MERCED SGMA

Merced Groundwater Subbasin

GROUNDWATER SUSTAINABILITY PLAN

Annual Report Water Years 2016–2019

Image courtesy: Veronica Adrover/UC Merced

April 2020

MERCED GROUNDWATER SUBBASIN GROUNDWATER SUSTAINABILITY PLAN: ANNUAL REPORT

WATER YEARS 2016-2019

April 2020

801 T Street
Sacramento, California 95811
916.999.8700

woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS

Acronym	Definition
AFY	Acre-Feet per Year
AWMP	Agricultural Water Management Plan
CASGEM	California Statewide Groundwater Elevation Monitoring Program
CCR	California Code of Regulations
CDEC	California Data Exchange Center
CEQA	California Environmental Quality Act
CWC	California Water Code
CWD	Chowchilla Water District
DDW	Division of Drinking Water
DPR	Department of Pesticide Regulation
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
ESJWQC	East San Joaquin Water Quality Coalition
GAMA	Groundwater Ambient Monitoring and Assessment
GICIMA	Groundwater Elevation Monitoring Groundwater Information Center Interactive Mapping Application
GPS	global positioning system
GQTMP	Groundwater Quality Trend Monitoring Program
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
IDC	IWFM Demand Calculator
ILRP	Irrigated Lands Regulatory Program
IRWM	Integrated Regional Water Management
IWFM	Integrated Water Flow Model
LGAWD	Le Grand Athlone Water District
LIDAR	Light Detection and Ranging
MAF	million acre-feet
MAR	managed aquifer recharge
MCL	Maximum Contaminant Level
MID	Merced Irrigation District
MIUGSA	Merced Irrigation-Urban Groundwater Sustainability
MSGSA	Merced Subbasin Groundwater Sustainability Agency
NRCS	National Agricultural Statistics Service
PRISM	Precipitation-Elevation Regressions on Independent Slopes Model
SDAC	Severely Disadvantaged Community

SGM	Sustainable Groundwater Management
SGMA	Sustainable Groundwater Management Act
SMCL	secondary maximum contaminant level
TAF	thousand acre-feet
TDS	total dissolved solids
TIWD	Turner Island Water District
TIWD GSA-1	Turner Island Water District Groundwater Sustainability Agency #1
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey

EXECUTIVE SUMMARY

The Merced Groundwater Subbasin (Subbasin) Groundwater Sustainability Plan (GSP) was adopted in late 2019 by the three Groundwater Sustainability Agencies (GSAs) that were formed in accordance with the Sustainable Groundwater Management Act (SGMA) to coordinate, develop, and implement a GSP for the Subbasin: Merced Irrigation-Urban Groundwater Sustainability Agency (MIUGSA), Merced Subbasin Groundwater Sustainability Agency (MSGSA), and Turner Island Water District Groundwater Sustainability Agency #1 (TIWD GSA-1) (MIUGSA, MSGSA, & TIWD GSA-1, 2019). The GSP was submitted to the California Department of Water Resources (DWR) in January 2020, ahead of the January 31, 2020 regulatory deadline for submission of GSPs for critically overdrafted subbasins.

California Water Code (CWC) §356.2 requires the submission of an annual report to DWR by April 1 of each year following the adoption of the GSP. The GSP included basin condition information through water year 2015. This first Annual Report provides an update on basin conditions and plan implementation progress within the Merced Subbasin for water years 2016-2019 (October 1, 2015 – September 30, 2019). Future annual reports will cover the preceding single water year. CWC §356.2 requires annual reports to include information about groundwater elevations (contour maps and hydrographs), groundwater extraction, surface water supply, changes in groundwater storage, and a description of progress towards implementation of the GSP since the previous annual report.

Groundwater Levels

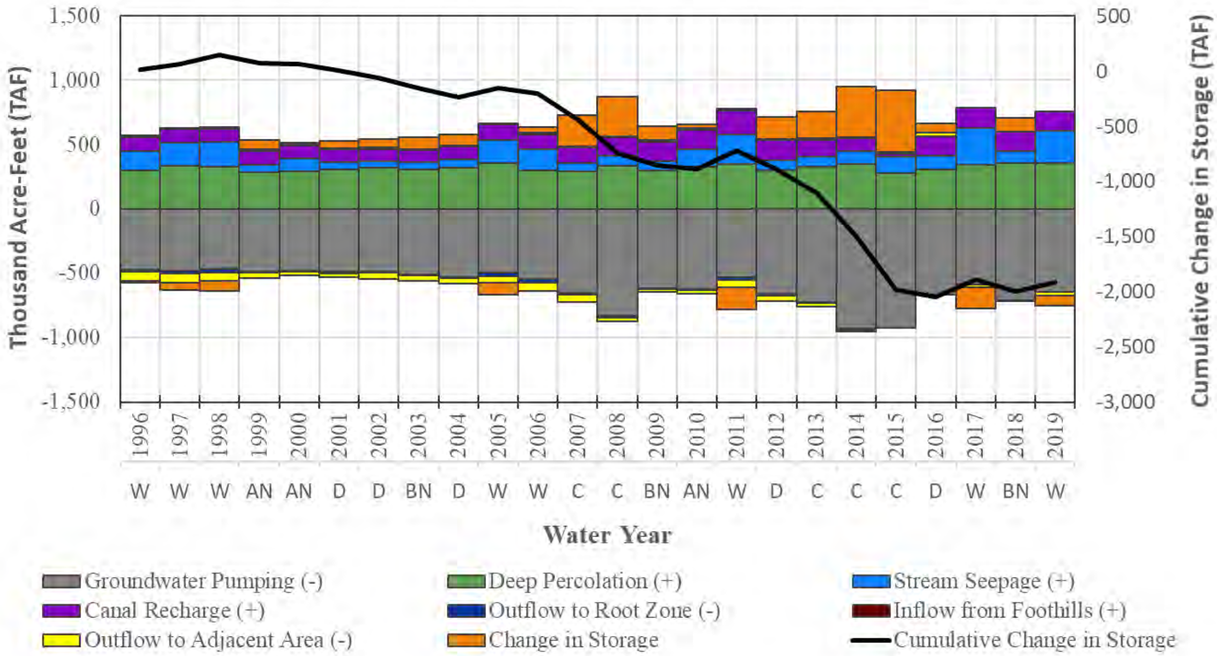
Water years 2016 through 2018 were dry, wet, and below normal, respectively, according to DWR's San Joaquin Valley Water Year Index (DWR, 2020a). DWR has not yet published a final index value for 2019, but with 4.9 MAF of summed runoff reported in the San Joaquin Valley Water Year Type Index (DWR, 2020b), it has been assumed to be a wet year for the purpose of this annual report. Generally, groundwater levels rose or stayed nearly the same over water years 2016-2019.

Based on data from 12 wells in the Above Corcoran Clay Principal Aquifer, average groundwater level change was +1.9 ft/yr from fall 2015 to fall 2019. Based on data from 17 wells in the Below Corcoran Clay Principal Aquifer, average groundwater level change was +2.8 ft/yr from fall 2015 to fall 2019. Based on data from 20 wells in the Outside Corcoran Clay Principal Aquifer, average groundwater level change was -0.2 ft/yr from fall 2015 to fall 2019. Hydrographs and contour maps of groundwater elevation can be found in Appendix A and Appendix B, respectively.

Groundwater Storage

The Merced Water Resources Model (MercedWRM) was updated with recent hydrologic and basin operation information from water years 2016-2019 to estimate historical change in storage of the Merced Subbasin. The cumulative change in storage during the updated historical water budget period of water years 2006-2019 was estimated as -1.73 MAF, or an average reduction of 126 thousand acre-feet (TAF) per year. During the shorter and more recent period of water years 2016-2019, the cumulative change in storage was estimated as 0.64 MAF, or an average increase to storage of 16 TAF per year. Figure ES-1 shows the cumulative change in storage against annual groundwater uses developed in the water budget and water year type.

Figure ES-1: Historical Annual Water Budget and Cumulative Change in Storage



1 "Change in Storage" is placed on the chart to balance the water budget. For instance, if annual outflows (-) are greater than inflows (+), there is a decrease in storage, and this is shown on the positive side of the bar chart to balance out the increased outflows on the negative side of the bar chart.

Source: Water year types based on San Joaquin Valley Water Year Index (DWR, 2020a)*, but 2019 has been assumed to be "W" (wet) due to runoff values above the previous threshold for wet years while waiting for DWR to publish a final 2019 value.*

Land Subsidence

Subsidence remains an ongoing concern in the basin. Subsidence is measured at static GPS control points throughout the San Joaquin Valley monitored by the US Bureau of Reclamation (USBR) as part of the San Joaquin River Restoration Program. Measurements have been recorded biannually in July and December of each year to monitor ongoing subsidence since 2011. Subsidence values in the last four years have remained below the minimum threshold (-0.75 ft/year). In a small number of cases in the last four years, the annual subsidence rate has been above the long-term measurable objective (-0.25 ft/year).

Groundwater Quality

The GSAs established a minimum threshold of 1,000 mg/L of Total Dissolved Solids (TDS) at representative monitoring sites for the degraded water quality sustainability indicator. The measurable objective and all interim milestones were set at 500 mg/L TDS. No wells in the GSP monitoring network were found to have a TDS concentration above the minimum threshold during the period covered by this annual report.

In addition to monitoring for TDS, the GSAs will be conducting water quality coordination activities for other water quality constituents. These activities include review of monitoring reports published by other monitoring programs as well as a review of data submitted by Department of Pesticide Regulation (DPR), Division of Drinking Water (DDW), Department of Toxic Substances Control (DTSC), and GeoTracker to the Groundwater Ambient Monitoring and Assessment (GAMA) database. The purpose of these reviews is to monitor the status of constituent concentrations throughout the Subbasin with respect to typical indicators such as applicable maximum contaminant level (MCL) or secondary maximum contaminant levels (SMCL). The GSAs have collected information from GAMA and will use this information to assess whether there is a need for changes to existing sustainable management criteria or developing additional sustainable management criteria for water quality.

