Key Merced Subbasin Draft GSP Sections for Review

Groundwater levels (p. 229)

3.3 GROUNDWATER LEVELS

3.3.1 Undesirable Results

Description of Undesirable Results

The undesirable result related to groundwater levels is defined in SGMA as:

> *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. [CWC §10721(x)(1)]*

The undesirable result for chronic lowering of groundwater levels in the Merced Subbasin is sustained groundwater elevations that are too low to satisfy beneficial uses within the basin over the planning and implementation horizon of this GSP. During development of the GSP, potential undesirable results identified by stakeholders included:

Undesirable results

Identification of Undesirable Results

For the Merced Subbasin, an undesirable result for declining groundwater levels is considered to occur during GSP implementation when November groundwater levels at greater than 25% of representative monitoring wells (at least 7 of 25) fall below their minimum thresholds for two consecutive years where both years are categorized hydrologically

as below normal, above normal, or wet[9]. Groundwater levels that fall below the minimum threshold during hydrologically dry or critical years are not considered to be an undesirable result, unless the groundwater levels fail to return to levels above the minimum threshold following the non-dry/critical years.

Note that dewatering of a single domestic well is not considered significant and unreasonable and is not considered an undesirable result.

Minimum Thresholds

3.3.2 Minimum Thresholds

Minimum Threshold Background

The minimum threshold definition for the chronic lowering of groundwater levels was developed to represent water levels that are just above conditions that could generate significant and unreasonable undesirable results in the Merced Subbasin, to the extent possible given available information. Future data may allow for refinement of this threshold.

The Subbasin, as described in the Section 2.1 - Hydrogeologic Conceptual Model, is composed of three principal aquifers: Above, Below, and Outside of the Corcoran Clay. The minimum threshold definition was applied to each of these areas by selecting monitoring wells considered representative within each principal aquifer and establishing a threshold groundwater elevation for each well.

Domestic wells were used during the analysis of developing the thresholds at monitoring wells, as they are generally shallower than agricultural and municipal wells and thus more protective for applying the threshold. Additionally, a domestic well going dry would generally have potential to cause health and safety impacts resulting from a loss of water for consumption, cooking, and sanitary purposes, in addition to the financial burden associated with finding alternative water sources or deepening wells.

Within the Merced Subbasin, groundwater levels have been declining for several years (see Section 2.2 - Current and Historical Groundwater Conditions). Groundwater levels during the recent drought declined at a faster rate, especially in the region designated as the Outside Corcoran Clay Principal Aquifer which is just east of the City of Merced, causing many domestic wells to go dry. As an emergency measure during the drought, Merced County facilitated a State of California tanked water program to make potable water available to approximately 130 domestic users whose wells had gone dry. This program ended in 2018. Figure 3-2 shows a map with the location of the tanked water program deliveries.

Groundwater Levels MT Selection (p. 231)

Minimum Threshold Selection

The minimum threshold for groundwater levels was defined as the construction depth of the shallowest domestic well within a 2-mile radius. Based on the undesirable results described in Section 3.3.1, dewatering of domestic wells is considered the most protective indicator, since domestic wells are expected to be the most shallow groundwater-accessing infrastructure.

Merced County's electronic well permitting database was used to determine the shallowest domestic well depth within two miles of each representative monitoring well (defined as a circle around the monitoring well with radius of 2 miles). The Merced County well permitting database includes domestic wells permitted by the County since the early- to mid-1990s. The database was filtered to omit known inactive wells, wells that do not meet County annual seal requirements (depth of 50 feet or less), and a small number of other outliers[10]. However, it is still possible that the resulting dataset includes wells that have become inactive but are not flagged in the County's database.

In the case of one representative monitoring well (CASGEM ID 28392), recent elevation data indicate the shallowest domestic well may already have been dewatered. In this case, the minimum threshold was moved to match the minimum groundwater elevation recorded at that location prior to January 1, 2015.

Representative Monitoring Wells (p. 232)

Representative Monitoring Wells for Minimum Threshold

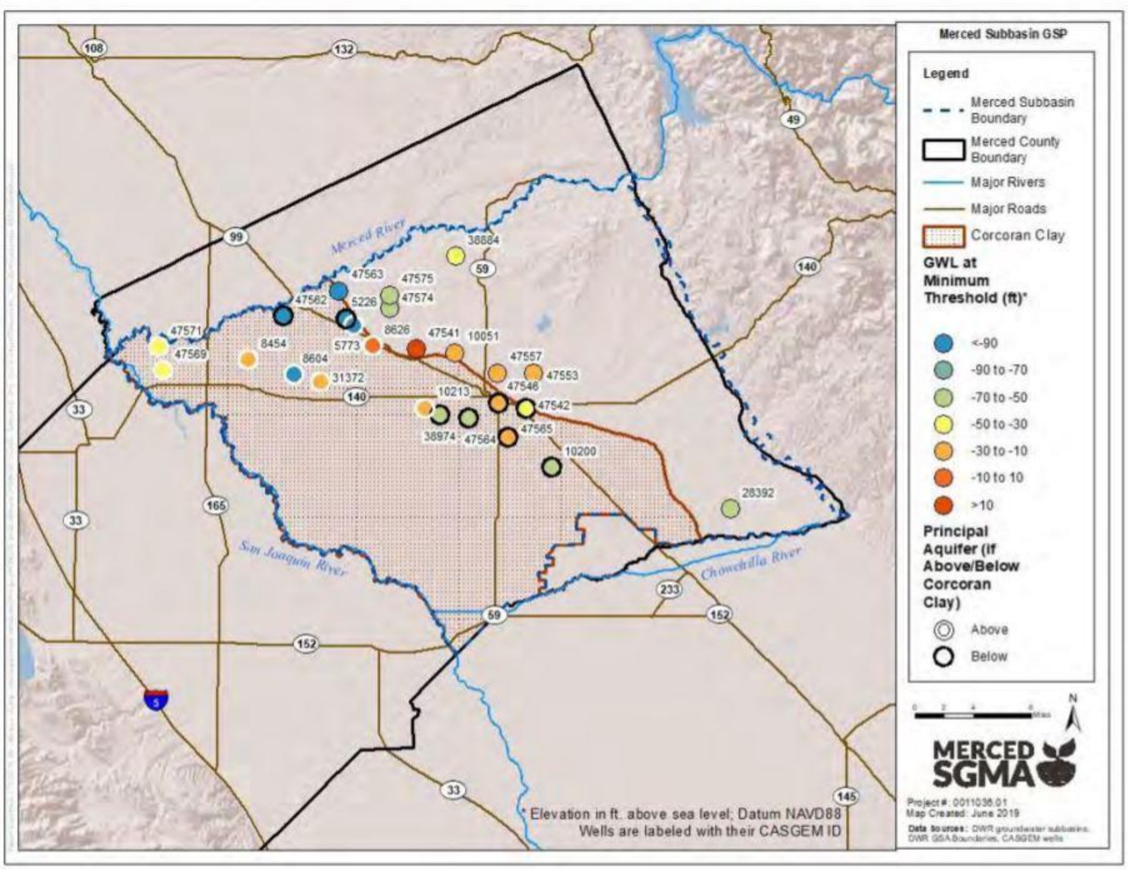
A subset of CASGEM wells serve as the representative monitoring wells. Minimum threshold groundwater elevations were developed for 25 out of 50 CASGEM wells in the Subbasin and are considered the best representation of the Subbasin using best available information. CASGEM wells were selected as they are actively managed and have previously been identified as appropriate for regional monitoring activities. Not all CASGEM wells were selected to be representative. For instance, only one well per unique set of multiple completion wells was considered for representative monitoring.

A data gap has been identified for the western portion of the Subbasin and this is described in more detail in Section 4.5.6 - Data Gaps.

As additional wells are added to the monitoring network, they will be considered for inclusion as representative monitoring wells based on their ability to contribute to characterization and management of groundwater conditions in the Subbasin. In the future, should representative wells be developed in areas of the Subbasin where there are no domestic wells within a 2-mile radius and/or there are no data available for pre-2015 groundwater levels, the GSAs will need to consider developing a new minimum threshold definition; however, this is not anticipated to occur until the five-year GSP update, if at all. At that time, the Subbasin may consider including projected groundwater levels from the MercedWRM as part of the minimum threshold definition. Figure 3-3 shows the minimum threshold groundwater elevations for all the representative monitoring wells. Additional information about the minimum threshold and associated groundwater elevations can be found in Table 3-1 following the discussion of measurable objectives.

Monitoring Sites (p. 233)

Figure 3-3: Minimum Threshold Groundwater Elevations at Representative Monitoring Well Sites



Measurable Objectives

3.3.3 Measurable Objectives and Interim Milestones

Measurable objectives are quantitative targets that establish a point above the minimum threshold that allow for a range of active management of the basin in order to achieve the sustainability goal for the basin. The condition between the measurable objective and the minimum threshold is known as the margin of operational flexibility (MoOF). The MoOF is intended to accommodate droughts, climate change, conjunctive use operations, or other groundwater management activities.

The measurable objective is set at the projected average future groundwater level, which was developed under the MercedWRM sustainable yield simulation described in Section 2.3 - Water Budget Information. In cases in which the average sustainable yield groundwater level was projected to be within 25 feet of the minimum threshold groundwater level or below the minimum threshold groundwater level, the measurable objective was set at a level 25 feet above the minimum threshold groundwater level. The value of 25 feet was based on a 10-year decline of -2.4 ft/yr in the Below Corcoran Clay Principal Aquifer in historical groundwater elevations discussed in Section 2.2.1.1 (Historical Groundwater Elevations), and was intended to provide a reasonable margin of operational flexibility. Table 3-1 shows the measurable objective for each representative monitoring well. Figure 3-4 contains an example hydrograph, showing the relationship between historical groundwater elevations, simulated groundwater levels, the

shallowest domestic well within a 2-mile radius, the minimum threshold groundwater level, and the measurable objective. Appendix F contains the full set of hydrographs, one for each representative monitoring well in Table 3-1.

