by the GSP Regulations (California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2).

G. **"Day” or “Days”** shall mean calendar day.

H. **"Fiscal and Contracting Entity”** shall mean either the GSP Administrator or GSP Coordinator while acting from their home agency to perform financial accounting and contracting duties on behalf of the NASb GSAs.

I. **"Fiscal Year”** shall mean the term to which the Annual Budget applies from July 1 through June 30.

J. **"Funds"** means funds received by the Fiscal and Contracting Entity from the Parties, or any other source for use in carrying out the purposes of this Agreement.

K. **"Groundwater Sustainability Agency" or "GSA"** shall mean an agency or combination of local agencies authorized by SGMA to regulate a portion of a groundwater subbasin cooperatively with all other Groundwater Sustainability Agencies formed in a subbasin, in compliancewith SGMA.

L. **"Groundwater Sustainability Plan" or "GSP"** shall have the definition set forth in SGMA.

M. **"GSP Coordinator"** shall mean a Coordination Committee Primary or Alternate Representative appointed from time to time by agreement of a majority of the NASb GSA Representatives, in the manner set forth in this Agreement, who is authorized to administer the activities contemplated by this Agreement. Generally, the nature of this position is technical coordination.

N. **"GSP Administrator"** shall mean a Coordination Committee Primary Representative appointed from time to time by agreement of a majority of the NASb GSA Representatives, in the manner set forth in this Agreement, who is authorized to coordinate the activities contemplated by this Agreement. Generally, the nature of this position is administrative including meeting coordination and documentation.

O. **"GSP Managers"** shall mean, collectively, the GSP Coordinator and the GSP Administrator.

P. **"GSP Plan Manager"** shall mean a Coordination Committee Primary or Alternate Representative appointed as GSP Plan Manager, as defined in SGMA, as part of this MOA and by the NASb GSAs from time to time by agreement of a majority of the NASb GSA Representatives. The GSP Plan Manager may also serve as the GSP Coordinator or the GSP Administrator. Generally, the duty of this position is to submit required documents to and be the point of contact with the DWR.

Q. **"Management Action"** shall have the definition set forth in SGMA.

R. **"NASb" or "Subbasin"** as used in this Agreement shall mean the North American Subbasin of the Sacramento Valley Groundwater Basin, DWR Basin No. 5-21.64 as its boundaries may be modified from time to time in accordance with California Water Code section 10722.2.

S. **“NASb GSAs”** as used in this Agreement shall mean the GSAs formed in the North American Subbasin consisting of the Reclamation District 1001 GSA; the Sacramento Groundwater Authority GSA; the South Sutter Water District GSA; the Sutter County GSA; and the West Placer GSA.

T. **“NASb GSA Representative” or “Representative”** shall mean the staff member (and/or alternates), designated from time to time by each NASb GSA, who is authorized to take actions under this Agreement to the extent permitted, until such time as the NASb GSA notifies the GSP Administrator and the other Parties of a change in its NASb GSA Representative.

U. **“Party” or "Parties"** shall mean the entities listed in the Preamble to this Agreement.

V. **“Project”** shall mean projects defined in the GSP and projects proposed by the Parties to this Agreement following adoption of the GSP.

W. **"SGMA"** shall mean the Sustainable Groundwater Management Act and all regulations adopted under the legislation (SB 1168, SB 1319 and AB 1739) that collectively comprise the Act, as that legislation and those regulations may be amended from time to time.

X. **“Super Majority”** shall mean a vote of four-fifths (4/5) of the Coordination Committee representatives voting on an item.

Y. **“Undesirable Results”** shall mean one or more of the following effects as defined in SGMA, caused by groundwater conditions occurring throughout the basin: (NASb specific measures can be found in the GSP):

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

2. Significant and unreasonable reduction of groundwater storage.
3. Significant and unreasonable seawater intrusion.
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

II. PURPOSE AND TERM

A. **Compliance with SGMA.** The purpose of this Agreement is to ensure that: (i) the NASb GSAs, including the members of each NASb GSA, are appropriately coordinated to achieve sustainable management of the basin; (ii) the NASb remains under the coordinated local management of the GSAs and does not become a "probationary" basin as defined by SGMA; and (iii) the NASb GSAs consistently implement the NASb GSP and any subsequent amendments or updates to the GSP as required by SGMA or as otherwise made by the NASb GSAs.