Plan Implementation Progress

Implementation of Projects

The GSP identifies 12 priority projects. These were selected for inclusion in the GSP based on their ability to address a list of priorities identified by the Stakeholder and Coordinating Committee members, and the public. Updates to specific projects are described in Section 3.3 of this annual report.

Implementation of Management Actions

The Merced Subbasin GSP includes two Management Actions. This has not changed as of the first Annual Reporting period. For the water allocation framework, an Ad Hoc Working Group was established with GSA staff to conduct discussions on the initial framework. GSA staff level discussions are ongoing. It is anticipated that allocation framework discussions at GSA Board and public meetings will occur starting in 2020. The MSGSA Demand Reduction Program: is being initiated in recognition of the need to reduce groundwater pumping in the basin. Development of this program is still in initial phases. Future implementation activities will include analysis, policies and procedures adoption, establishing monitoring and reporting tools, and conducting outreach.

1. INTRODUCTION

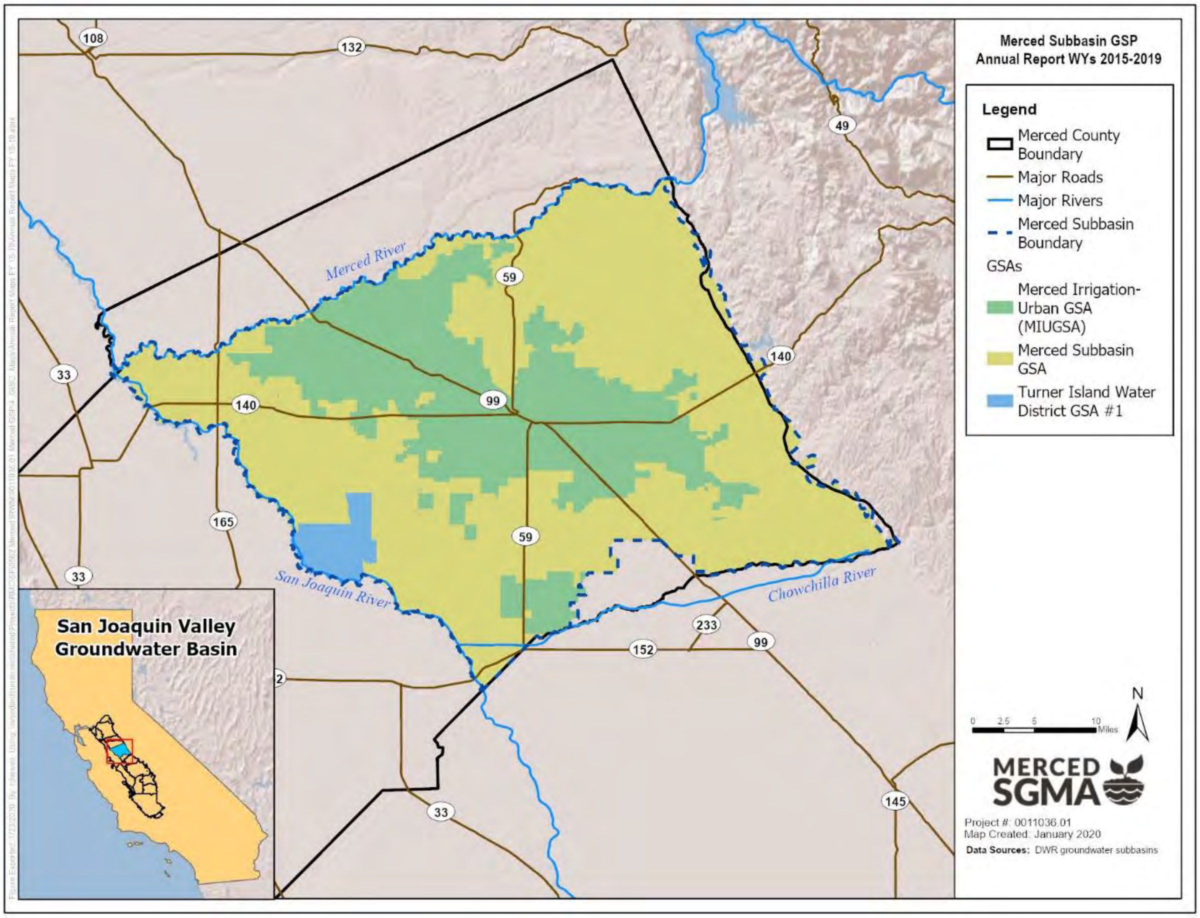
The Merced Groundwater Subbasin (Subbasin) Groundwater Sustainability Plan (GSP) was adopted in late 2019 by the three Groundwater Sustainability Agencies (GSAs) that were formed in accordance with the Sustainable Groundwater Management Act (SGMA) to coordinate, develop, and implement the GSP: Merced Irrigation-Urban Groundwater Sustainability Agency (MIUGSA), Merced Subbasin Groundwater Sustainability Agency (MSGSA), and Turner Island Water District Groundwater Sustainability Agency #1 (TIWD GSA-1) (MIUGSA, MSGSA, & TIWD GSA-1, 2019). The GSP was submitted to the California Department of Water Resources (DWR) in January 2020, ahead of the January 31, 2020 regulatory deadline for submission of GSPs for critically overdrafted subbasins.

California Water Code (CWC) §356.2 requires the submission of an annual report to DWR by April 1 of each year following the adoption of the GSP. This first Annual Report provides an update on basin conditions and plan implementation progress within the Merced Subbasin for water years 2016-2019 (October 1, 2015 – September 30, 2019). Future annual reports will cover the preceding single water year. CWC §356.2 requires annual reports include information about groundwater elevations (contour maps and hydrographs), groundwater extraction, surface water supply, changes in groundwater storage, and a description of progress towards implementation of the GSP since the previous annual report.

The annual report is organized into two sections: Basin Settings and Plan Implementation. Basin Settings provides updates to water budgets and other basinwide information for the water years following the GSP to current (2016-2019). The Plan Implementation section discusses progress on implementation of the GSP since its adoption in December 2019 with a focus on updates on the status of projects identified in the GSP.

Figure 1-1 shows a map of the Merced Subbasin and the extent of the three GSAs. An inset map shows the location of the Merced Subbasin within the larger San Joaquin Valley Groundwater Basin located in the Central Valley of California. A more detailed description of the Merced Subbasin can be found in the GSP's Section 1.2 (Plan Area) and Section 2.1 (Hydrogeologic Conceptual Model).

Figure 1-1: Location Map



2. BASIN SETTING

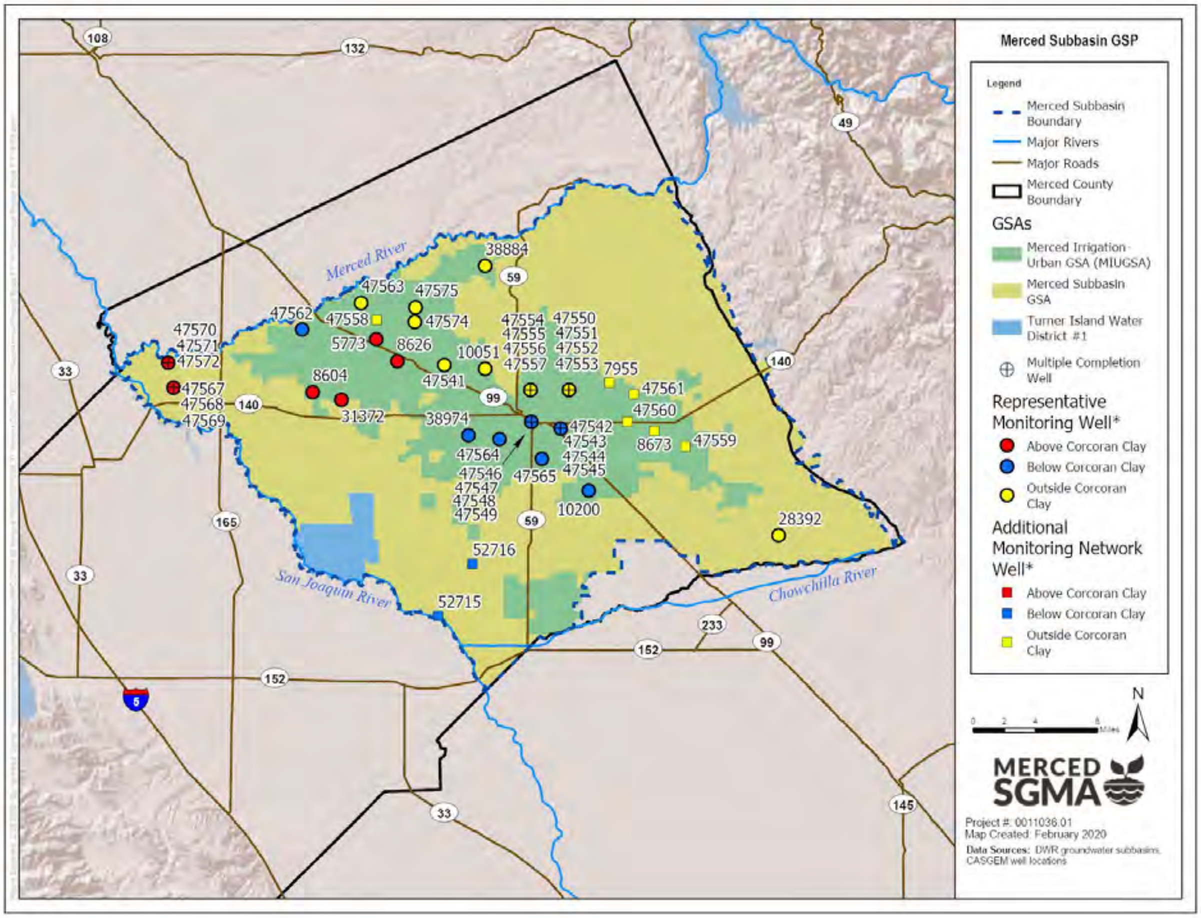
2.1 Groundwater Elevations

Water years 2016 through 2018 were dry, wet, and below normal, respectively, according to DWR's San Joaquin Valley Water Year Index (DWR, 2020a). DWR has not yet published a final index value for 2019, but with 4.9 MAF of runoff reported in the San Joaquin Valley Water Year Type Index (DWR, 2020b), it has been assumed to be wet year[1] for the purpose of this annual report. Generally, groundwater levels rose or stayed nearly the same over water years 2016-2019. While groundwater fluctuations caused water levels to temporarily fall below the minimum threshold at one representative well, no undesirable results were triggered as a result, according to the sustainable management criteria set in the GSP.