Interim Milestones

To facilitate the Subbasin reaching its measurable objective for groundwater levels, interim milestones have been established to keep implementation on track. Where historical groundwater levels are consistently higher than the measurable objective, interim milestones were set equal to the measurable objective. When at least one historical groundwater level is below the measurable objective, the interim milestones were developed as follows:

- Year 5 (2025) and Year 10 (2030): set at the lowest groundwater level in the past 5 years (2014-2018). For three sites without groundwater level data 2014-2018, the most recent groundwater level from 2012 or 2013 was used instead.
- Year 15 (2035): set at the midpoint between the recent historical low and the measurable objective.

Interim milestones are shown on Table 3-1.

Groundwater Elevations for Representative Monitoring Wells (p. 235)

Table 3-1: Groundwater Elevations at Minimum Threshold and Measurable Objective, 2015 Groundwater Elevations, and Interim Milestones for Representative Wells

State Well ID	CASGEM ID	Principal Aquifer	Minimum Threshold Elevation[1]	Measurable Objective Elevation[1]	2015 Elevation[1,2]	2015 Elevation Measurement Date[2]	Interim Milestone Elevation[1]		
							2025	2030	2035
06S12E33D001M	5773	Above	-102.5	50.4	57.5	10/9/2014	46.5	46.5	48.4
07S11E07H001M	8454	Above	-17.4	72.6	29.4	12/1/2013	50.5	50.5	61.6
07S11E15H001M	8604	Above	-112.0	63.6	58.9	10/20/2014	31.2	31.2	47.4
07S12E03F001M	8626	Above	4.9	41.5	59.4	10/15/2014	41.5	41.5	41.5
07S13E30R002M	10213	Above	-28.9	41.1	18.6	12/1/2013	41.1	41.1	41.1
07S11E24A001M	31372	Above	-27.2	54.9	60.6	10/20/2014	50.8	50.8	52.9
07S10E17D003M	47569	Above	-43.0	66.3	67.6	10/14/2014	70.2	70.2	68.2
07S10E06K002M	47571	Above	-39.8	63.6	62.0	10/14/2014	49.9	49.9	56.7
06S12E29L002M	5226	Below	-156.0	54.4	68.4	3/1/2012	36.1	36.1	45.3
08S14E15R002M	10200	Below	-52.8	5.5	100.5	12/1/2013	5.5	5.5	5.5
07S13E32H001M	38974	Below	-55.6	34.3	86.4	10/16/2014	34.3	34.3	34.3
07S14E35E001M	47542	Below	-31.1	10.4	73.6	8/19/2014	10.4	10.4	10.4
07S14E30R001M	47546	Below	-10.9	14.1	72.9	8/20/2014	14.1	14.1	14.1
06S11E27F001M	47562	Below	-107.2	69.0	65.8	10/16/2014	58.8	58.8	63.9
07S13E34G001M	47564	Below	-50.3	21.8	78.2	10/16/2014	-101.5	-101.5	-39.8
08S14E06G001M	47565	Below	-15.1	12.5	71.9	10/31/2014	12.5	12.5	12.5
07S13E09A001M	10051	Outside	-27.5	34.0	85.7	10/8/2014	34.0	34.0	34.0
08S16E34J001M	28392	Outside	-88.5	-51.9	-88.5	10/30/2014	-51.9	-51.9	-51.9
06S13E04H001M	38884	Outside	-35.7	70.8	138.0	12/1/2013	69.3	69.3	70.0
07S12E07C001M	47541	Outside	14.7	39.7	61.1[3]	3/4/2015[3]	39.7	39.7	39.7
07S14E16F004M	47553	Outside	-21.1	14.9	74.3	8/21/2014	61.2	61.2	38.1
07S13E13H004M	47557	Outside	-23.2	9.2	75.8	9/23/2014	9.2	9.2	9.2
06S12E17M001M	47563	Outside	-126.5	68.5	53.5	10/9/2014	29.4	29.4	49.0
06S12E23P001M	47574	Outside	-75.0	46.9	66.0	9/29/2014	46.9	46.9	46.9
06S12E23C001M	47575	Outside	-89.0	58.7	59.0	9/29/2014	58.7	58.7	58.7

1. *Minimum Thresholds, Measurable Objectives, 2015 Elevations, and Interim Milestones are reported as groundwater elevations in feet above sea level, datum: NAVD88.*
2. *"2015 Elevations" are shown for the most recent elevation recorded before 1/1/2015. For most wells, this is fall 2014. A handful of wells show a most recent elevation prior to 1/1/2015 that is in 2012 or 2013.*
3. *CASGEM ID 47541 does not have groundwater elevations recorded prior to 1/1/2015, so the earliest elevation in 2015 is reported.*

Groundwater Storage (p. 236-237)

3.4 REDUCTION OF GROUNDWATER STORAGE

3.4.1 Undesirable Results

Undesirable results related to significant and unreasonable depletions of groundwater storage are not present and not expected to occur in the Subbasin, as described below.

The Merced Subbasin has approximately 50 million acre-feet (MAF) of fresh (non-saline) groundwater storage as of 2015 (see Section 2.2.2 - Groundwater Storage in Current and Historical Groundwater Conditions), and analysis of groundwater storage has shown a cumulative change in storage of less than -3 MAF over the 20-year period of 1995-2015. This cumulative change in storage, which includes both representative dry and wet years, reflects a rate of overdraft of approximately 0.3% per year. It is not reasonable to expect that the available groundwater in storage would be exhausted.

3.4.2 Minimum Thresholds and Measurable Objectives

Minimum thresholds and measurable objectives for reduction of groundwater storage were not developed because, as discussed previously, undesirable results related to groundwater storage are not present and are not reasonably expected to occur in the Subbasin.

Interconnected Surface Water (p. 244)

3.8 DEPLETIONS OF INTERCONNECTED SURFACE WATER

Depletions of interconnected surface water are a reduction in flow or levels of surface water caused by groundwater use. This reduction in flow or levels, at certain magnitudes or timing, may have adverse impacts on beneficial uses of the surface water and may lead to undesirable results. Quantification of depletions is relatively challenging and requires significant data on both groundwater levels near streams and stage information supported by groundwater modeling.

Undesirable Results – using groundwater levels as a proxy

Identification of Undesirable Results

As chronic lowering of groundwater levels is used as a proxy for depletions of interconnected surface water, the identification of undesirable results for the depletion of interconnected surface water sustainability indicator is performed through the identification of undesirable results for the chronic lowering of groundwater levels sustainability indicator (see Section 3.3.1).

Minimum Thresholds and Measurable Objectives (p. 246)

3.8.2 Minimum Thresholds and Measurable Objectives

As chronic lowering of groundwater levels is used as a proxy for depletions of interconnected surface water, the measurable objective and interim milestones for the depletion of interconnected surface water sustainability indicator are the measurable objective and interim milestones for the chronic lowering of groundwater levels sustainability indicator.

Land Subsidence Monitoring (p. 53)

1.2.2.3.1 UNAVCO's Plate Boundary Observatory Program

The UNAVCO PBO network consists of a network of about 1,100 continuous global positioning system (CGPS) and meteorology stations in the western United States to measure deformation resulting from the constant motion of the Pacific and North American tectonic plates in the western United States. Information from this monitoring can support monitoring of land subsidence resulting from extraction of groundwater. There are two CGPS stations within Merced County but not within the Merced Subbasin: P303, near the City of Los Banos, and P252, near the City of Gustine. Both station P303 and P252 have subsidence data from 2005 to present (2017).

1.2.2.3.2 United States Bureau of Reclamation

The most comprehensive subsidence monitoring within Merced County comes from USBR's SJRRP. USBR has been surveying 85 static GPS points across the San Joaquin Valley biannually, in July and December of each year, to monitor ongoing subsidence since 2011. The Merced Subbasin contains 11 of the total 85 static GPS points, with an additional 9 points within Merced County and 31 additional GPS points located within 20 miles of the county boundary, primarily to the south.

1.2.2.3.3 United States Geological Survey

There are no known extensometers monitored by the USGS within Merced County. However, there are three USGS cable extensometers directly south of the County, with the closest extensometer approximately 3 miles southwest of the city of Dos Palos (the other two extensometers are 13 and 15 miles south of Dos Palos). The three extensometers have recorded data since 1958, 1961, and 1964, with periodic gaps in the data (i.e., most monitoring occurred in the 1960s through 1990s with a lapse in data until the early 2000s). Only the two farthest extensometers are currently monitoring subsidence, the third extensometer that is closer to the county boundary has been offline since a cable broke in 2012 (USGS, 2017).