B. **Responsibilities of Parties.** The Parties agree that by executing this Agreement, they are committing to the other Parties to carry out the actions specified in this Agreement in good faith, and in a manner consistent with their individual responsibilities to comply with the California Sustainable Groundwater Management Act of 2014 ("SGMA").

C. **Agreement Term.** This Agreement shall remain in effect until amended or terminated by the Parties as provided herein.

III. ORGANIZING PRINCIPLES

A. **Obligation to Coordinate.**

1. The Parties shall strive to provide for, in addition to the interests of GSAs, the interests of all legal users and stakeholders of groundwater within the NASb. To that end, the Parties intend to update and seek input from the public and other interested stakeholders as part of the NASb GSP implementation and SGMA compliance.

2. The Parties shall consider the interests of all beneficial users and uses of groundwater within the NASb, GSA member agencies, and members of the general public. To that end, the Parties intend to update and seek input from the public and other interested stakeholders as part of the NASb GSP implementation and SGMA compliance.

3. Those Parties with land use authorities shall communicate with and inform other Parties of potential land use decisions as they may relate to the GSP and the intended objectives of SGMA.

4. The Parties will share with each other information that is relevant to GSP implementation and SGMA compliance as provide herein.

B. **Obligation to Fund Common Activities, Projects, and Management Actions**.

The Parties agree to fund common activities that are approved in accordance with this Agreement, to achieve the sustainability goals for the NASb, as may be amended from time to time, and to meet the requirements of SGMA. Common activities include, but are not limited to, monitoring, analysis, and reporting of groundwater conditions and implementation of projects or actions determined necessary for sustainability. For planning and budgeting purposes, anticipated common activities will be estimated over a five-year period for each five-year period leading up to the required GSP updates due to DWR by January 31 of, 2027, 2032, 2037 and 2042. The Parties agree that this Agreement constitutes a binding commitment to fund the approved five-year costs presented and approved, by all Parties, at the beginning of each five-year period.

Individual NASb GSAs will have an obligation to fund approved and required projects or management actions determined necessary by actual measured “Undesirable Results” conditions to mitigate Undesirable Results from discretionary projects or actions (or inactions) taken by them or by their GSA members to ensure the sustainable management criteria are met in compliance with SGMA.

C. **Duties of Individual Parties**.

1. Each Party agrees to individually undertake activities and actions to carry out SGMA, in accordance with the terms of the GSP, within their respective GSA boundaries in the NASb. Each Party, or the GSA that Party is a member of, is individually responsible to make decisions consistent with the GSP and to fund and implement activities, plans, or decisions necessary to prevent Undesirable Results within their respective GSA.

2. Each Party shall appoint and authorize one Primary Representative and one Alternate to participate in coordination functions as described herein, and to facilitate reasonably timely and informed input and direction to the Coordination Committee and the GSP Managers.

3. By execution of this Agreement, each Party confirms the authority of its Primary Representative or Alternate to provide input and direction to the Coordination Committee and the GSP Managers on behalf of that Party, and each Party understands that the Coordination Committee and the GSP Managers may undertake further consideration or conduct further analysis on the basis of that input and direction.

4. Each Party shall work cooperatively and in good faith with other Parties within their respective GSA boundaries to manage local groundwater to meet Sustainability Criteria as established and defined within the NASb GSP and to investigate, and address if applicable, Undesirable Results as defined within the NASb GSP.

5. Parties with land use authorities shall work in good faith when making land use decisions to do so in a manner consistent with the GSP and shall seek to achieve the intended objectives of SGMA within the NASb.

IV. GOVERNANCE

A. NASb Coordination Committee.

1. **Purpose.** The purpose of the NASb Coordination Committee is to oversee GSP implementation and SGMA compliance for the NASb.

2. **Representatives.** Each GSA a shall appoint a Primary representative from the staff level to the Coordination Committee. Each GSA shall also appoint an Alternate representative, from the staff level, to serve in the place of Primary representative should the Primary representative be unavailable to attend a Coordination Committee meeting(s). Each NASb GSA Representative and Alternate will serve at the pleasure of the appointing Party. There will be no limit on the term of participation.