Based on data from 12 wells in the Above Corcoran Clay Principal Aquifer, average groundwater level change was +1.9 ft/yr from fall 2015 to fall 2019. Based on data from 17 wells in the Below Corcoran Clay Principal Aquifer, average groundwater level change was +2.8 ft/yr from fall 2015 to fall 2019. Based on data from 20 wells in the Outside Corcoran Clay Principal Aquifer, average groundwater level change was -0.2 ft/yr from fall 2015 to fall 2019. These values do not take into account that monitoring wells are not evenly distributed throughout the Subbasin, but the overall values still function to provide an overview of trends based on available data. Figure 2-1 shows the location of the wells in the Merced Subbasin GSP monitoring network for groundwater levels. Individual hydrographs for these wells can be found in Appendix A. All available data are shown. Hydrographs for representative monitoring wells also display the minimum threshold and measurable objective that were developed in Chapter 3 (Sustainability Indicators) of the GSP. The hydrographs also show a water year type indicator according to the San Joaquin Valley Water Year Hydrologic Classification Index. As previously stated, at the time of publishing, DWR has not yet announced the water year type designation for 2019, but for the purpose of this annual report it has been estimated to be "W" (wet).

[1] Runoff (unimpaired flow) of equal to or greater than 3.8 MAF is considered hydrologically "wet".

Figure 2-1: Groundwater Level Monitoring Network



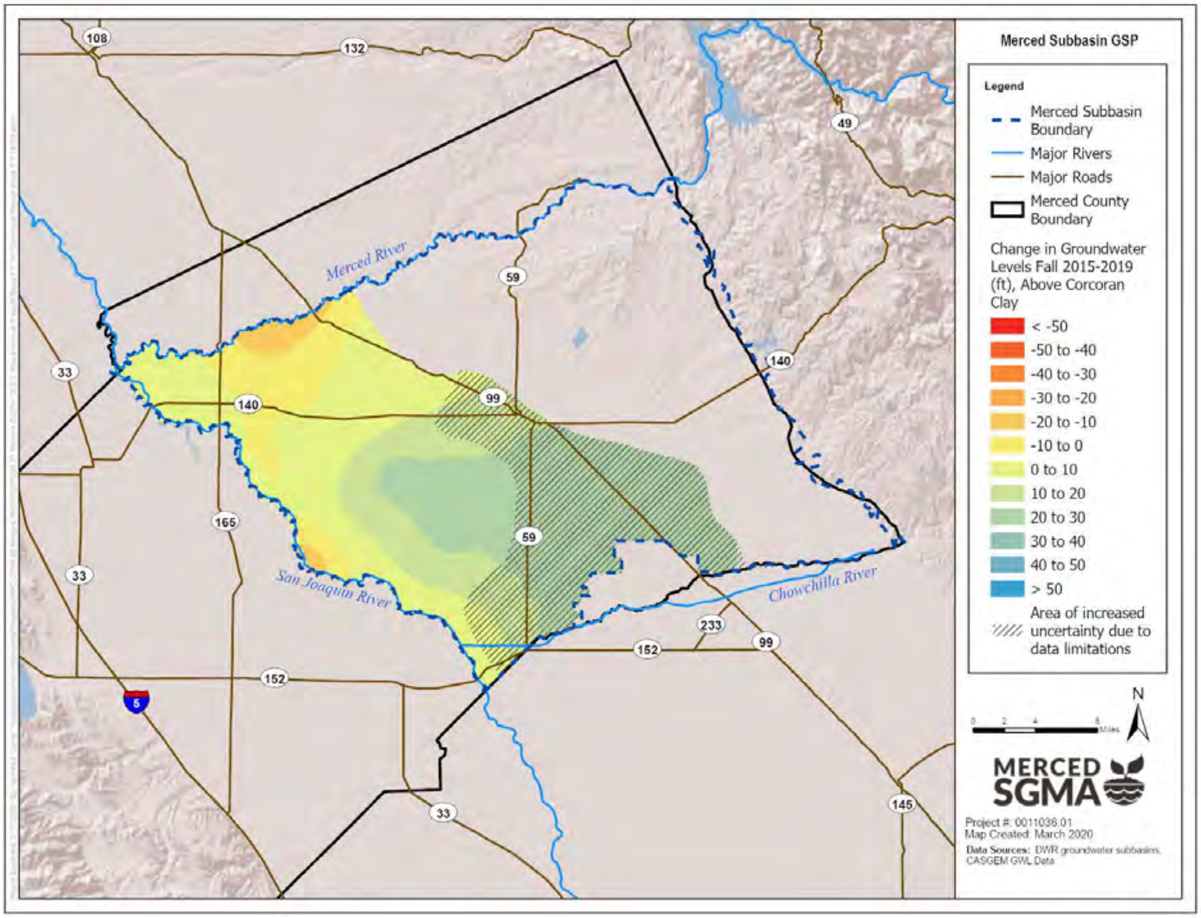
Appendix B show contour maps of seasonal high (spring) and seasonal low (fall) groundwater elevations for each of the three principal aquifers for each water year from 2016 through 2019, inclusive of fall 2019. Groundwater level data were obtained from the California Statewide Groundwater Elevation Monitoring (CASGEM) system and GSP monitoring network for groundwater levels. Groundwater levels reported by both CASGEM and voluntary wells in the Merced, Turlock, Delta-Mendota, Chowchilla, and Madera Subbasins were used to develop contours. Measurements from neighboring subbasins were included to provide spatial coverage for contoured groundwater levels along the edges of the Merced Subbasin. The contour maps for the Above Corcoran Clay and Outside Corcoran Clay Principal Aquifers show hatched areas labeled “Area of increased uncertainty due to data limitations” which indicate a region with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due the data limitations. The GSP identifies this as a data gap and the GSAs have applied for Prop 68 funding to develop and implement a plan to address critical data gaps in the basin.

Groundwater level contours at 20-foot intervals were developed using an extrapolation method of inverse distance weighting, with local averaging performed to generate smoother contour lines. Groundwater measurements were classified as spring if they were recorded in the month of March (± 5 days) and classified as fall if they were recorded in the month of October (± 5 days). Contour maps for each season and principal aquifer can be found in Appendix B.

Many voluntary wells do not consistently report groundwater elevations each spring and fall. A linear regression was applied to estimate the groundwater elevations for the missing seasons for voluntary wells located within the Merced Subbasin. The estimate is necessary to provide consistent results between time periods, despite variability in available data. The linear regression was applied separately at each well for fall and spring measurements. Wells at which groundwater elevation was estimated for the purpose of developing contours are called out in the contour maps in Appendix B.