Land Subsidence (p. 174)

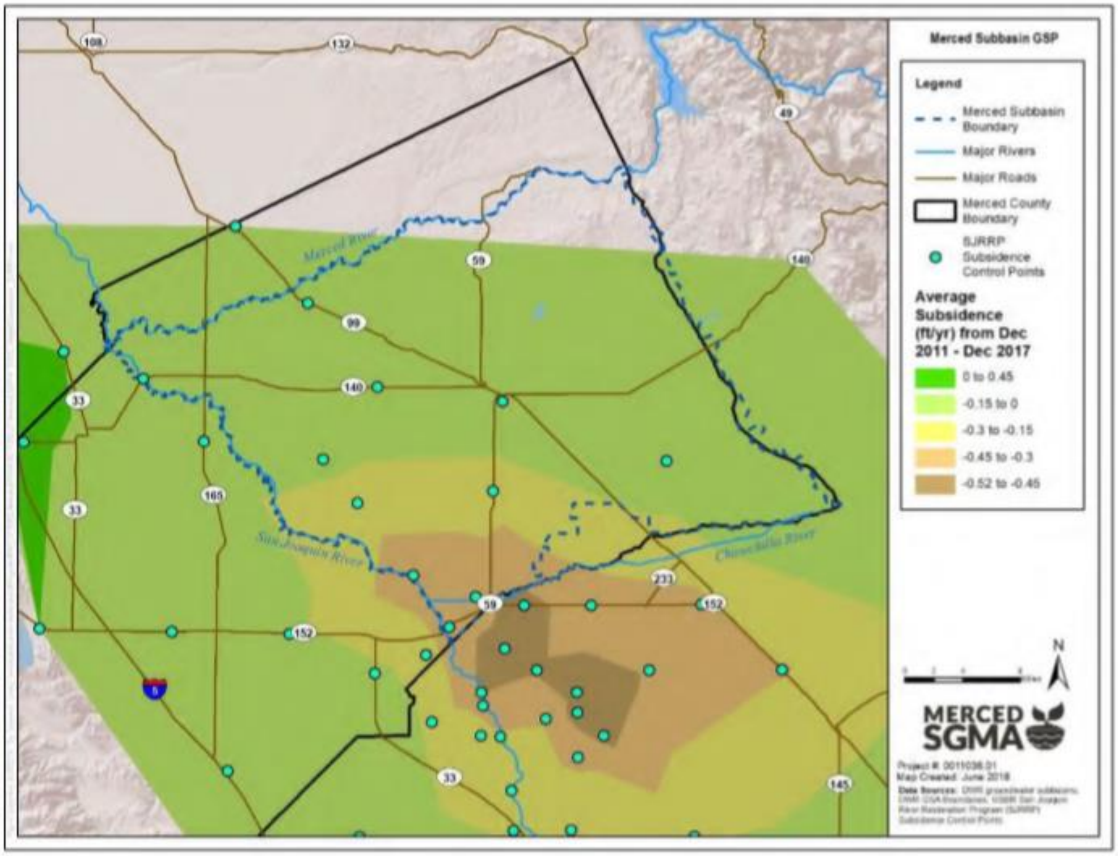
2.2.5 Land Subsidence

Land subsidence is a significant issue in the southwestern portion of the Subbasin and in the neighboring Delta-Mendota and Chowchilla Subbasins. While there are no extensometers in the area to provide data on the depths at which compaction is occurring, the subsidence is thought to be caused by groundwater extraction below the Corcoran Clay and compaction of clays below the Corcoran Clay (DWR, 2017).

The transition from pasture or fallowed land to row and permanent crops adjacent to the San Joaquin River is thought to have created an increased groundwater pumping demand in an area that is not, at this time, serviced by an irrigation district or alternate surface water supply (Reclamation, 2016). This demand is thought to have resulted in recent increases in land subsidence along the river. The subsidence poses difficulties for local, state, and federal agencies with existing or planned infrastructure in the area (Reclamation, 2016).

Subsidence rates are variable, and highest during the drought period. Annual subsidence averaged up to 0.45 feet per year from December 2011 to December 2017, as shown in Figure 2-79 based on data from USBR's San Joaquin River Restoration Program (SJRRP) (see description of program in Section 1.2.2.3 - Land Subsidence Monitoring). This relatively long period averages years of drought and years of normal or wet precipitation. Noting that these measurements incorporate both elastic and inelastic subsidence, the highest maximum annual rate of subsidence reported in Reclamation's regular mapping program was -0.67 feet per year, seen from December 2012 to December 2013 (see Figure 2-80), closely followed by -0.65 feet per year from December 2014 to December 2015. The lowest maximum annual rate of subsidence reported in Reclamation's regular mapping program was -0.18 feet per year, seen from December 2016 to December 2017 (see Figure 2-81).

Figure 2-79: Average Land Subsidence December 2011 – December 2017



Sustainable Management Criteria Land Subsidence (p. 241)

3.7 LAND SUBSIDENCE

3.7.1 Undesirable Results

Description of Undesirable Results

An Undesirable Result for land subsidence would be significant and unreasonable reduction in the viability of the use of infrastructure over the planning and implementation horizon of this GSP. Land subsidence that substantially interferes with surface land uses causes damage to public and private infrastructure (e.g., roads and highways, flood control, canals, pipelines, utilities, public buildings, residential and commercial structures).

The undesirable result related to land subsidence is defined in SGMA as: Significant and unreasonable land subsidence that substantially interferes with surface land uses. [CWC §10721(x)(5)]

The main conveyance facility that has the potential to be damaged or have reduced flood conveyance capacity due to subsidence is the Eastside Bypass, located in the southwest corner of the Merced Subbasin.

Identification of Undesirable Results

Exceedances of minimum threshold rates of land subsidence at three or more monitoring sites out of four for two consecutive years, where both years are categorized hydrologically as below normal, above normal, or wet13, will quantitatively indicate that the Subbasin has reached undesirable results for land subsidence.

Land subsidence can be the direct result of over extraction of groundwater in the Subbasin. Subsidence has been observed in the southwestern portion of the Subbasin and encompasses areas included in all three GSAs. Subsidence in the Subbasin is thought to be caused by groundwater extraction below the Corcoran Clay and compaction of clays below the Corcoran Clay (DWR, 2017). The transition from pasture or fallowed land to row and permanent crops adjacent to the San Joaquin River is thought to have created an increased groundwater pumping demand in an area that is not, at this time, provided with significant alternate surface water supplies (Reclamation, 2016).

Potential Effects of Undesirable Results

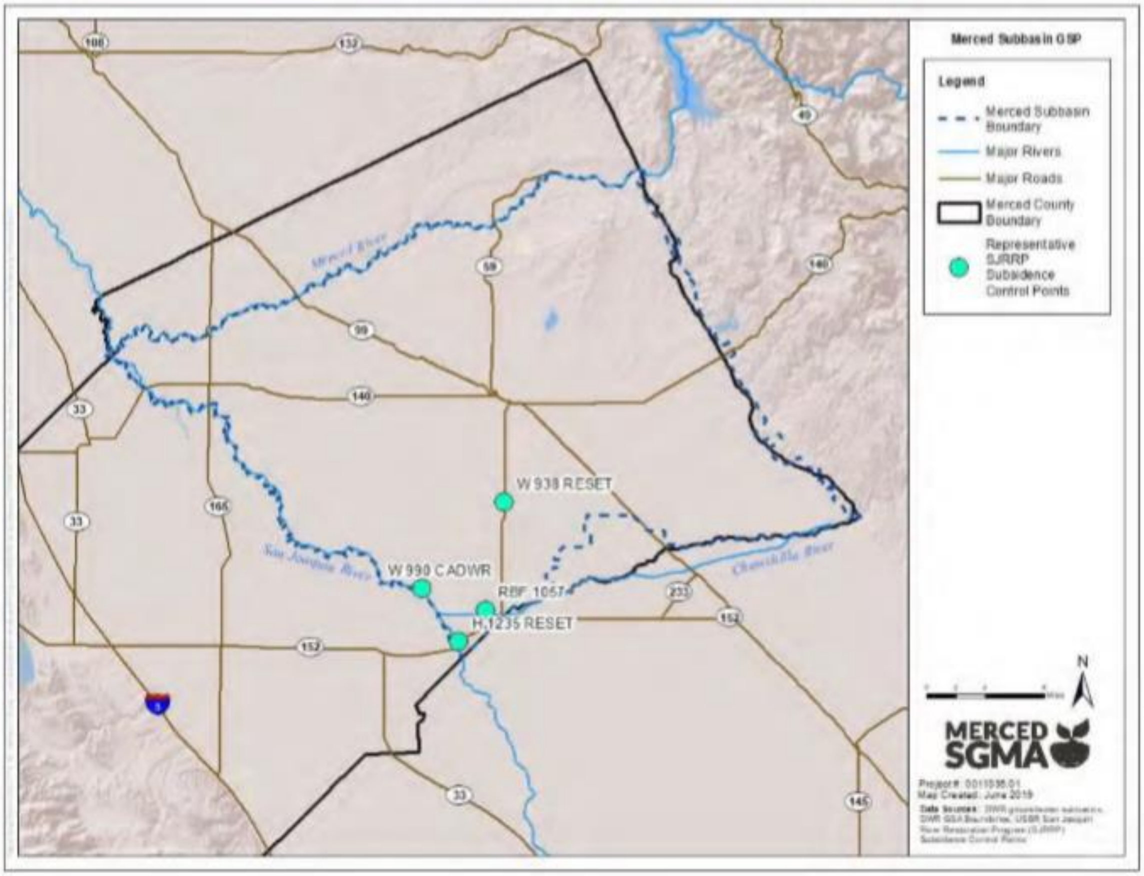
Compaction of subsurface materials can lead to land subsidence, which changes the ground surface and potentially impacts existing infrastructure and land use. Changes in land surface gradients due to land subsidence could impact the integrity of conveyance structures, which are typically gravity-driven. Subsidence could result in the need for higher dams or pumps to move surface water. Similarly, the capacity of flood conveyance systems can be reduced due to subsidence, resulting in a need for higher levees or other flood control infrastructure. As a result, negative impacts of land subsidence could include potential increases in the conveyance costs of irrigation water and in the ability to convey floodwater.

3.7.2 Minimum Threshold

The minimum threshold for land subsidence was selected to prevent undesirable results. While the sensitivity of local infrastructure to land subsidence is not well understood, the ability to convey water supplies and flood water, including the ability to maintain levees, are currently observed to be the most sensitive to land subsidence. Should additional information be developed on vulnerability to subsidence, this minimum threshold may be refined.

The minimum threshold is applied at four locations within the area of subsidence risk which are monitored for land subsidence by the US Bureau of Reclamation (USBR) on a semi-annual basis since 2011 as part of its San Joaquin River Restoration Program. These locations, and their maximum single year (December-to-December) subsidence rates recorded during USBR's monitoring period of 2011 to 2018, are listed below. A map of the locations is shown in Figure 3-5. • W 990 CADWR: maximum recent subsidence of -0.65 ft/year (December 2014 – December 2015) • RBF 1057: maximum recent subsidence of -0.67 ft/year (December 2012 – December 2013) • H 1235 Reset: maximum recent subsidence of -0.61 ft/year (December 2012 – December 2013) • W 938 Reset: maximum recent subsidence of -0.58 ft/year (December 2014 – December 2015)

Figure 3-5: Minimum Threshold Subsidence Locations



Within the Merced Subbasin, while subsidence has been recognized by the GSAs as an area of concern, it is not considered to have caused a significant and unreasonable reduction in the viability of the use of infrastructure. However, it is noted that subsidence has caused a reduction in freeboard of the Middle Eastside Bypass over the last 50 years and has caused problems in neighboring subbasins, highlighting the need for ongoing monitoring and management in the Merced Subbasin.