3. **Engagement** Each GSA agrees to use best efforts to ensure at least one of its NASb GSA Representatives attend Coordination Committee meetings. If a NASb GSA is not represented by at least one of its NASb GSA representatives at more than two consecutive meetings, the GSP Administrator may request the GSA appoint a new representative(s).

4. **Meeting Frequency.** The NASb Coordination Committee will strive to meet at least quarterly of each calendar year but may meet more or less frequently as otherwise determined by the Coordination Committee. Meetings of the Coordination Committee are not public meetings unless specifically advertised as public by the Coordination Committee and as provided below.

   The NASb Coordination Committee will hold at least one annual public meeting to inform and update stakeholders on NASb activities and basin wide conditions. Nothing within this Agreement precludes the Coordination Committee or individual NASb GSAs from holding additional public stakeholder meetings regarding GSP activities. NASb GSAs shall provide reasonable notice to the Coordination Committee of any planned public meetings regarding GSP activities that they intend to hold regarding NASb GSP activities.

   If a NASb GSA holds a public meeting for their stakeholders regarding GSP activities, the GSA shall provide the Coordination Committee with documentation of the meeting for posting on the NASb website. Acceptable documentation includes but is not limited to presentation recording (if recorded), presentation materials, and meeting agenda/minutes.

5. **Designation of Fiscal and Contracting Entity.** The Coordination Committee shall designate either the GSP Administrator or GSP Coordinator to serve as the Fiscal and Contracting Entity for the Coordination Committee.

6. **Responsibilities.** The Coordination Committee will have the responsibility and authority to act on or otherwise manage the following, on its own account, or through the Fiscal and Contracting Entity, as the case may be:

   i. Selection of the GSP Plan Manager, GSP Coordinator, GSP Administrator, and the Contracting Entity, if not otherwise identified herein.

   ii. Development and adoption of an annual work plan and associated annual budget.

   iii. Approval of service providers, scope of work, fee, and schedule for contracted work.

   iv. Review, comment, and approval of technical work, including monitoring, analysis, and reporting.

   v. Selection of Projects and Management Actions.

   vi. Reporting back to their respective NASb GSAs on GSP implementation.

7. **Quorum.** A majority (three of five – 3/5) of NASb GSA Representatives (one from each GSA) on the Coordination Committee will constitute a Quorum. A Quorum is required for the Coordination Committee to meet.

8. **Meeting Location.** The Coordination Committee may meet in a virtual setting or in person at locations agreed to by the Coordination Committee.

9. **Agenda.** An Agenda will be developed by the GSP Coordinator or GSP Administrator in advance of each Coordination Committee meeting.

B. **GSP Coordinator, GSP Administrator, GSP Plan Manager, and Fiscal and Contracting Entity.**

1. **Selection.** The Parties hereby appoint the Primary or Alternate Representative from the Sacramento Groundwater Authority GSA to be the GSP Coordinator and GSP Plan Manager. The Parties hereby appoint the Primary Representative from the West Placer GSA to be the GSP Administrator. The Fiscal and Contracting Entity shall be selected by the Coordination Committee.

2. **Term.** The Coordination Committee will reaffirm the GSP Managers and the Fiscal and Contracting Entity at the first meeting of the Coordination Committee of each calendar year and they will also be reevaluated at the time of each GSP Update as required by SGMA. If the GSP Coordinator and/or the GSP Administrator or the Fiscal and Contracting Entity is unable to fulfill the required responsibilities as set forth herein, the Coordination Committee shall, by a Super Majority vote, reassign the role to another NASb GSA Representative, or, through the Fiscal and Contracting Entity, retain Consultant services. If the Fiscal and Contracting Entity is unable to fulfil the required responsibilities as set forth herein, the Coordinating Committee shall reassign the role to another Party to fulfill the responsibilities.