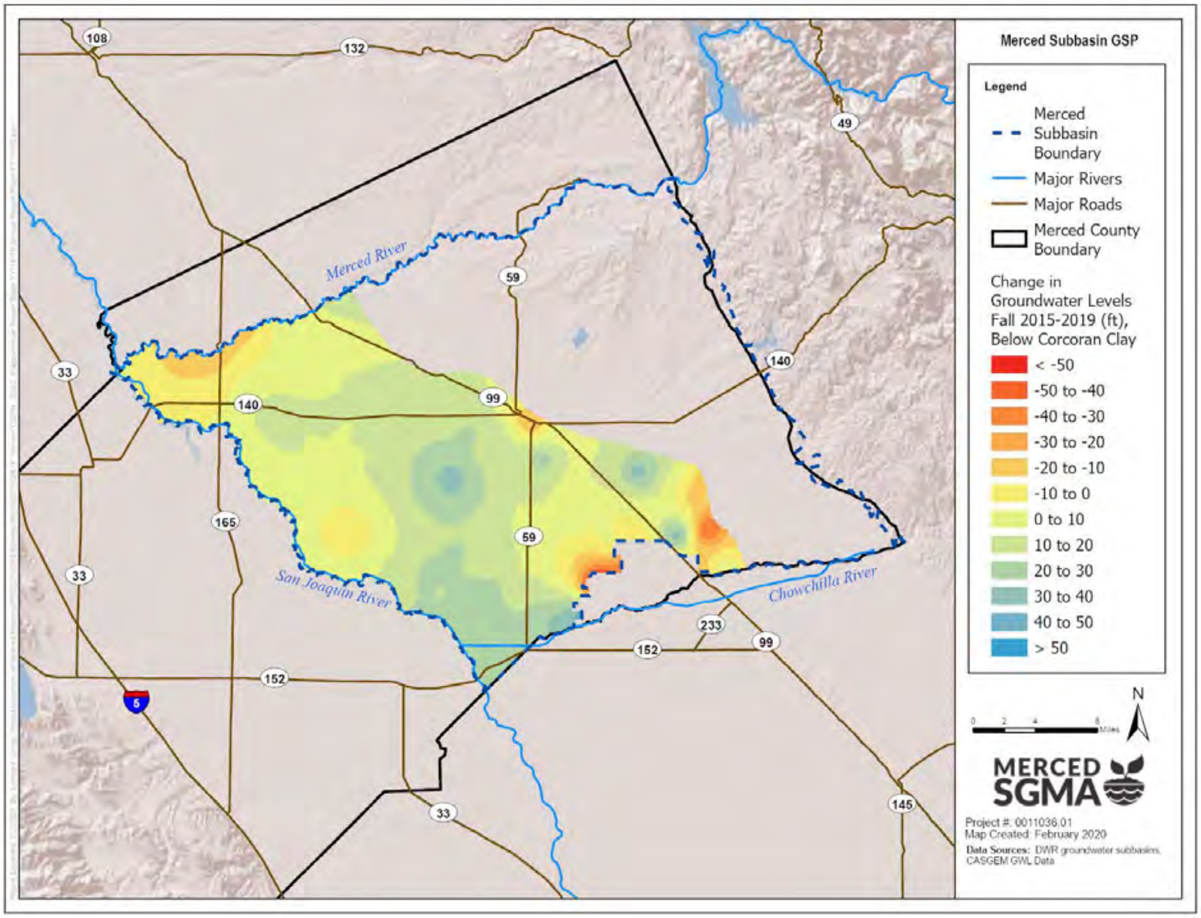
Figure 2-2 through Figure 2-4 show the total change in groundwater levels between fall 2015 and fall 2019 for each principal aquifer, based on comparing the interpolated groundwater level surfaces developed from CASGEM and GSP monitoring network data. The Above Corcoran Clay Principal Aquifer generally shows a net increase in groundwater levels throughout most of the aquifer, with a decrease recorded along the northern edge by the Merced River. The Below Corcoran Clay Principal Aquifer shows moderate increases in groundwater levels in the central and southern portions, with decreases along the northeast edge at the confluence of the Merced River and San Joaquin River. Decreasing groundwater levels are shown along the western and southwestern edges of the principal aquifer. In the Outside Corcoran Clay Principal Aquifer, groundwater levels were found to increase along most of the northern and north-central portions of the aquifer, while groundwater levels declined somewhat along most of the southern and south-central portions of the aquifer.

Figure 2-2: Total Change in Groundwater Levels Fall 2015 – Fall 2019, Above Corcoran Clay



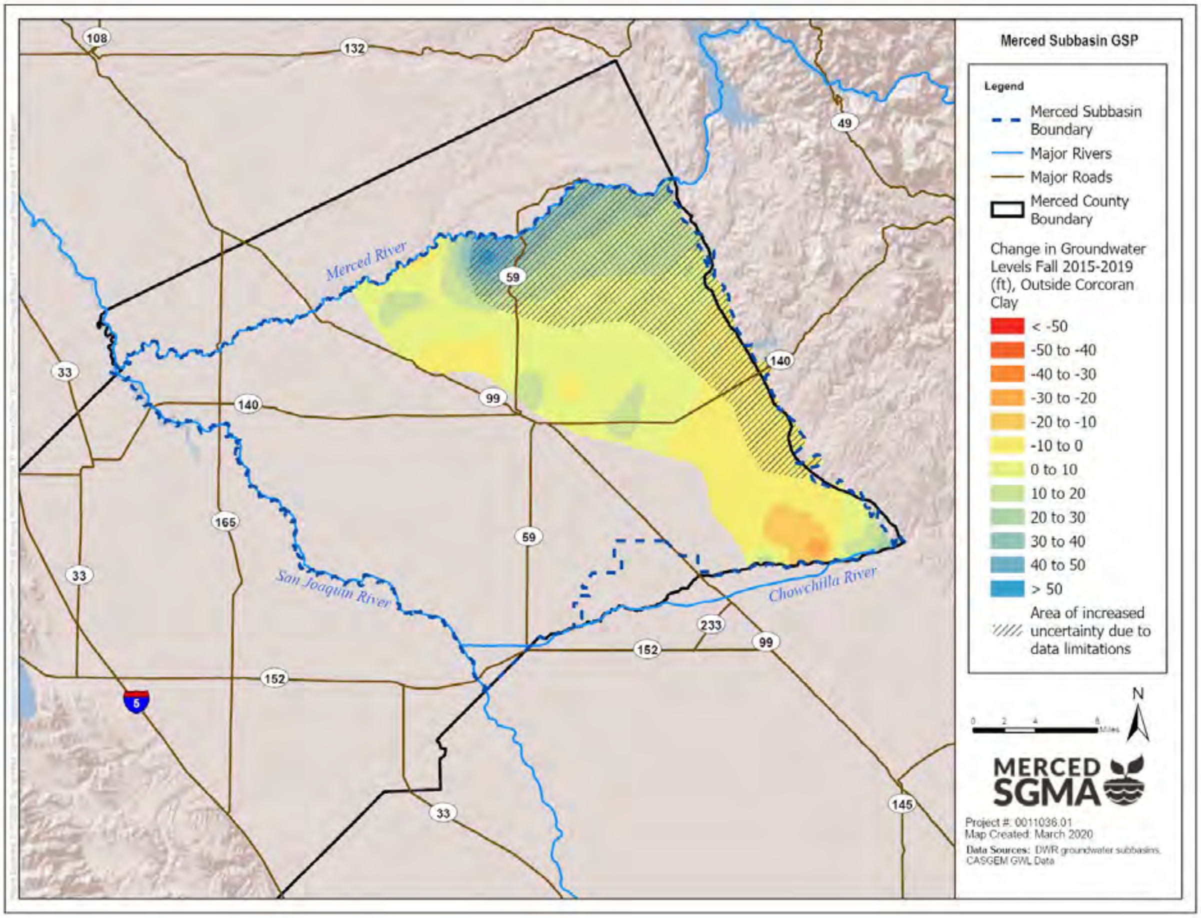
1. *For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in Appendix B.*
2. *The hatched area labeled "Area of increased uncertainty due to data limitations" indicates a region with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due the data limitations. The GSP identifies this as a data gap and the GSAs intend to develop a data gaps plan to address it.*

Figure 2-3: Total Change in Groundwater Levels Fall 2015 – Fall 2019, Below Corcoran Clay



1. For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in Appendix B.

Figure 2-4: Total Change in Groundwater Levels Fall 2015 – Fall 2019, Outside Corcoran Clay



1. *For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in Appendix B.*
2. *The hatched area labeled "Area of increased uncertainty due to data limitations" indicates a region with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due the data limitations. The GSP identifies this as a data gap and the GSAs intend to develop a data gaps plan to address it.*

Table 2-1 lists the representative monitoring wells for the sustainability indicator of chronic lowering of groundwater levels, with a comparison of most recent fall 2019 groundwater elevations against minimum threshold, measurable objective, and interim milestone 2025 elevations.

Note that three representative groundwater level monitoring wells have been removed from the groundwater monitoring network because it was discovered that they are each completed in multiple Principal Aquifers:

- CASGEM ID 8454, Site Code 373388N1207968W001, originally thought to be completed only within the Above Corcoran Clay Principal Aquifer
- CASGEM ID 10213, Site Code 372907N1205779W001, originally thought to be completed only within the Above Corcoran Clay Principal Aquifer

- CASGEM ID 5226, Site Code 373796N1206777W001, originally thought to be completed only within the Below Corcoran Clay Principal Aquifer

Table 2-1: Groundwater Elevation at Representative Monitoring Wells

State Well ID	Site Code	CASGEM ID	Princi-pal Aquifer	Fall 2019 GW Elevation [1]	Minimum Threshold Elevation[1]	Measurable Objective Elevation[1]	Interim Milestone 2025[1]
06S12E33D001M	373732N1206679W001	5773	Above	53.49	-102.5	50.4	46.5
07S11E15H001M	373243N1207424W001	8604	Above	58.02	-112.0	63.6	31.2
07S12E03F001M	373532N1206432W001	8626	Above	54.33	4.9	41.5	41.5
07S11E24A001M	373166N1207091W001	31372	Above	55.13	-27.2	54.9	50.8
07S10E17D003M	373278N1209054W002	47569	Above	67.65	-43.0	66.3	70.2
07S10E06K002M	373510N1209113W001	47571	Above	65.52	-39.8	63.6	49.9
08S14E15R002M	372335N1204199W001	10200	Below	74.16	-52.8	5.5	5.5
07S13E32H001M	372838N1205602W001	38974	Below	95.4	-55.6	34.3	34.3
07S14E35E001M	372904N1204207W001	47542	Below	74.44	-31.1	10.4	10.4
07S14E30R001M	372964N1204867W001	47546	Below	N/A[2]	-10.9	14.1	14.1
06S11E27F001M	373821N1207551W001	47562	Below	66.52	-107.2	69.0	58.8
07S13E34G001M	372806N1205241W001	47564	Below	85.7	-50.3	21.8	-101.5
08S14E06G001M	372617N1204747W001	47565	Below	82.36	-15.1	12.5	12.5
07S14E12N001M	373327N1203960W001	7955	Outside	108.3	56.0	81.0	105.3
07S13E09A001M	373457N1205429W001	10051	Outside	69.74	-27.5	34.0	34.0
08S16E34J001M	371902N1201985W001	28392	Outside	-119.5	-88.5	-51.9	-51.9
06S13E04H001M	374421N1205407W001	38884	Outside	80.31	-35.7	70.8	69.3
07S12E07C001M	373496N1205890W001	47541	Outside	48.12	14.7	39.7	39.7
07S14E16F004M	373260N1204432W004	47553	Outside	83.64	-21.1	14.9	61.2
07S13E13H004M	373260N1204880W004	47557	Outside	68.37	-23.2	9.2	9.2
07S15E30D001M	372734N1203071W002	47560	Outside	117.82	62.9	87.9	101.8
06S12E17M001M	374074N1206859W001	47563	Outside	59.48	-126.5	68.5	29.4
06S12E23P001M	370000N1200000W001	47574	Outside	53	-75.0	46.9	46.9
06S12E23C001M	370000N1200000W002	47575	Outside	60	-89.0	58.7	58.7