Despite wetter conditions, subsidence in the Merced Subbasin between December 2017 and December 2018 was approximately -0.17 ft/yr and -0.32 ft/year, depending on the location. Subsidence is a gradual process that takes time to develop and time to halt. Some portion of the experienced subsidence is inelastic compaction, meaning that the soil subsidence due to groundwater pumping is permanent. As a result, some level of future subsidence, likely at rates similar to those currently experienced, is likely to be underway already and will not be able to be prevented.

Given the lack of historical undesirable results experienced in the Subbasin, combined with the expectation that some level of future subsidence is already underway due to continued compaction of historically dewatered subsurface materials, the land subsidence minimum threshold was set at a rate of -0.75 ft/year. This rate is slightly higher than actual subsidence rates experienced between 2011 and 2018, which did not result in significant and unreasonable effects within the Merced Subbasin.

The minimum threshold subsidence rate may be reconsidered if additional information becomes available on the sensitivity of existing infrastructure on subsidence and for consistency with neighboring subbasins.

3.7.3 Measurable Objectives and Interim Milestones

The measurable objective for subsidence is based on recent subsidence rates, which are believed to be reflective of subsidence due to historical dewatering: -0.25 ft/year. Interim milestones are also set at -0.25 ft/year.

The GSAs have also defined a locally-derived, non-regulatory level of -0.50 ft/yr of subsidence that will act as an adaptive management threshold. If subsidence rates are observed at or beyond this level at representative monitoring sites, then the GSAs may consider additional actions in an effort to avoid continued increase in subsidence rates prior to reaching the minimum threshold.

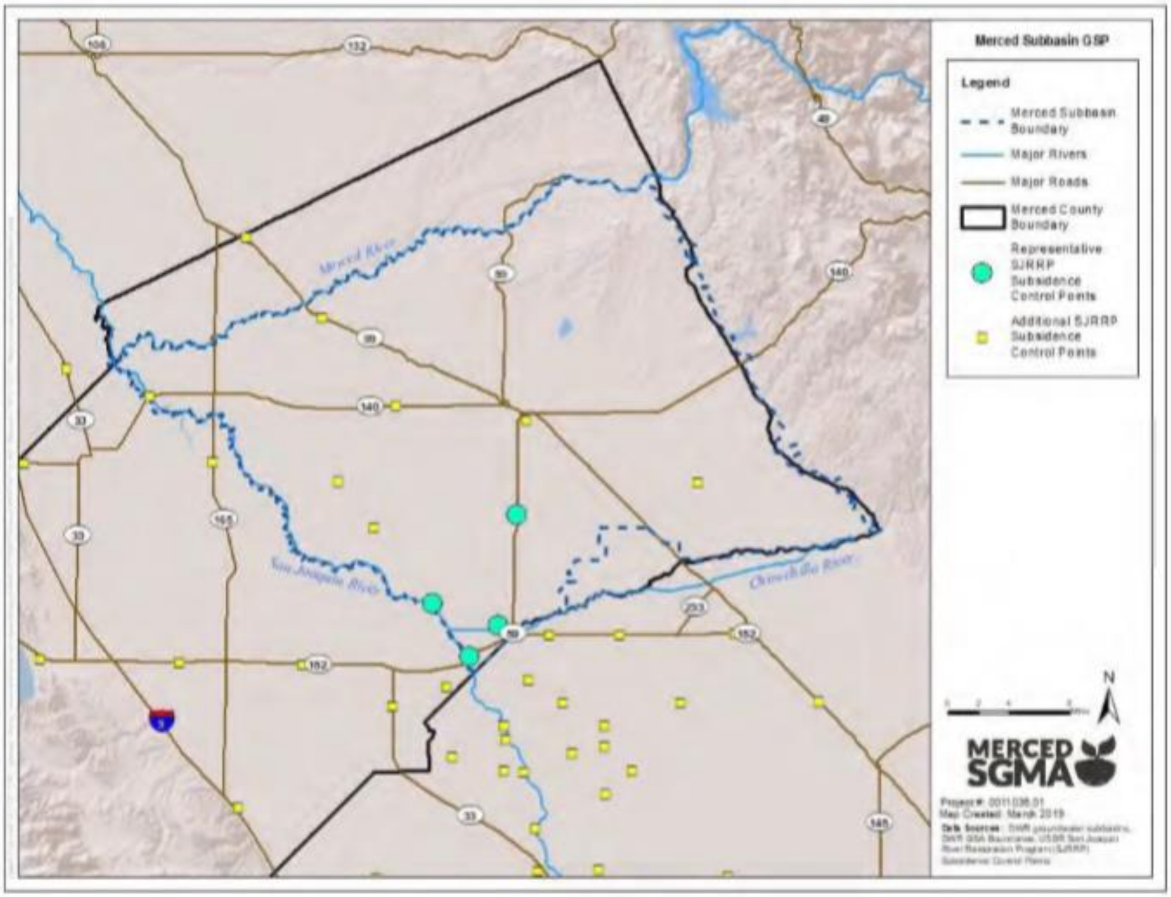
Monitoring Networks (p. 273)

4.9.1 Monitoring Sites Selected for Monitoring Network

The Merced Subbasin GSP subsidence monitoring network includes all 71 subsidence control points monitored by the United States Bureau of Reclamation (USBR) as part of the San Joaquin River Restoration Program (SJRRP), noting that many of these are outside of the Subbasin, but provide regional context. The control points outside the Subbasin are opportunistically selected, in that they both meet the needs of GSP monitoring for the Subbasin and are being actively monitored for other purposes. The selected sites are not necessarily the specific sites shown and listed below, but rather the sites that continue to be monitored under SJRRP monitoring program. Thus, monitoring would not continue if sites were removed from the program. Additionally, sites added to the program would be added to the monitoring network.

Figure 4-8 shows the Merced Subbasin GSP Subsidence Monitoring Network sites. Figure 4-8: Merced Subbasin GSP Subsidence Monitoring Network Sites

Figure 4-8: Merced Subbasin GSP Subsidence Monitoring Network Sites



4.9.2 Monitoring Frequency

USBR conducts subsidence measurements on a semiannual basis. Measurements are recorded in the middle of July and the middle of December as part of the SJRRP.

4.9.4 Representative Monitoring

The Merced Subbasin GSP subsidence monitoring network includes four representative monitoring sites at which minimum thresholds and measurable objectives were defined. Representative monitoring sites were selected for the subsidence monitoring network because of their proximity to the region of known subsidence in the southern corner of the Subbasin. Other subsidence control points within and outside of the Merced Subbasin will be used to construct maps of regional subsidence rates for ongoing monitoring, tracking, and analysis.

Figure 4-8 (above) shows the locations of the land subsidence monitoring network monitoring and representative sites in the vicinity of the Merced Subbasin. Additional SJRRP subsidence control points are located as far south as Fresno County.

Table 4-9 details the land subsidence monitoring network sites. Representative sites are identified with an asterisk (*) next to the SJRRP ID and Local ID.

Table 4-9: Merced Subbasin GSP Subsidence Monitoring Network and Representative Site Details

SJRRP ID	Local ID	Elevation (ft above MSL)	Latitude	Longitude
119	109.28	111.03	37.46356	-120.81269
121	375 USE	127.64	36.98302	-120.50087
170	4S3	97.9	37.22997	-120.70143
HS2494	57.95 USBR	183.31	37.24608	-121.07802
120	604.164	606.63	36.99646	-119.70152
122	ALEX 5	167.37	36.77005	-120.39230
2160	BLYTHE	232.29	36.53247	-119.87233
2147	BURNSIDE	195.1	36.48785	-120.15206
124	D 158 RESET	146.55	37.08372	-120.44936
125	DWIGHT	183.51	36.82226	-120.50180
2362	DWR 154.33	146.69	37.01822	-120.43325
126	E1420	167.16	37.28817	-120.47662
2076	F 158 RESET 1967	178.59	37.08358	-120.36555
128	F 928	619.26	36.62403	-120.65904
129	FIREPORT	145.42	36.85731	-120.46284
130	FREMONT	73.14	37.31065	-120.92791
131	G 706 RESET	242.93	37.22833	-120.27055
132	G 990	124.4	36.99616	-120.50295
133*	H 1235 RESET*	119.82	37.06187	-120.54345
2348	HARMON	112.54	37.01497	-120.63602
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
162*	RBF 1057*	119.54	37.09215	-120.51025
158	RBF1026	149.65	36.85772	-120.39088
152	SALT RM1	84.04	37.19244	-120.83978
153	SHAWN	154.1	36.81757	-120.43339
154	SPEAK AZ MK	229.61	36.72608	-120.02468
108	SSH	78.63	37.24767	-120.85146
155	T 987 CADWR	109.39	37.18612	-120.65872
127	USHER	181.93	36.85100	-120.23693
2448	V513	197.46	36.48511	-120.00531
2065*	W 938 RESET*	144.43	37.19818	-120.48807
156*	W 990 CADWR*	111.2	37.11342	-120.58833
123	WES	159.71	36.95263	-120.35004
157	WILLIAM 3	113.61	37.03363	-120.57226

4.9.5 Monitoring Protocols

Subsidence monitoring will continue to be performed by USBR in accordance with agency protocols (Appendix K).

4.9.6 Data Gaps

As noted in Section 4.9.3, data gaps exist regarding an understanding of the depth at which subsidence is occurring. It is recommended that one or more extensometers be installed to collect this type of data.