3. **Responsibilities.**

   i. The GSP Coordinator will be responsible for the following:

      a. Coordinate the preparation and submittal of Annual Reports as required by SGMA.

      b. Coordinate the preparation and submittal of GSP Updates as required by SGMA.

   ii. The GSP Administrator will be responsible to:

      a. Plan and facilitate Coordination Committee meetings and action items.

   iii. The GSP Plan Manager will be responsible to:
   a. To submit required documents to and be the point of contact with the DWR.

iv. The Fiscal and Contracting Entity will be responsible to:

a. Collect the established contributions to the annual budget at the beginning of each budget year.

b. Contract with service providers, including professional consultants and construction contractors, to implement common GSP activities.

v. The GSP Managers, if requested by the Coordination Committee shall:

a. Prepare grant applications and administration of grants.

b. Contract for consulting services after review and recommendation of the Coordination Committee.

c. Manage projects.

vi. The Fiscal and Contracting Entity shall comply with the procurement and contracting requirements of their respective entity, as well as state and federal laws as applicable.

vii. The GSP Managers shall be designated to fulfill, or provide direction to the Fiscal and Contracting Entity for the following actions upon and after prior approval by the Coordination Committee:

a. To undertake or arrange for approved activities in accordance with the provisions of this Agreement consistent with the approved budget and approving action by the Coordinating Committee.

b. To apply for, accept and expend Funds for use in carrying out the purposes of this Agreement consistent with the approved budget and approving action by the Coordinating Committee.

c. To hold Funds for the purposes herein mentioned provided such Funds are not presently needed to pay costs related to the authorized uses of such Funds under this Agreement consistent with the approved budget and approving action by the Coordinating Committee.

d. To make and enter into contracts reasonably necessary to carry out the purpose of this Agreement, consistent with the approved budget, recommended action and scope of activities by the Coordinating Committee and within that agency's procurement rules and regulations.

viii. Fiscal and Contracting Entity shall have the following responsibilities:

a. Serve as the contracting counterparty for engagement of third-party service providers, including consultants and contractors as the Coordination Committee directs, be engaged through approved contracts.

b. Establish separate accounts, and receive, hold, manage, and provide strict accounting for funds contributed by the members, or obtained from other sources such as grant proceeds, in furtherance of this Agreement. The Fiscal and Contracting Entity shall perform these functions as a fiduciary for the Committee.

V. INFORMATION SHARING

A. **Obligation to Share Information.** The Parties acknowledge and recognize pursuant to this Agreement that the Parties will need to exchange information amongst and between the Parties. The Parties agree that each NASb GSA shall provide the data reasonably required to implement the GSP, develop the Annual Report and update the GSP as required by SGMA.

B. **Procedure for Exchange of Information.**

1. The Parties shall exchange relevant public and non-privileged information through collaboration and/or informal requests made at the Coordination Committee level or through subcommittees designated by the Coordination Committee. However, to the extent it is necessary to make a written request for information to another Party, each Party shall designate arepresentative to respond to information requests and provide the name and contact information of the designee to the Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, email, or other electronic means to the designated representative. The designated representative shall respond in a reasonably timely manner.

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 Coordination Committee.

3. The Parties agree that the Coordination Committee is not a public agency and shall take reasonable steps to refer any data requests made under the Public Records Act or otherwise to the appropriate NASb GSA or public entity.

4. To the extent that a court order, subpoena, or the California Public Records Act is applicable to a Party and applicable or relevant to the GSP, such Party in responding to a request made pursuant to any such authority for release of information exchanged from another Party or Parties shall notify each Party in writing of its proposed release of information within a reasonable time prior to disclosure to allow the appropriate entity the ability to seek a court order restricting such disclosure.

C. **Disclosures.** The Parties agree to disclose to the other Parties non-privileged information that is reasonably relevant to GSP implementation and SGMA compliance. Information that is not time sensitive (e.g., groundwater quality results) shall be disclosed through the NASb GSA representative at the next Coordination Committee meeting or to the GSP Managers. Information that is deemed time sensitive (e.g., groundwater substitution request with timelines attached) shall be disclosed within 5 business days in writing, via mail, email, or other electronic means, to each NASb GSA Coordination Committee Primary or Alternate Representative and to the GSP Managers.

VI. FUNDING PROVISIONS

A. **Budget.**

1. The Coordination Committee shall create, approve, and recommend an Annual Budget aligned to the fiscal year, which will run from July 1 through June 30. The initial annual budget shall be prepared and agreed to within ninety (90) days of the effective date of this Agreement and include a five-year look ahead and budget estimate for the period leading up to the first required GSP update. Thereafter, a Budget shall be agreed upon no later than February 1 of the preceding fiscal year or other such date as approved

by the Coordination Committee. The Budget must be approved by unanimous vote of the Coordinating Committee and recommended for approval to and subsequently approved by the governing body of each Party to this Agreement.

a. Where the Annual Budget anticipates expenditures attributable to multiple NASb GSAs, the Fiscal and Contracting Entity, as approved by the Coordination Committee, will be responsible for handling funds and reporting on financial accounts as otherwise described in Section III, herein. Funds collected but not used in a fiscal year will roll over as a contribution for the following year.