1. *All elevations reported in feet above sea level, datum NAVD88.*
2. *For CASGEM ID 47546, no measurements were recorded in 2019 due to pumping.*
3. *For CASGEM ID 28392, the fall 2019 measurement is below the minimum threshold. This is an October measurement (sustainable management criteria are developed based on November groundwater levels) with a Questionable Measurable flag of "nearby pump operating".*

2.2 Groundwater Extractions

Table 2-2 summarizes monthly groundwater extractions for water years 2016-2019 by water use sector and method of measurement. Table 2-3 shows the same information summed annually by water year. Groundwater extraction data were requested from groundwater agencies located in the Merced Subbasin, listed below:

- City of Atwater
- City of Livingston
- City of Merced
- Merced Irrigation District (MID)
- Turner Island Water District GSA #1
- Stevinson Water District
- Merquin County Water District
- Planada Community Services District
- Lone Tree Mutual Water Company
- American Water, Meadowbrook
- Winton Water and Sanitary District
- Le Grand Community Services District
- Merced National Wildlife Refuge

All reported values from agencies were direct (metered). Quantitative estimates of accuracy of measurement (e.g. by percentage or +/- AF) were requested from each agency but not provided by most. Metered data are expected to have a qualitative high level of accuracy.

Groundwater extractions from private irrigators and domestic wells are estimated by the Merced Water Resources Model (MercedWRM) based on factors including land use, evapotranspiration, and population. Details about the setup of the MercedWRM can be found in the GSP, while recent updates to the model can be found in Section 2.5.1 of this annual report. Maps illustrating the general location and volume of groundwater extractions as estimated by the MercedWRM can be found in Figure 2-5 (averaged across water years 2016-2019) and Figure 2-6 (for water year 2019 only). These estimated data are expected to have a qualitative medium level of accuracy.

Table 2-2: Monthly Groundwater Extractions (in AF), Water Years 2016-2019

Month	Sector					Total
	Agriculture		Urban		Habitat[4]	
	Agency Pumping[1]	Private Pumping[2]	Agency Pumping[1]	Private Pumping[3]	Merced National Wildlife Refuge	
Oct-2015	3,574	68,396	2,972	805	1,755	77,502
Nov-2015	473	1,570	1,938	510	1,819	6,310
Dec-2015	34	0	1,890	536	1,807	4,267
Jan-2016	26	0	1,832	520	1,341	3,720
Feb-2016	398	0	1,794	515	1,615	4,321
Mar-2016	992	22,440	1,664	908	467	26,471
Apr-2016	1,060	44,010	2,380	670	256	48,376
May-2016	1,655	66,595	3,103	830	0	72,182
Jun-2016	3,291	92,706	4,003	1,090	0	101,090
Jul-2016	5,114	105,690	4,438	1,190	0	116,433
Aug-2016	4,598	105,021	4,428	1,226	0	115,273
Sep-2016	2,094	73,655	2,922	1,861	0	80,533
Oct-2016	1,926	48,289	3,045	943	1,273	55,475
Nov-2016	804	2,536	2,007	541	1,417	7,304
Dec-2016	433	0	1,964	551	1,916	4,864
Jan-2017	0	0	1,906	540	382	2,828
Feb-2017	196	0	1,668	464	0	2,327
Mar-2017	5	19,894	1,717	941	272	22,829
Apr-2017	615	52,625	2,139	606	0	55,986
May-2017	834	60,839	3,572	972	320	66,536
Jun-2017	1,638	85,899	3,856	1,059	491	92,943
Jul-2017	2,792	91,781	3,490	2,246	552	100,861
Aug-2017	4,204	86,930	4,354	1,215	597	97,300
Sep-2017	1,768	67,311	3,723	996	391	74,189
Oct-2017	990	42,713	3,476	970	2,120	50,268
Nov-2017	847	2,368	1,905	1,114	2,280	8,514
Dec-2017	1,515	0	2,078	580	2,286	6,459
Jan-2018	447	0	1,650	956	2,187	5,240
Feb-2018	1,402	0	1,671	995	2,057	6,126
Mar-2018	489	39,990	1,677	921	1,047	44,124
Apr-2018	1,282	69,364	2,533	704	0	73,882
May-2018	1,684	78,665	2,883	1,847	0	85,080
Jun-2018	4,126	92,831	4,239	1,133	0	102,328

Month	Sector					Total
	Agriculture		Urban		Habitat[4]	
	Agency Pumping[1]	Private Pumping[2]	Agency Pumping[1]	Private Pumping[3]	Merced National Wildlife Refuge	
Jul-2018	5,996	104,154	3,852	2,483	0	116,485
Aug-2018	4,852	100,151	3,586	2,274	0	110,863
Sep-2018	2,365	81,750	3,978	1,080	88	89,261
Oct-2018	1,239	50,013	3,443	1,016	2,211	57,922
Nov-2018	52	1,232	2,579	749	1,990	6,602
Dec-2018	0	0	1,932	549	1,918	4,399
Jan-2019	6	0	1,945	562	2,120	4,632
Feb-2019	0	0	1,707	487	1,845	4,039
Mar-2019	250	20,961	1,953	561	1,668	25,393
Apr-2019	1,061	75,358	2,804	788	164	80,175
May-2019	1,474	38,403	3,337	981	14	44,210
Jun-2019	2,954	107,517	3,269	2,264	448	116,452
Jul-2019	3,816	97,031	3,606	2,530	0	106,982
Aug-2019	4,078	97,135	3,696	2,510	0	107,420
Sep-2019	2,394	71,870	4,041	1,157	117	79,579

1. *"Agency Pumping" indicates direct metered volumes of pumped groundwater reported by agricultural purveyors and urban water suppliers. Metered data are expected to have a qualitative high level of accuracy.*

2. *"Private Pumping" for the agricultural sector is estimated by the MercedWRM based on land use and evapotranspiration data. See Section 2.5.1 - MercedWRM Update (Water Years 2016-2019). These estimated data are expected to have a qualitative medium level of accuracy.*

3. *"Private Pumping" for the urban sector (primarily from domestic wells in rural regions) is estimated by the MercedWRM based on census data for population multiplied by a volumetric water use factor averaged from the urban regions. See Section 2.5.1 - MercedWRM Update (Water Years 2016-2019). These estimated data are expected to have a qualitative medium level of accuracy.*

4. *The "Habitat" sector includes only direct (metered) volumes of groundwater extractions at Merced National Wildlife Refuge. Metered data are expected to have a qualitative high level of accuracy. Groundwater pumping for other wetland/habitat areas are included in the "Agriculture" sector due to a lack of information for demands from these wetlands/habitat areas. Demands were estimated based on DWR land use categorizations of native vegetation or agricultural land.*

Table 2-3: Annual Groundwater Extractions (in AF), Water Years 2016-2019

Water Year	Sector					Total
	Agriculture		Urban		Habitat[4]	
	Agency Pumping[1]	Private Pumping[2]	Agency Pumping[1]	Private Pumping[3]	Merced National Wildlife Refuge	
2016	23,310	580,083	33,364	10,661	9,060	656,477
2017	15,215	516,103	33,441	11,072	7,611	583,442
2018	25,994	611,986	33,528	15,057	12,065	698,630
2019	17,321	559,521	34,313	14,154	12,495	637,804

1. *"Agency Pumping" indicates direct metered volumes of pumped groundwater reported by agricultural purveyors and urban water suppliers. Metered data are expected to have a qualitative high level of accuracy.*
2. *"Private Pumping" for the agricultural sector is estimated by the MercedWRM based on land use and evapotranspiration data. See Section 2.5.1 - MercedWRM Update (Water Years 2016-2019). These estimated data are expected to have a qualitative medium level of accuracy.*
3. *"Private Pumping" for the urban sector (primarily from domestic wells in rural regions) is estimated by the MercedWRM based on census data for population multiplied by a volumetric water use factor averaged from the urban regions. See Section 2.5.1 - MercedWRM Update (Water Years 2016-2019). These estimated data are expected to have a qualitative medium level of accuracy.*
4. *The "Habitat" sector includes only direct (metered) volumes of groundwater extractions at Merced National Wildlife Refuge. Metered data are expected to have a qualitative high level of accuracy. Groundwater pumping for other wetland/habitat areas are included in the "Agriculture" sector due to a lack of information for demands from these wetlands/habitat areas. Demands were estimated based on DWR land use categorizations of native vegetation or agricultural land.*

Figure 2-5: Map of Average Annual Groundwater Extractions (Water Years 2016-2019)