4.9.7 Plan to Fill Data Gaps

The number and location of extensometers will be developed in coordination with the SJRRP, the USGS, and other entities associated with subsidence studies, such as the State Water Project, Central Valley Project, California High Speed Rail Authority, and the Central Valley Flood Protection Board. Interbasin coordination will include efforts to coordinate on the installation of extensometers in the Chowchilla and Delta-Mendota Subbasins to better understand trends and any potential correlation to groundwater levels in the different principal aquifers across all subbasins. Extensometers located nearby but outside of the Subbasin may still fill the existing data gap.

Given the expense of extensometers, they may be installed in a phased manner, as funding is available. Funding of a collective effort will be a major component in proceeding with these installations.

Within two years after the approval of the GSP by DWR, the GSAs will provide a plan to fill identified gaps, with a timeline for priorities of implementation.

Plan Implementation Subsidence (p. 325)

7.5 Plan Implementation

Subsidence The subsidence monitoring program for the GSP will utilize monitoring data from the San Joaquin River Restoration Program’s (SJRRP) subsidence control points. Installation of extensometers has been recommended to help understand the depth at which subsidence is occurring. This will involve coordination with the SJRRP, the USGS, and other entities associated with subsidence studies, as well as interbasin coordination efforts with Chowchilla and DeltaMendota Subbasin on the funding and installation of extensometers to better understand trends and any potential correlation to groundwater levels in the different principal aquifers across all subbasins.

Plan Area Groundwater Quality Monitoring (p. 51)

1.2.2.2 Groundwater Quality Monitoring

Numerous agencies within Merced County collect or maintain groundwater quality data and are described in the sections below.

1.2.2.2.1 State Agencies

1.2.2.2.1.1 DWR Water Data Library (WDL)

The WDL contains water quality data recorded at 211 unique monitoring wells within the Merced Subbasin, with sampling dates from 1946 through 1988. The majority of monitoring activity took place in the 1950s and 1960s, and most wells have one to two days of sampling results, as wells are not regularly sampled. The most frequently sampled parameters (more than 1,000 sample results) are dissolved chloride, sodium, calcium, boron, magnesium, and sulfate as well as conductance, pH, and total alkalinity and hardness. Nutrients, metals, and total dissolved solids (TDS) were also sampled but have fewer sample results available.

1.2.2.2.1.2 California Department of Pesticide Regulations

The CDPR maintains a well inventory database containing data from wells sampled for pesticides by a variety of agencies, including the California Department of Public Health (prior to reporting being taken over by the SWRCB), CDPR, DWR, USGS, and SWRCB DDW. These agencies monitor a variety of wells, including monitoring, domestic, large and small water systems, irrigation, and community wells for 35 different pesticides and report measurements to the CDPR. Exact locations are not known, but based on estimation of coordinates via county, township, range, and section, there are 951 wells are monitored within the Merced Subbasin with groundwater quality measurements on pesticides, such as DBCP and xylene, sampled between 1979 through 2015.

1.2.2.2.1.3 Groundwater Ambient Monitoring and Assessment Program (GAMA)

Established in 2000, the GAMA Program monitors groundwater quality throughout California. GAMA is intended to create a comprehensive groundwater monitoring program throughout the state and increase public availability and access to groundwater quality and contamination information. Agencies submit data from monitoring wells for 244 constituents including TDS, nitrates and nitrites, arsenic, and manganese. GAMA data for the Merced Subbasin contains wells monitored by the DDW, CDPR, environmental monitoring wells monitored by regulated facilities, and USGS, with sampling performed from 1930 through 2016. Most wells have one or two days with sampling results because wells are not regularly sampled. Agencies submitting data to GAMA are summarized below.

Division of Drinking Water

The SWRCB DDW monitors public water system wells for Title 22 requirements (such as organic and inorganic compounds, metals, microbial, and radiological analytes). Data are available for active and inactive drinking water sources for water systems that serve the public – wells defined as serving 15 or more connections or more than 25 people per day. Data are electronically transferred from certified laboratories to the DDW daily. Wells are monitored for Title 22 requirements, including pH, alkalinity, bicarbonate, calcium, magnesium, potassium, sulfate, barium, copper, iron, zinc, and nitrate. In the Merced Subbasin, DDW reported groundwater quality data for 177 wells from 1984 through 2016.

California Department of Pesticide Regulations

CDPR is described above. CDPR reports data to GAMA. Unlike data reported directly from CDPR, GAMA provides latitude and longitude coordinates for CDPR wells. In the Merced Subbasin, CDPR reported groundwater quality measurements for 170 wells with water quality data from 1981 through 2012. CDPR only monitors for pesticides and therefore does not have results on water quality constituents such as nitrates and TDS.

DWR DWR's groundwater quality data are incorporated from the WDL, described earlier in this section.

Environmental Monitoring Wells

Environmental monitoring wells are monitored by facilities that in many cases have identified contamination but may not necessarily require an investigation and cleanup (i.e., monitoring through Geotracker described below). Environmental monitoring wells that fall under the GAMA program typically include municipal water purveyors or small water supply systems. 355 wells were identified in the GAMA data download with water quality measurements taken from 2000 through 2016. Contaminated sites often have concentrations of constituents that are not indicative of regional groundwater quality, so environmental monitoring wells may often be excluded from water quality analysis. However, these wells and associated data may have utility in SGMA analysis related to the presence and impact of point-source contamination.

United States Geological Survey

USGS data within the GAMA database reports groundwater quality data for 173 wells within the Merced Subbasin, monitored from 1950 through 2012.

1.2.2.2.1.4 GeoTracker

GeoTracker, operated by the SWRCB, is a subset program of the GAMA program. GeoTracker GAMA does not regularly monitor for general groundwater quality constituents. GeoTracker contains records for sites that require cleanup, such as leaking underground storage tank sites, Department of Defense sites, and cleanup program sites. GeoTracker also contains records for various unregulated projects as well as permitted facilities including: Irrigated Lands Regulatory Program, oil and gas production, operating permitted underground storage tanks, and land disposal sites. GeoTracker receives records and data from SWRCB programs and other monitoring agencies. 669 are sites within Merced County, with increased density near cities such as Merced, Atwater, Livingston, Gustine, Los Banos, and Dos Palos. Of the 669 sites identified in Merced County, 80 are listed as active or open.

1.2.2.2.2 Regional Monitoring

1.2.2.2.2.1 Merced County Department of Public Health, Division of Environmental Health

Merced County Department of Public Health, Division of Environmental Health monitors 60 domestic wells in Merced County for chloride. Additionally, it has monitored nine domestic wells within the Merced Subbasin for general minerals, inorganics, dibromochloropropane (DBCP), and ethylene dibromide (EDB) since 1988 (AMEC, 2008).

1.2.2.2.2.2 Irrigated Lands Regulatory Program

The RWQCB initiated the Irrigated Lands Program in 2003, later renamed to the Irrigated Lands Regulatory Program, to regulate discharge from irrigated agriculture to surface waters and groundwater. The program monitors for a variety of pollutants found in runoff from irrigated lands, including pesticides, fertilizers, pathogens, salts, and sediment. Groundwater is required to be sampled biannually.

The Eastern San Joaquin Water Quality Coalition (ESJWQC) represents the region with waste discharge orders. ESJWQC monitors the Turlock, Merced, and Chowchilla groundwater subbasins. The ESJWQC submitted a Groundwater Quality Assessment Report (GAR) in 2015. The GAR characterizes past and present groundwater quality (nitrates, salinity, TDS, and pesticides) and the impact of irrigated agricultural practices on groundwater quality.

Basin Settings Groundwater Quality (p. 148)

2.2.4 Groundwater Quality

Groundwater in the Merced Subbasin contains both anthropogenic and naturally occurring constituents. While groundwater quality is often sufficient to meet beneficial uses, some of these constituents either currently impact groundwater use within the Subbasin or have the potential to impact it in the future. Depending on the water quality constituent, the issue may be widespread or more of a localized concern.

The primary naturally-occurring water quality constituents of concern are arsenic and uranium. There are also aesthetic issues related to iron and manganese.

The primary water quality constituents of concern related to human activity include salinity, nitrate, hexavalent chromium, petroleum hydrocarbons (such as benzene and MTBE), pesticides (such as DBCP, EDB, 1,2,3 TCP), solvents (such as PCE, TCE), and emerging contaminants (such as PFOA, PFOS). Of these issues, nitrate is the most

X-Axis Abbreviation Description W Wet year type AN Above normal year type BN Below normal year type D Dry year type C Critical year type

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widespread issue with a direct impact on public health. Salinity is also an issue due to the widespread nature of the problem and difficulty of management given increases in salinity as a result of both urban and agricultural use.

The Merced County Department of Public Health, Division of Environmental Health maintains a list of areas of known adverse water quality in the County, shown below in Table 2-8.

Table 2-8: Adverse Groundwater Quality by Area

Region	Parameters
Atwater	Nitrates, DBCP[2], EDB[2], TCE[3] and 1,2,3 TCP[2&3]
Cressey	Nitrates & DBCP
El Nido	Nitrates, Arsenic, Sodium, & TDS[4]
Le Grand	Hard Water[1]
Livingston	Nitrates, Arsenic, DBCP, EDB, TCE and 1,2,3 TCP
McSwain Area	Nitrates, DBCP, EDB, TCE and 1,2,3 TCP
Merced	Nitrates & Hard Water
Planada	DBCP & Hard Water
Stevinson	Arsenic, Sodium, TDS[4], Manganese, Chlorides, Hard Water, & Tannins
Winton	Nitrates, DBCP, EDB, TCE and 1,2,3 TCP

Source: (Merced County Department of Public Health, Division of Environmental Health, 2018)

[1] Hard Water = Total hardness > 150 mg/L (mg/L = milligrams per liter = parts per million)
[2] Dibromochlopropane (DBCP), Ethylene Dibromide (EDB) and 1,2,3 Trichloropropane (1,2,3 TCP) are soil fumigants, use of DBCP and EDB was banned in 1977.
[3] TCE and 1,2,3 TCP are solvent/degreases.
[4] TDS refers to the total dissolved solids in water.