   The Annual Budget shall identify the activities, costs, and cost share to each NASb GSA associated with common expenses required to meet SGMA / GSP compliance. The first year annual Draft Budget is contained in Exhibit 1. Also included in Exhibit 1 is a five-year projection of total costs required to submit the first required NASb GSP update by January 31, 2027.

B. **Coordination Expenses.** Each NASb GSA shall share in the general operating and administrative costs of complying with SGMA and implementing the GSP as approved in the Annual Budget. Approved budgeted costs shall be shared in accordance with the percentages set forth in Exhibit 2 attached hereto and incorporated herein. The cost share formula shall remain in effect for the five-year projected expenses in Exhibit 1 at which time the formula will be reviewed for equity.

C. **Alternative Funding Sources.** The Coordination Committee may pursue State of California, federal, local, or private company grants, but shall not create any indebtedness without prior approval of all Parties to this Agreement.

D. **Accounting of Funds**. The Fiscal and Contracting Entity shall maintain a strict accounting of funds collected, spent, and maintained on behalf of the Coordinating Committee, and shall provide fiscal statements not less frequently than Annually. The books and records of the Fiscal Agent shall be open to inspection by any Party upon reasonable notice.

E. **Individual Party Resources**. Each Party shall bear its own costs associated with activities performed under this Agreement. No Party shall incur debt, liabilities, or obligations on behalf of any other Party unless provided for in a separate agreement.

VII. DECISION-MAKING

A. **Voting.**

1. In the event a vote of the Coordination Committee is necessary, each GSA Representative shall be entitled to one vote. Said vote may be cast by either the Primary or Alternate Representative.

2. The GSA Representative (or, if applicable, GSA Alternate Representative) must be in attendance at a meeting to vote.

3. Prior to voting, the Coordination Committee shall endeavor in good faith to reach consensus on the matters to be determined such that any subsequent vote shall be to confirm the consensus of the Coordination Committee. If any NASb GSA Representative objects to a consensus-based decision prior to a vote being cast, the Representative shall work in good faith to reasonably resolve such objection, and, if the same is not resolved collaboratively, then the matter will proceed to a vote for final resolution.

B. **Unanimous vote Requirements for Certain Actions**. Coordination Committee recommendation of the Annual Budget will require a unanimous vote.

C. **Super Majority Vote Requirements for Certain Actions.** All actions not considered as general business, as determined by the Coordination Committee, shall require a Super Majority vote of the Coordination Committee.

VIII. GROUNDWATER MONITORING NETWORK

A. **Obligation to Develop and Maintain a Groundwater Monitoring Network.** In accordance with SGMA, the Parties hereby agree to coordinate in the development, information sharing, and maintenance of a Groundwater Monitoring Network at the Subbasin level and as established pursuant to the

NASb GSP. This may include but not be limited to the addition of monitoring wells if determined necessary to assess basin conditions in accordance with the GSP and/or SGMA, making repairs to and taking measurements at monitoring network facilities, and collection and analysis of water quality samples.

IX. DATA MANAGEMENT SYSTEM

A. **Obligation to Develop and Maintain a Data Management System.** In accordance with SGMA, the Parties hereby agree to coordinate in the development, information sharing and maintenance of a Data Management System capable of storing and reporting information relevant to the reporting requirements established pursuant to the GSP and SGMA. Data shall be provided in the format required by the Data Management System.

X. REQUEST TO JOIN, WITHDRAW AND TERMINATION

A. **Request to Join.** Requests to join this Agreement shall be considered by the Coordination Committee and per the provisions of Section XIII, Other Provisions/Modifications.

B. **Termination of Participation.**

1. Each Party may, in its sole discretion, unilaterally withdraw from and terminate its participation in this Agreement effective upon ninety (90) days prior written notice to the NASb GSA Representatives participating on the Coordination Committee and the GSP Managers, provided that the withdrawing Party will remain responsible for its proportionate share of any indebtedness incurred prior to the effective date of withdrawal. Such withdrawal by a Party will not cause a termination of this Agreement as to the remaining Parties.