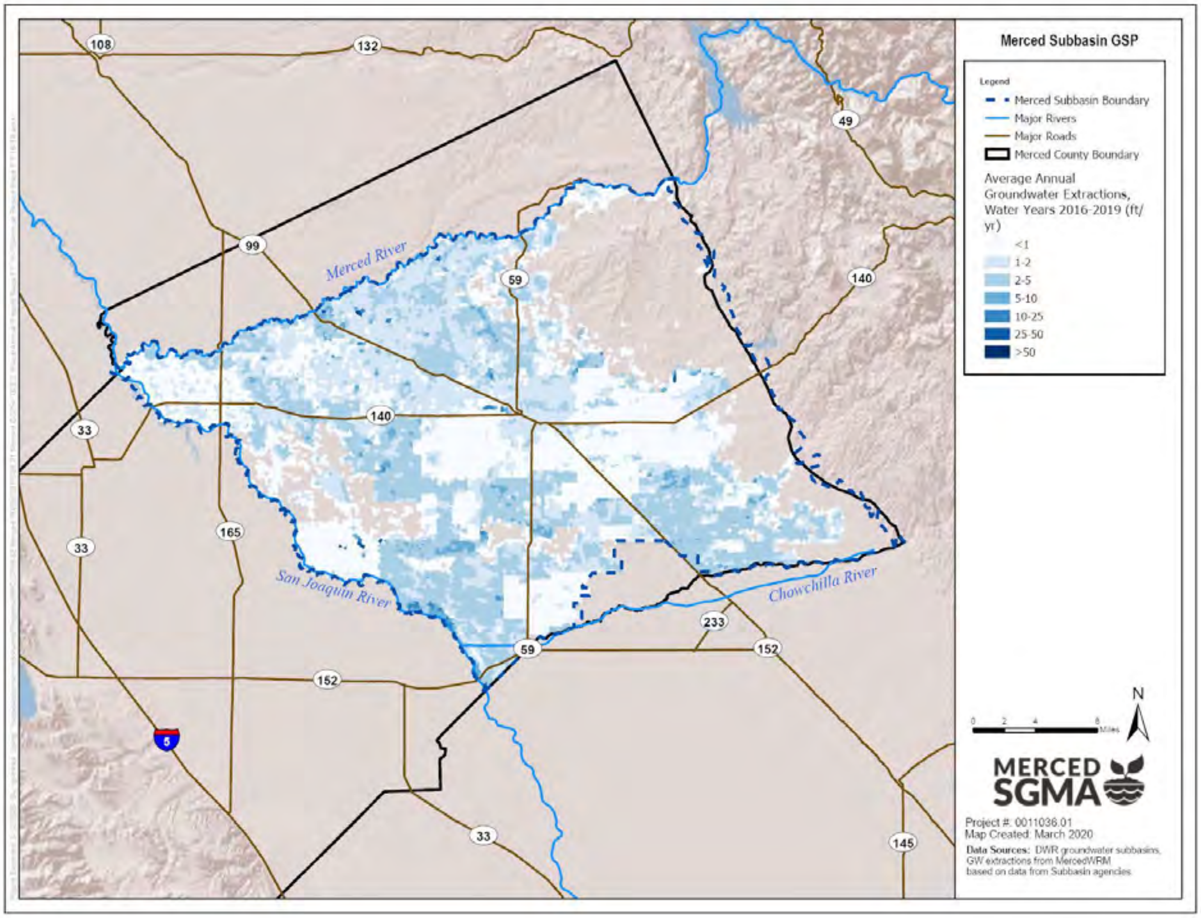
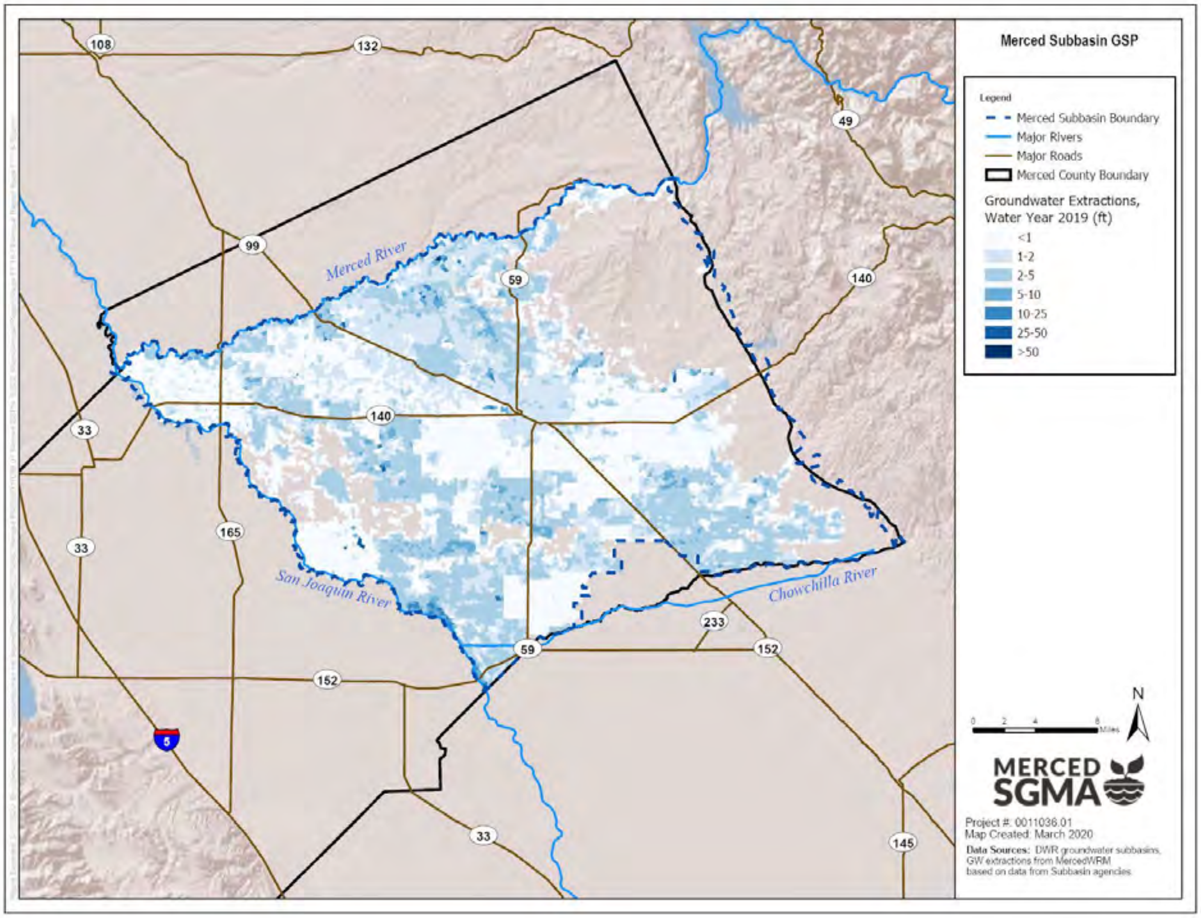


Figure 2-6: Map of Groundwater Extractions (Water Year 2019)



2.3 Surface Water Supply

SGMA requires that the GSP annual report tabulate "*Surface water supply used* *<u>or available for use</u>…*" (emphasis added, CCR §356.2 [b] [3]). Table 2-4 summarizes total monthly surface water available for use for water years 2016-2019, broken down by method of measurement. Table 2-5 provides the same values summed annually by water year. These tables report total surface water diversions and not surface water used, which is difficult to parse out by sector. Direct (metered) measurements were provided by MID, TIWD, and Lone Tree Mutual Water Company; a few months of data included additional estimations made directly by TIWD and Lone Tree Mutual Water Company (not from a model output). Metered data are expected to have a qualitative high level of accuracy while estimated data are expected to have a qualitative medium level of accuracy. Note that MID diversions include surface water ultimately used by Stevinson Water District, Merquin County Water District, Merced National Wildlife Refuge, Le Grand-Athlone Water District, and Lone Tree Mutual Water Company, which fall under the various agricultural, urban, and habitat sectors. Diversions made by Lone Tree Mutual Water Company are exclusively flood flow diversions.

Note that there are several riparian diverters in the Subbasin whose diversions have not been captured for the purpose of the annual report because they divert a relatively small volume of surface water compared to the diversions made by agencies.

Table 2-4: Monthly Surface Water Available for Use (in AF), Water Years 2016-2019

Month	Method of Measurement[1]		Total
	Direct (Metered)	Estimate[2]	
Oct-2015	1,057	0	1,057
Nov-2015	980	0	980
Dec-2015	351	0	351
Jan-2016	476	0	476
Feb-2016	1,365	0	1,365
Mar-2016	3,123	0	3,123
Apr-2016	23,662	0	23,662
May-2016	66,761	0	66,761
Jun-2016	83,575	0	83,575
Jul-2016	96,255	0	96,255
Aug-2016	73,909	0	73,909
Sep-2016	47,153	0	47,153
Oct-2016	21,613	0	21,613
Nov-2016	2,430	0	2,430
Dec-2016	2,229	0	2,229
Jan-2017	2,959	0	2,959
Feb-2017	6,413	239	6,652
Mar-2017	30,434	2,178	32,612
Apr-2017	39,388	1,366	40,754
May-2017	88,525	4,183	92,708
Jun-2017	99,657	10,516	110,173
Jul-2017	115,290	6,222	121,512
Aug-2017	98,693	520	99,213
Sep-2017	57,979	520	58,499
Oct-2017	39,672	29	39,701
Nov-2017	3,128	0	3,128
Dec-2017	2,640	0	2,640
Jan-2018	2,705	0	2,705
Feb-2018	3,834	0	3,834
Mar-2018	15,939	0	15,939
Apr-2018	35,054	0	35,054
May-2018	79,171	0	79,171
Jun-2018	99,207	0	99,207
Jul-2018	111,082	0	111,082

Month	Method of Measurement[1]		Total
	Direct (Metered)	Estimate[2]	
Aug-2018	86,341	0	86,341
Sep-2018	51,557	0	51,557
Oct-2018	35,896	0	35,896
Nov-2018	2,196	0	2,196
Dec-2018	1,301	0	1,301
Jan-2019	1,307	0	1,307
Feb-2019	919	0	919
Mar-2019	16,142	0	16,142
Apr-2019	44,926	0	44,926
May-2019	62,291	0	62,291
Jun-2019	94,235	0	94,235
Jul-2019	111,507	0	111,507
Aug-2019	95,530	0	95,530
Sep-2019	55,249	0	55,249