General Notes from the Merced County Department of Public Health, Division of Environmental Health:

a. Chlorides, manganese, hard water, iron, tannins, TDS, and sodium in drinking water are, of themselves, not known causes of health problems.
b. The water quality information above refers to private wells in unincorporated areas and does not necessarily apply to the municipal water supply of the towns and cities.

The sections below provide information on the historical and current groundwater quality conditions for constituents grouped by (1) salinity and nutrient constituents (Section 2.2.4.1), (2) metals (Section 0), (3) pesticides (Section 0), and (4) point-source contamination (Section 2.2.4.4), which includes petroleum hydrocarbons, solvents, and emerging contaminants. Salinity and nitrate data from 2008-2018 are described in the section below for each of the Principal Aquifers. Water quality data for the remaining constituents are based on more limited range of data collected 2007-2012, largely without depth, that were analyzed for the 2013 Salt and Nutrient Study as part of the Merced Integrated Regional Water Management (IRWMP). These data limitations have been identified as a data gap, and it is expected that additional water quality monitoring will be developed as part of this GSP which will further inform the understanding of current water quality conditions in the Subbasin, particularly as they pertain to depth and the characterization of the three Principal Aquifers.

3.6 DEGRADED WATER QUALITY (p. 236)

3.6.1 Undesirable Results

Description of Undesirable Results

The undesirable result related to degraded water quality is defined in SGMA as: Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies. [CWC §10721(x)(4)]

Undesirable results for degraded water quality would be impacts caused by groundwater extractions and other SGMA groundwater management activities in the Subbasin that cause significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP.

In identifying undesirable results for the Subbasin, the GSAs sought input from beneficial users through multiple venues including the stakeholder advisory committee and public workshops held in locations specifically selected to provide access to disadvantaged communities. The protection of water quality for drinking and for agricultural use was identified as a priority for users in the basin. Degraded water quality is unique among the six sustainability indicators because it is already the subject of extensive federal, state, and local regulations carried out by numerous entities and SGMA does not directly address the role of GSAs relative to these other entities (Moran & Belin, 2019). The GSAs also sought input from the Merced County Division of Environmental Health as to which constituents of concern in the Subbasin could be tied to groundwater management activities and therefore managed through SGMA. While the Division of Environmental Health has identified several constituents of concern in the Subbasin (see Section 2.2.4 - Groundwater Quality in Current and Historical Groundwater Conditions), this GSP focuses on only those constituents where groundwater management activities have the potential to cause undesirable results. The GSAs and Subbasin

stakeholders, in consultation with the Division of Environmental Health, determined that salinity is the only constituent of concern currently known to be directly tied to groundwater management activities and therefore appropriate to include in the GSP.

Identification of Undesirable Results

An undesirable result is considered to occur during GSP implementation when at least 25% of representative monitoring wells (5 of 19 sites) exceed the minimum threshold for degraded water quality for two consecutive years.

Potential Causes of Undesirable Results

Groundwater in the Merced Subbasin contains both anthropogenic and naturally-occurring constituents. While groundwater quality is typically sufficient to meet beneficial uses, some of these constituents either currently impact groundwater use within the Subbasin or have the potential to impact it in the future. Depending on the water quality constituent, the issue may be widespread or more of a localized concern. The focus of this GSP is on constituents that are exacerbated or ameliorated due to groundwater management activities.

Salinity was selected by the GSAs based on stakeholder input and the recommendation of the Merced County Division of Environmental Health as the only constituent to monitor in the GSP because the causal nexus between salinity concentrations and groundwater management activities has been established (see Section 3.6.2 - Minimum Thresholds). Relatively high salinity groundwater in the basin has been shown to migrate due to groundwater extraction activities. These areas of relatively high salinity groundwater are primarily located along the west side of the Subbasin, adjacent to the San Joaquin River and urban use areas such as the cities of Livingston and Atwater. High salinity groundwater is principally the result of the migration of a deep saline water body which originates in regionallydeposited marine sedimentary rocks that underlie the San Joaquin Valley. Groundwater pumping can cause the upwelling of saline brines originating from naturally-occurring marine sedimentary rocks. Though Corcoran Clay naturally impedes high TDS groundwater, high permeability pathways through the clay from the Below Corcoran Principal Aquifer to the Above Corcoran Principal Aquifer may be created by perforated wells. In addition, this poorerquality water can migrate across the Subbasin from the west to the east (AMEC, 2008). Better quality groundwater (less than 1,000 mg/L) in these western and southwestern areas is generally found at shallower depths (AMEC, 2008), generally in the Below Corcoran Principal Aquifer .

Note that accumulation of salts due to agricultural activities, urban wastewater, or other land use activities do not have an established causal nexus with groundwater management activities.

Potential Effects of Undesirable Results

If groundwater quality were degraded to levels causing undesirable results, the effect could potentially cause a reduction in usable supply to groundwater users, with domestic wells being most vulnerable as treatment or access to alternate supplies may be unavailable or at a high cost for small users. Water quality degradation could cause potential changes in irrigation practices, crops grown, crop productivity, adverse effects to property values, and other economic effects. Degraded water quality could have impacts on native vegetation or managed wetlands. Additionally, reaching undesirable results levels for groundwater quality could adversely affect current and projected municipal uses, and users could have to install wellhead treatment systems or seek alternate supplies.

3.6.2 Minimum Thresholds

Minimum Threshold Applicability

Degraded water quality is unique among the six sustainability indicators because it is already the subject of extensive federal, state, and local regulations carried out by numerous entities, and SGMA does not directly address the role of

GSAs relative to these other entities (Moran & Belin, 2019). SGMA does not specify water quality constituents that must have minimum thresholds. Groundwater management is the mechanism available to GSAs to implement SGMA. Establishing minimum thresholds for constituents that cannot be managed by increasing or decreasing pumping was deemed inappropriate by the GSAs and basin stakeholders. Other water quality concerns are being addressed through various water quality programs (e.g., CV-SALTS and ILRP) and agencies (e.g., RWQCB, EPA) that have the authority and responsibility to address them. The GSAs will abide by any future local restrictions that may be implemented by the agencies or coalitions managing these programs. These water quality issues without a causal nexus in the Merced Subbasin include: • Naturally occurring constituents such as arsenic, uranium, iron, and manganese: the GSAs do not have control over the presence of these constituents in aquifer materials. Thresholds are not set for these constituents as there is no demonstrated local correlation between fluctuations in groundwater elevations and/or flow direction and concentrations of these constituents at wells. • Constituents from human activities that are not managed under SGMA: pesticides, herbicides, and fertilizers may be present from agricultural and, to a lesser degree, urban uses. Existing programs, including CV-SALTS, ILRP, and regulation by the California Department of Pesticide Regulation, are designed to address these concerns. Thresholds are not set for these constituents as the GSAs have no authority to limit the loading of nutrients or agrochemicals. However, as mentioned above, the GSAs will abide by any future local restrictions that may be implemented by agencies managing such programs. • Constituents from human activities at contaminated sites managed under other regulatory authority: constituents at the former Castle Air Force Base and other smaller contaminated sites are under cleanup orders set by state or federal agencies. The potentially responsible parties are required to contain contaminants and remediate the groundwater. Data collected as part of GSP monitoring will be provided to regulators upon request. Thresholds are not set for these constituents as the GSAs are not responsible and do not have authority for containment or cleanup of these sites.

The major water quality issue being addressed by sustainable groundwater management is the migration of relatively higher salinity water into the freshwater principal aquifers. The nexus between water quality and water supply management exists for the pumping-induced movement of low-quality water from the west and northwest to the east.

The GSAs sought input from the Merced County Division of Environmental Health (Division) during the development of water quality minimum thresholds. The Division agrees that salinity is a good indicator for water quality issues and trends that are related to Subbasin groundwater management activities. In addition, the Division recommended that the GSAs make use of resources like GeoTracker and Envirostor and to closely coordinate with agencies that already monitor contamination plumes.

While the GSP does not set thresholds for the types of constituents described above, current conditions in the basin are summarized in see Section 2.2.4 (Groundwater Quality) and monitoring of these constituents is included in ongoing monitoring efforts listed below and will be summarized in future GSP updates. The GSAs will conduct the following ongoing water quality coordination activities: • Monthly review of data submitted to the Department of Pesticide Regulation (DPR), Division of Drinking Water (DDW), Department of Toxic Substances Control (EnviroStor), and GeoTracker as part of the Groundwater Ambient Monitoring and Assessment (GAMA) database. • Quarterly check-ins with existing monitoring programs, such as CV-SALTS and ESJWQC GQTM. • Annual review of annual monitoring reports prepared by other programs (such as CV-SALTS and ILRP)

• GSAs will invite representative(s) from the Regional Water Quality Control Board, Merced County Division of Environmental Health, and ESJWQC to attend an annual meeting of the GSAs to discuss constituent trends and concerns in the Subbasin in relation to groundwater pumping.

The purpose of these reviews will be to monitor and summarize the status of constituent concentrations throughout the Subbasin with respect to typical indicators such as applicable MCLs or SMCLs. The Merced Subbasin GSP Annual Report and 5-Year Update will include a summary of the coordination and associated analyses of conditions. The GSP 5-year updates may include evaluation of whether minimum thresholds for additional constituents are needed.

Minimum Threshold Selection

Salinity is a measure of the amount of dissolved particles and ions in water. Salinity can include several different ions, but the most common are chloride, sodium, nitrate, calcium, magnesium, bicarbonate, and sulfate. While there are several different ways to measure salinity, the two most frequently used are Total Dissolved Solids (TDS) and Electrical Conductivity (EC). TDS is a measure of all dissolved substances that can pass through a very small filter (typically with 2-micrometer pores) and is typically reported in milligrams per liter (mg/L). EC measures the ability of an electric current to pass through water because conductivity is proportional to the amount of dissolved salts in the water. It is generally reported in microSiemens/cm. Salinity throughout this GSP is reported in terms of TDS.