2. Upon withdrawal, the withdrawing Party acknowledges it has a continuing obligation to comply with SGMA and any coordination guidelines or regulations issued by the Department of Water Resources or the State Water Resources Control Board. The Withdrawing Party also acknowledges the need to coordinate with all NASb GSAs in accordance

with applicable law. This obligation shall survive the withdrawal from this Agreement and is for the express benefit of the remaining Parties.

3. Subject to the requirements of Section XI, Procedures for Resolving Conflict, nothing in this section shall be construed as a limitation on the right of a Party to seek legal remedies against a Withdrawing Party.

4. Upon withdrawal, any Party shall be entitled to use any data or other information developed under this Agreement during its time as a Party to this Agreement. After withdrawal, a Party shall be entitled to utilize the NASb GSP for future implementation of SGMA compliance within its legal boundary. Should the Withdrawing Party have an obligation under State law to comply with SGMA, the Withdrawing Party agrees to comply with the coordination requirements set forth in SGMA allowing multiple GSPs over a basin.

C. **Termination.** The Agreement shall terminate if the requirements of SGMA are no longer applicable. This Agreement may be terminated by a unanimous vote of the Parties. However, in the event of termination, each of the Parties will remain responsible for its proportionate share of all debts, liabilities and obligations incurred prior to the effective date of termination.

XI. PROCEDURES FOR RESOLVING CONFLICT

A. Procedures for Resolving Conflict

1. If any dispute arises among the Parties relating to this Agreement or the rights and obligations arising from this Agreement, the aggrieved Party or Parties shall provide written notice to the GSP Managers of the dispute. Within 20 days after receipt of such written notice, the GSP Administrator and/or GSP Coordinator shall call a meeting of the Coordination Committee. Members of the Coordination Committee shall attempt in good faith to resolve the dispute through informal means for a period of 60 days. If the Parties, through the Coordination Committee, cannot agree upon resolution of the dispute within 60 days from the date of the first meeting of the Coordination Committee on the issue in dispute, the Parties shall submit the dispute to non-binding mediation prior to commencement of any legal action. The cost of mediation shall be paid in equal proportion

amongst Parties involved in the dispute. Upon completion of mediation, if the controversy has not been resolved, any Party may exercise any and all rights to bring a legal action relating to the dispute.

2. In the event a dispute or claim is not resolved by a mutually agreeable settlement through negotiation or mediation, the aggrieved Party may file suit in Placer County Superior Court, Sacramento County Superior Court, or Sutter County Superior Court.

XII. OTHER PROVISIONS

A. **Agreement Limitations.** The Parties expressly intend that this Agreement shall not limit or interfere with the respective Parties' rights and authorities over their own internal matters, including, but not limited to, a Party's legal rights to surface water supplies and assets, groundwater supplies and assets, facilities, operations, water management and water supply matters. The Parties make no commitments by entering into this Agreement to share or otherwise contribute their water supply assets as part of the development or implementation of a GSP.

B. **Amendment of Agreement.** The Parties agree this Agreement may be amended from time to time by a written amendment approved by unanimous vote of the Coordination Committee and subsequent approval by all Parties.

C. **Non-Indemnification.** No Party to this Agreement, nor any director, officer or employee of a Party, shall be responsible for any damage or liability occurring by reason of anything done or omitted to be done by another Party under or in connection with this Agreement.

D. **Good Faith.** The Parties agree to exercise their best efforts and good faith to effectuate all terms and conditions of the Agreement and, to take appropriate, expedient, or proper actions reasonably necessary to carry out the intent and purposes of this Agreement.

E. **Governing Law.** The validity and interpretation of this Agreement will be governed by the laws of the State of California.

F. **Counterparts.** This Agreement may be executed in any number of counterparts, each of which will be an original, but all of which will constitute one and the same agreement.

G. **Construction and Interpretation.** The Agreement has been developed through negotiation and each of the Parties has had a full and fair opportunity to review and to make suggestions to revise the terms of this Agreement. As a result, the normal rule of construction that any ambiguities are to be resolved amongst the drafting Parties shall not apply in the construction or interpretation of this Agreement.