1. *This table reports total surface water diversions and not surface water used, which can be difficult to parse out by sector. Note that MID diversions include surface water ultimately used by Stevinson Water District, Merquin County Water District, Merced National Wildlife Refuge, Le Grand-Athlone Water District, and Lone Tree Mutual Water Company, which fall under the various agriculture, urban, and habitat sectors.*
2. *Estimates provided in this table came directly from TIWD and Lone Tree Mutual Water Company and are expected to have a qualitative medium level of accuracy.*

Table 2-5: Annual Surface Water Available for Use (in AF), Water Years 2016-2019

Water Year	Method of Measurement[1]		Total
	Direct (Metered)	Estimate[2]	
2016	398,665	0	398,665
2017	565,609	25,745	591,354
2018	530,330	29	530,360
2019	521,498	0	521,498

1. *This table reports total surface water diversions and not surface water used, which can be difficult to parse out by sector. Note that MID diversions include surface water ultimately used by Stevinson Water District, Merquin County Water District, Merced National Wildlife Refuge, Le Grand-Athlone Water District, and Lone Tree Mutual Water Company, which fall under the various agriculture, urban, and habitat sectors.*
2. *Estimates provided in this table came directly from TIWD and Lone Tree Mutual Water Company and are expected to have a qualitative medium level of accuracy.*

2.4 Total Water Use

Table 2-6 summarizes monthly combined groundwater use (Table 2-2) and surface water available for use (Table 2-4) for water years 2016-2019 by water use sector and method of measurement. Table 2-7 shows the same information summed annually by water year. The same qualifications for method of measurement and sector of use apply from Table 2-2 and Table 2-4.

Table 2-6: Monthly Total Water Use, Water Years 2016-2019

Month	Sector					Total
	Agriculture		Urban		Habitat	
	Direct (Metered)	Estimate[1]	Direct (Metered)	Estimate[1]	Direct (Metered)	
Oct-2015	4,631	68,396	2,972	805	1,755	78,559
Nov-2015	1,453	1,570	1,938	510	1,819	7,290
Dec-2015	385	0	1,890	536	1,807	4,618
Jan-2016	502	0	1,832	520	1,341	4,196
Feb-2016	1,762	0	1,794	515	1,615	5,686
Mar-2016	4,115	22,440	1,664	908	467	29,593
Apr-2016	24,722	44,010	2,380	670	256	72,038
May-2016	68,416	66,595	3,103	830	0	138,943
Jun-2016	86,866	92,706	4,003	1,090	0	184,665
Jul-2016	101,370	105,690	4,438	1,190	0	212,688
Aug-2016	78,507	105,021	4,428	1,226	0	189,182
Sep-2016	49,247	73,655	2,922	1,861	0	127,685
Oct-2016	23,538	48,289	3,045	943	1,273	77,088
Nov-2016	3,234	2,536	2,007	541	1,417	9,734
Dec-2016	2,662	0	1,964	551	1,916	7,094
Jan-2017	2,959	0	1,906	540	382	5,787
Feb-2017	6,609	239	1,668	464	0	8,979
Mar-2017	30,439	22,072	1,717	941	272	55,441
Apr-2017	40,003	53,991	2,139	606	0	96,739
May-2017	89,359	65,022	3,572	972	320	159,244
Jun-2017	101,295	96,415	3,856	1,059	491	203,116
Jul-2017	118,082	98,003	3,490	2,246	552	222,373
Aug-2017	102,897	87,450	4,354	1,215	597	196,512
Sep-2017	59,747	67,831	3,723	996	391	132,687
Oct-2017	40,661	42,742	3,476	970	2,120	89,969
Nov-2017	3,975	2,368	1,905	1,114	2,280	11,642
Dec-2017	4,155	0	2,078	580	2,286	9,099
Jan-2018	3,152	0	1,650	956	2,187	7,946
Feb-2018	5,236	0	1,671	995	2,057	9,959

Month	Sector					Total
	Agriculture		Urban		Habitat	
	Direct (Metered)	Estimate[1]	Direct (Metered)	Estimate[1]	Direct (Metered)	
Mar-2018	16,428	39,990	1,677	921	1,047	60,063
Apr-2018	36,336	69,364	2,533	704	0	108,936
May-2018	80,856	78,665	2,883	1,847	0	164,251
Jun-2018	103,333	92,831	4,239	1,133	0	201,535
Jul-2018	117,078	104,154	3,852	2,483	0	227,568
Aug-2018	91,193	100,151	3,586	2,274	0	197,204
Sep-2018	53,922	81,750	3,978	1,080	88	140,818
Oct-2018	37,135	50,013	3,443	1,016	2,211	93,818
Nov-2018	2,247	1,232	2,579	749	1,990	8,798
Dec-2018	1,301	0	1,932	549	1,918	5,700
Jan-2019	1,313	0	1,945	562	2,120	5,939
Feb-2019	919	0	1,707	487	1,845	4,958
Mar-2019	16,391	20,961	1,953	561	1,668	41,534
Apr-2019	45,986	75,358	2,804	788	164	125,100
May-2019	63,766	38,403	3,337	981	14	106,501
Jun-2019	97,188	107,517	3,269	2,264	448	210,686
Jul-2019	115,323	97,031	3,606	2,530	0	218,489
Aug-2019	99,609	97,135	3,696	2,510	0	202,950
Sep-2019	57,642	71,870	4,041	1,157	117	134,828

1. *While direct (metered) volumes were provided directly by reporting agencies, the estimate column is a mixture of calculated estimates provided by the MercedWRM (for groundwater, see Table 2-2) and estimates provided directly from agencies reporting diversions (for surface water, see Table 2-4).*

Table 2-7: Annual Total Water Use, Water Years 2016-2019

Water Year	Sector					Grand Total
	Agriculture		Urban		Habitat	
	Direct (Metered)	Estimate[1]	Direct (Metered)	Estimate[1]	Direct (Metered)	
2016	421,975	580,083	33,364	10,661	9,060	1,055,142
2017	580,825	541,847	33,441	11,072	7,611	1,174,796
2018	556,325	612,015	33,528	15,057	12,065	1,228,990
2019	538,819	559,521	34,313	14,154	12,495	1,159,302

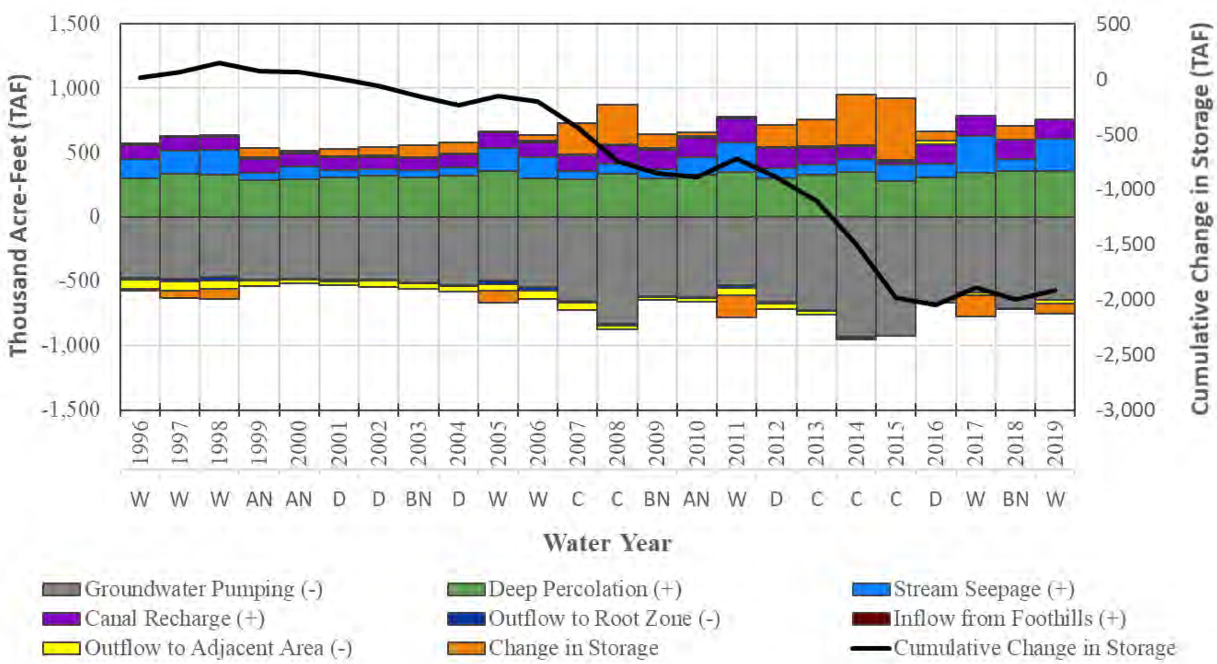
1. *While direct (metered) volumes were provided directly by reporting agencies, the estimate column is a mixture of calculated estimates provided by the MercedWRM (for groundwater, see Table 2-3) and estimates provided directly from agencies reporting diversions (for surface water, see Table 2-5).*

2.5 Change in Groundwater Storage

The Merced Water Resources Model (MercedWRM) was used to estimate historical change in storage of the Merced Subbasin from water years 1996-2019. See Section 2.5.1 for more information about the recent model update for this annual report. In 2015 (as published in the GSP), the total fresh groundwater storage was estimated as 45.3 million acre-feet (MAF) and the cumulative change in storage from 2006-2015 was estimated as -1.92 MAF, or 192 thousand acre-feet (TAF) per year. This time period of 2006-2015 was selected as the historical water budget time period representative of average precipitation and capturing recent Subbasin operations. After extending the historical water budget through water year 2019, the current (2019) total fresh groundwater storage was estimated as 46.0 MAF and the cumulative change in storage from water years 2006-2019 was estimated as -1.73 MAF, or an average reduction of 126 TAF per year. During the shorter and more recent period of water years 2016-2019, the cumulative change in storage was estimated as 0.64 MAF, or an average increase to storage of 16 TAF per year. Figure 2-7 shows the cumulative change in storage against groundwater uses developed in the water budget and water year type.