The minimum threshold for salinity is defined based on the potential impact of salinity on drinking water and agricultural beneficial uses, as aligned with state and federal regulations. The recommended drinking water secondary MCL for TDS is 500 mg/L with an upper limit of 1,000 mg/L and a short-term limit11 of 1,500 mg/L (SWRCB, 2006). The secondary MCL was established by the USEPA and then adopted by the SWRCB. The secondary MCL is a secondary drinking water standard established for aesthetic reasons such as taste, odor, and color and is not based on public health concerns. For agricultural uses, salt tolerance varies by crop, with common crops in the Merced Subbasin (almonds, sweet potatoes, tomatoes, alfalfa, corn, and grapes (Merced County Department of Agriculture, 2017)) tolerant of irrigated water with TDS below about 1,200 mg/L at a 90% crop yield potential (Ayers & Westcot, 1985). 12

Salinity levels within the Merced Subbasin have historically ranged from less than 90 mg/L to greater than 3,000 mg/L as TDS. Generally, similar to other basins in the eastern San Joaquin Valley, TDS tends to increase from the foothills to the trough of the Valley. TDS in the eastern two-thirds of the Subbasin is generally less than 400 mg/L. TDS increases westward and southwestward towards the San Joaquin River and southward towards the Chowchilla River. In these areas, high TDS water is found in wells deeper than 350 feet (AMEC, 2008). TDS is slightly elevated in certain urban portions of the northern Subbasin, such as beneath the Atwater and Winton areas (AMEC, 2008).

Most recent 2000-2016 TDS concentrations in the Merced Subbasin, as analyzed by the CV-SALTS program, ranged widely from 90 mg/L to 2,005 mg/L. In the northwest area of the Above Corcoran Clay, average TDS is greater than 751 mg/L. Average TDS concentration in the Below Corcoran Clay is lowest in the North (less than 501 mg/L) and increases in the Southwest to over 1,000 mg/L (Luhdorff and Scalmanini Consulting Engineers, 2016). In pockets of the Subbasin with elevated TDS (greater than 1,000 mg/L), water use behaviors have already shifted to accommodate these concentrations. For example, agriculture has focused on more salt-tolerant crops, and more saline water supplies are blended with less saline water supplies. As a result, TDS concentrations in excess of 1,000 mg/L where currently experienced are not considered to be undesirable. There is, however, a desire on the part of Subbasin stakeholders to

Short-term limits are acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources (California Code of Regulations Title 22 § 64449). 12 An average value of 1.8 dS/m was converted using University of California Agriculture and Natural Resources salinity unit conversion formula of TDS (mg/L) = Electrical Conductivity (dS/m) * 640 (applicable for electrical conductivity ranging 0.1 to 5 dS/m).

limit increases in salinity in parts of the Subbasin where TDS is below 1,000 mg/L to prevent undesirable results such as requirements to change cropping, blending supplies, etc.

Given these conditions, the minimum threshold for salinity was defined as 1,000 mg/L as TDS to be protective against undesirable results related to elevated salinity.

Representative Monitoring Wells for Minimum Threshold

The East San Joaquin Water Quality Coalition (ESJWQC) is a group of agricultural interests and growers formed to represent all dischargers who own or operate irrigated lands east of the San Joaquin River within Madera, Merced, Stanislaus, Tuolumne, and Mariposa Counties, as well as portions of Calaveras County. The ESJWQC has developed a Groundwater Quality Trend Monitoring workplan (GQTM) as part of the Irrigated Lands Regulatory Program (ILRP), which includes a targeted set of domestic wells (denoted as principal wells) supplemented by public water system wells (denoted as complementary wells) (ESJWQC, 2018). All ESJWQC GQTM program principal and complementary monitoring wells in the Merced Subbasin are used as representative monitoring wells for this GSP. Additional information about minimum thresholds can be found in Table 3-2 following the discussion of measurable objectives. More information about these representative monitoring wells and plans to fill data gaps are included in Section 4.8 - Groundwater Quality Monitoring Network.

3.6.3 Measurable Objectives and Interim Milestones

The measurable objective is a TDS concentration of 500 mg/L, which aligns with the Secondary MCL for TDS. The margin of operational flexibility (MoOF) is 500 mg/L TDS, the difference between the measurable objective of 500 mg/L and the minimum threshold of 1,000 mg/L. In the case of degraded water quality, specifically for salts, there is a natural tendency for salt concentrations to increase over time due to agricultural and urban uses of water, which add salts either directly or increases concentrations through evapotranspiration. As previously noted, such increases are not due to a causal nexus with groundwater management activities and would not constitute an undesirable result under this GSP. Continued monitoring data will be analyzed for trends, and future increasing trends will be analyzed for evidence of the sources of the trends, such as upward migration of relatively higher salinity water due to overpumping or due to continued agricultural and urban uses. If caused by upward migration, GSAs will respond accordingly due to the causal nexus with groundwater pumping.

Table 3-2 shows the measurable objective for each representative monitoring well. Interim milestones are set at the same concentrations as the measurable objectives.

Table 3-2: Groundwater Quality Minimum Threshold & Measurable Objective Concentrations

ESJWQC GQTM Well ID	Complementary or Principal?[1]	Principal Aquifer	TDS Concentration at Minimum Threshold (mg/L)	TDS Concentration at Measurable Objective (mg/L)
P06	Principal	Outside	1,000	500
P07	Principal	Below	1,000	500
P08	Principal	Outside	1,000	500
P09	Principal	Below	1,000	500
P10	Principal	Below	1,000	500
C35	Complementary	Above	1,000	500

C41	Complementary	Above	1,000	500
C45	Complementary	Above	1,000	500
C38	Complementary	Below	1,000	500
C44	Complementary	Below	1,000	500
C40	Complementary	Outside	1,000	500
C42	Complementary	Outside	1,000	500
C43	Complementary	Outside	1,000	500
C46	Complementary	Outside	1,000	500
C47	Complementary	Outside	1,000	500
C39	Complementary	Outside	1,000	500
C48	Complementary	Outside	1,000	500
C49	Complementary	Unknown	1,000	500
C50	Complementary	Unknown	1,000	500

1. *Complementary and Principal wells are defined in Section 4.8.1 - Monitoring Wells Selected for Monitoring Network.*

Delta-Mendota Subbasin Annual Report Template

Table of Contents

Executive Summary

Chapter 1 – Introduction

- Figure:
    - Map depicting location of the six GSP regions

Chapter 2 – Groundwater Elevation Data

- Written description of groundwater elevation data
- Figures:
    - Contour map - seasonal high (Spring) for the reporting year
        i. Indicate groundwater elevation data locations (no names included in SCVWD example)
        ii. Consider depicting confined and recharge areas (if determined necessary)
    - Contour map - seasonal low (Fall) for the reporting year
        i. Indicate groundwater elevation data locations (no names included in SCVWD example)
        ii. Consider depicting confined and recharge areas (if determined necessary)
    - Map – location of groundwater monitoring wells and names
    - Hydrographs for Subbasin Monitoring Network representative sites through fall of reporting year (ex: for 2020 submission, last data point will be September 2019)
    - Graph - Water Year Type over time
        i. Can consider including this breakdown that shows water year type for the historic period
- **Next Steps:**
    i. Determine naming process for identifying wells used in contour maps
    ii. Discuss resolution and format for spatial and temporal data reporting
    iii. Confirm timing for monitoring site reporting process
        1. All data shared to DMS by October 31
        2. Early December – GSP representatives meet to create contour maps in person
        3. Any other timing needs?

Chapter 3 – Water Supply and Use

- Introduction/explanation of water supply in the Subbasin

Groundwater Extraction

- Overview of groundwater extraction, use of groundwater
- Figure:
    - Map depicting groundwater pumping in the Subbasin that illustrates general location and volume of groundwater extractions during the reported water year
        i. By GSP Group? Do we coordinate this?
- Table:
    - Summary of groundwater pumping by source and sector, method of measurement (metered/estimated), and level of accuracy
- **Next Steps:**

i. Determine inclusion/naming process for identifying wells used in groundwater extraction map
    1. Should the implementation guidelines help dictate when the Subbasin will have a map that will satisfy the Annual Report requirements
ii. Level of detail in table

Surface Water Supply (Used or Available for Use)

- Reported based on quantitative data that describes annual volume and source for reporting year

Groundwater Recharge

In-lieu Use of Water Supplies

Total Water Use

- Table
    - Summarizing surface water use by source and by sector for reported water year
- **Next Steps:**
    - Determine level of detail for table, reporting process

Commented [CH1]: SCVWD Example - Water use includes: Groundwater Pumped, District Treated Water, District Raw Surface Water Deliveries, SFPUC Supplies to Local Retailers, Recycled Water
Water use types provided by Subbasin and County
Example also includes measurement method, accuracy, source, sector

Change in Groundwater Storage

- Figures
    - Maps depicting change in groundwater elevation and storage for the reported water year for both principal aquifers (upper and lower)
        - Maps to be QC'd by hydrogeologists
    - Graphs for groundwater use and change in storage in the Subbasin for upper and lower:
        - 1 – Graph of cumulative (line) and annual (bar) change in storage (both AF) for historic period through reported water year
        - 2 – Bar graph of groundwater pumping (AF) for historic period through reported water year
- Regional Monitoring Program – Subsidence Rates and Survey Data
- **Next Steps:**
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            2. Subbasin