H. **Severability.** If any term, provision, covenant, or condition of this Agreement is determined to be unenforceable by a court of competent jurisdiction, it is the Parties' intent that the remaining provisions of this Agreement will remain in full force and effect and will not be affected, impaired, or in validated by such a determination.

I. **Authority of Signers.** The individuals executing this Agreement represent and warrant that they have the authority to enter into this Agreement and to legally bind the Party for whom they are signing to the terms and conditions of this Agreement.

IN WITNESS WHEREOF, the Parties have executed this Agreement on the day and year first above-written.

CITY OF LINCOLN

By: Mark Scott

Printed Name/Title: Mark Scott, Interim City Manager

Date: 1-13-22

Approved As to Form: K Mollenkopf

[Title]

Date: 1/12/21 Kristine Mollenkopf, City Attorney

CITY OF ROSEVILLE

By:

Dominick Casey
City Manager

ATTEST:

Sonia Orozco
City Clerk

APPROVED AS TO FORM:

Michelle Sheidenberger
City Attorney

APPROVED AS TO SUBSTANCE:

Richard D. Plecker
Environmental Utilities Director

Attachment D

COUNTY OF PLACER

By: Ken Grehm

Ken Grehm, Director of Public Works

Date: 1/18/2022

Approved As to Form: Robert Sandman

[Title] Assistant County Counsel

Date: 1/18/22

COUNTY OF SUTTER

By: DAN FLORES

Dan Flores, Chairman: [signature]

Date: 12.14.21

Approved As to Form: [signature]

County Counsel's Office

Date: 12/10/21

NATOMAS CENTRAL MUTUAL WATER COMPANY

By: [signature]

Printed Name/Title: Brett Gray, General Manager

Date: 1-7-22

Approved As to Form: [signature]

Date: January 19, 2022

PLACER COUNTY WATER AGENCY

By: [signature]

Printed Name/Title: Andrew Fecko, General Manager

Date: January 6, 2022

Approved As to Form: [signature]

Date: 1/10/22

RECLAMATION DISTRICT 1001

By: ______________________

Printed Name/Title: Kimberly Reese/General Manager

Date: December 22, 2021

Approved As to Form: ______________________

[Title]

Date: ______________________

SACRAMENTO GROUNDWATER AUTHORITY

By: ______________________

Jim Peifer, Executive Director

Date: 1/10/2022

SOUTH SUTTER WATER DISTRICT

By: ______________________

Printed Name/Title: Dennis Michel, Acting President

Date: December 16, 2021

Approved As to Form: ______________________

[Title] Brad Arnold, General Manager

Date: December 16, 2021

ATTACHMENTS:

Exhibit 1: 2022 Annual Budget and Four-Year Projection Summary

Exhibit 2: Cost Sharing Acreage Summary

Exhibit 1

2022 ANNUAL BUDGET AND FOUR-YEAR PROJECTION SUMMARY					
GSA Name	**Estimated Annual Contribution by GSAs (a)**				
	2022	**2023**	**2024**	**2025**	**2026**
Reclamation District 1001	11,673	11,673	11,673	11,673	11,673
Sacramento Groundwater Authority	83,171	83,171	83,171	83,171	83,171
South Sutter Water District	44,521	44,521	44,521	44,521	44,521
Sutter County	13,583	13,583	13,583	13,583	13,583
West Placer Groundwater Sustainability Agency	76,912	76,912	76,912	76,912	76,912
TOTAL	**$229,860**	**$229,860**	**$229,860**	**$229,860**	**$229,860**
FIVE-YEAR TOTAL	**$1,149,300**				

NOTES:

a. The Parties acknowledge the need to establish an aggregate contingency budget of up to 20%. Any future use of any portion of the contingency budget shall be provided to each GSA for review and approved by a unanimous vote of the Parties at a GSA Basin Coordination Meeting before implementation. Upon approval of the use of the contingency budget, SGA will invoice the Parties to collect the agreed upon contingency amount.

Exhibit 2

COST SHARING SUMMARY		
GSA Name	**Total Acreage**	**Percent Share**
Reclamation District 1001	17,394.5	5.08%
Sacramento Groundwater Authority	123,933.3	36.18%
South Sutter Water District	66,340.6	19.37%
Sutter County	20,240.2	5.91%
West Placer Groundwater Sustainability Agency	114,607.8	33.46%
TOTAL	**342,516.4**	**100%**