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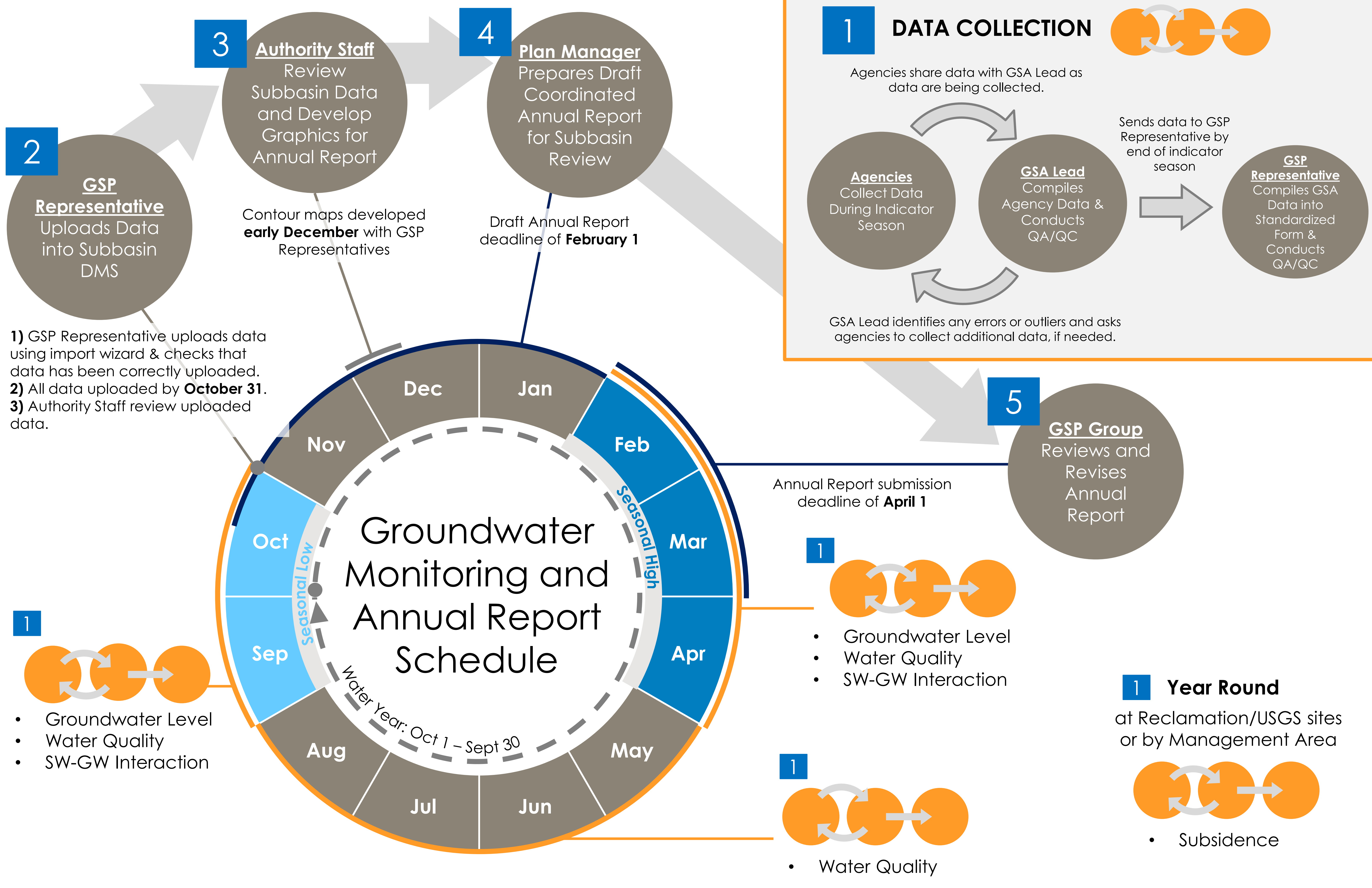
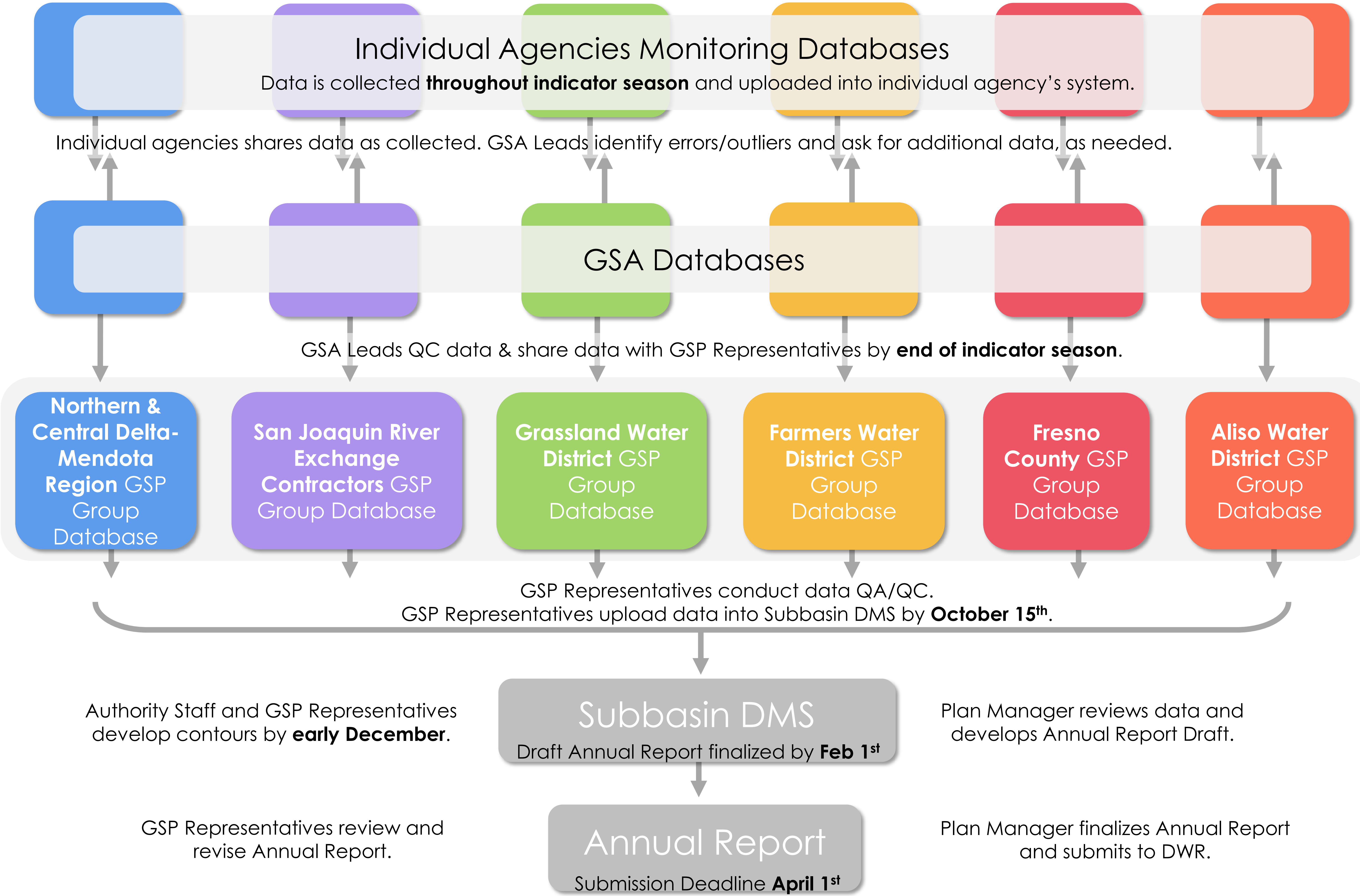
    - Monitoring Network with respect to filling data gaps
    - Representative Monitoring Sites – presenting data collected
    - Tracking of Sustainable Management Criteria



1 DATA COLLECTION
Agencies share data with GSA Lead as data are being collected.
Agencies Collect Data During Indicator Season
GSA Lead Compiles Agency Data & Conducts QA/QC
Sends data to GSP Representative by end of indicator season
GSP Representative Compiles GSA Data into Standardized Form & Conducts QA/QC
GSA Lead identifies any errors or outliers and asks agencies to collect additional data, if needed.
2 GSP Representative Uploads Data into Subbasin DMS
1) GSP Representative uploads data using import wizard & checks that data has been correctly uploaded.
2) All data uploaded by October 31.
3) Authority Staff review uploaded data.
3 Authority Staff Review Subbasin Data and Develop Graphics for Annual Report
Contour maps developed early December with GSP Representatives
4 Plan Manager Prepares Draft Coordinated Annual Report for Subbasin Review
Draft Annual Report deadline of February 1
5 GSP Group Reviews and Revises Annual Report
Annual Report submission deadline of April 1
Groundwater Monitoring and Annual Report Schedule
Water Year: Oct 1 – Sept 30
Seasonal Low
Seasonal High
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1
• Groundwater Level
• Water Quality
• SW-GW Interaction
1
• Groundwater Level
• Water Quality
• SW-GW Interaction
1
• Water Quality
1 Year Round
at Reclamation/USGS sites or by Management Area
• Subsidence


Individual Agencies Monitoring Databases
Data is collected throughout indicator season and uploaded into individual agency's system.
Individual agencies shares data as collected. GSA Leads identify errors/outliers and ask for additional data, as needed.
GSA Databases
GSA Leads QC data & share data with GSP Representatives by end of indicator season.
Northern & Central Delta-Mendota Region GSP Group Database
San Joaquin River Exchange Contractors GSP Group Database
Grassland Water District GSP Group Database
Farmers Water District GSP Group Database
Fresno County GSP Group Database
Aliso Water District GSP Group Database
GSP Representatives conduct data QA/QC.
GSP Representatives upload data into Subbasin DMS by October 15th.
Authority Staff and GSP Representatives develop contours by early December.
Subbasin DMS
Draft Annual Report finalized by Feb 1st
Plan Manager reviews data and develops Annual Report Draft.
GSP Representatives review and revise Annual Report.
Annual Report
Submission Deadline April 1st
Plan Manager finalizes Annual Report and submits to DWR.