Sustainable management criteria were not developed for this sustainability indicator because significant and unreasonable reduction of groundwater storage is not present and not likely to occur in the Subbasin. The 2006-2019 cumulative change in storage described above, 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.

Figure 2-7: Historical Annual Water Budget – Groundwater System, Merced Subbasin



[1] "Change in Storage" is placed on the chart to balance the water budget. For instance, if annual outflows (-) are greater than inflows (+), there is a decrease in storage, and this is shown on the positive side of the bar chart to balance out the increased outflows on the negative side of the bar chart.

Source: Water year types based on San Joaquin Valley Water Year Index (DWR, 2020a)*, but 2019 has been assumed to be "W" (wet) due to runoff values above the previous threshold for wet years while waiting for DWR to publish a final 2019 value.*

Figure 2-8 through Figure 2-10 show the average annual change in groundwater storage by principal aquifer from water years 2016-2019 in a spatial format as estimated by outputs from the MercedWRM. Figure 2-11 through Figure 2-13 show the total change in groundwater storage by principal aquifer for water year 2019. The change in storage is shown in units of feet or feet/year. The MercedWRM calculates a change in volume per area of model element. Since the model elements vary in size, visually displaying a map of volume change per model element is not spatially intuitive, so the results have been normalized to show change in depth by dividing the volume by area per model element.

While net Subbasin storage increased marginally during water years 2016-2019, the figures below show areas of relative decrease in storage (negative change in depth shown in green shades) and relative increase in storage (positive change in depth shown in blue shades). Note that along the eastern edge of the Outside Corcoran Clay Principal Aquifer (foothills), relatively higher magnitude decreases in storage are shown, despite minimal to no expected pumping in this area and known uncertainty due to a lack of nearby groundwater level data. The MercedWRM shows this decrease in storage due to declining groundwater levels outside of these areas both in Merced and in Chowchilla which are drawing subsurface flow.

Figure 2-8: Average Annual Change in Storage Water Years 2016-2019 (AFY), Above Corcoran Clay

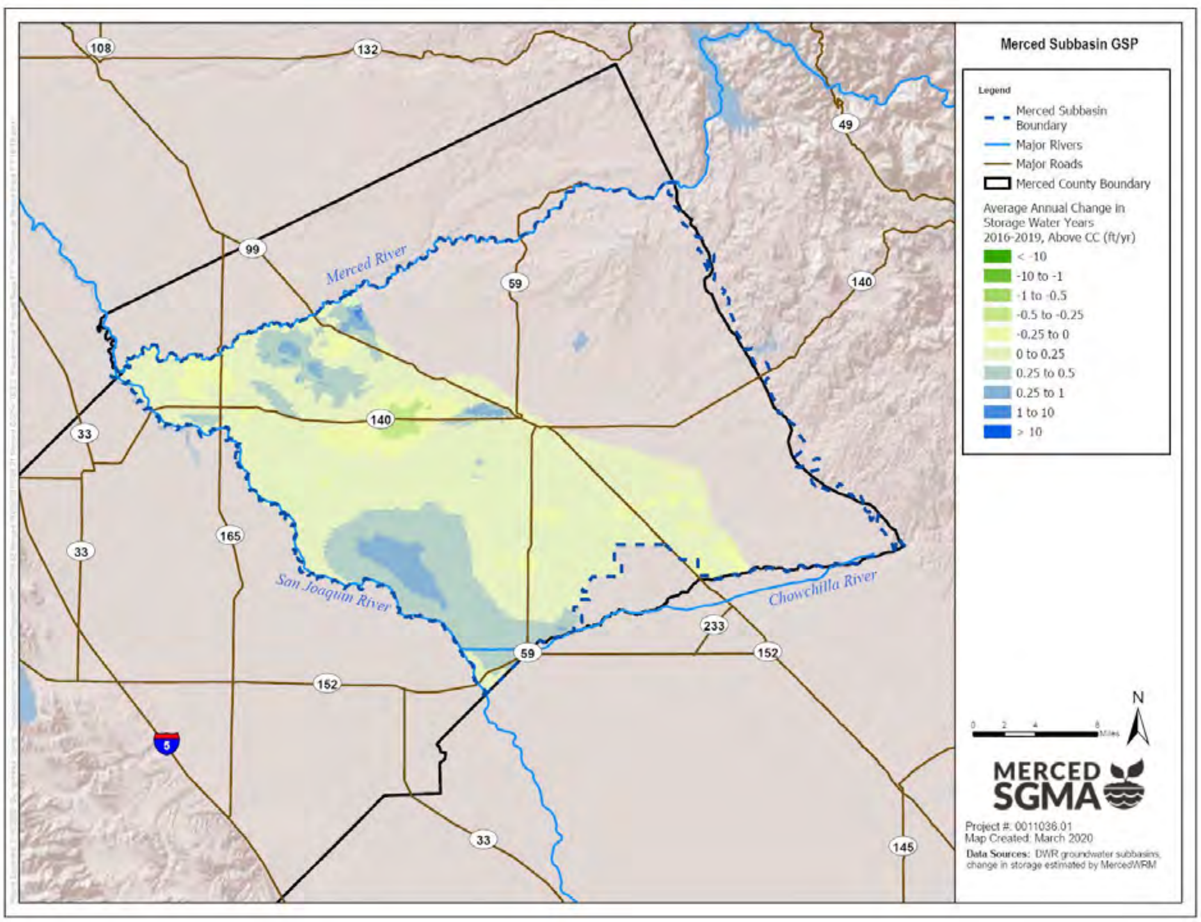


Figure 2-9: Average Annual Change in Storage Water Years 2016-2019 (AFY), Below Corcoran Clay

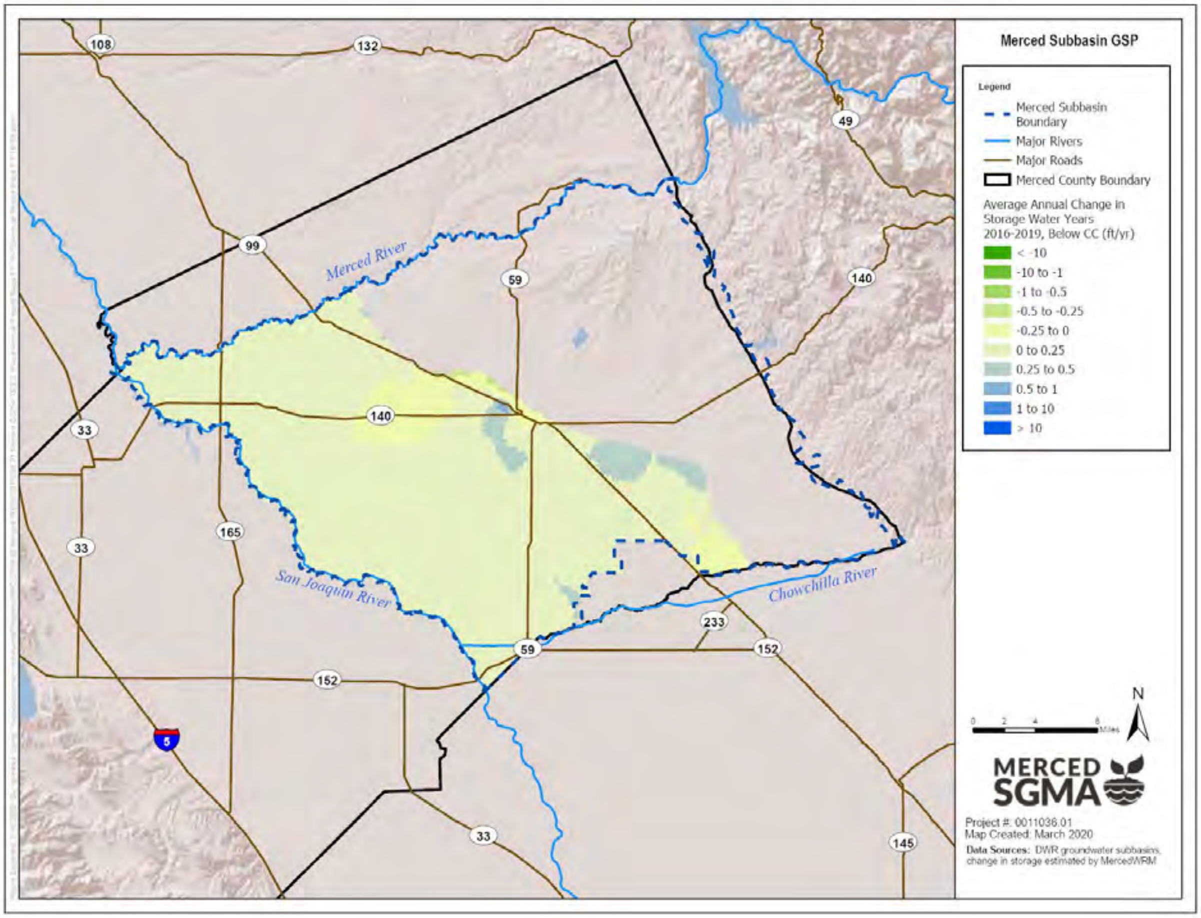


Figure 2-10: Average Annual Change in Storage Water Years 2016-2019 (AFY), Outside Corcoran Clay

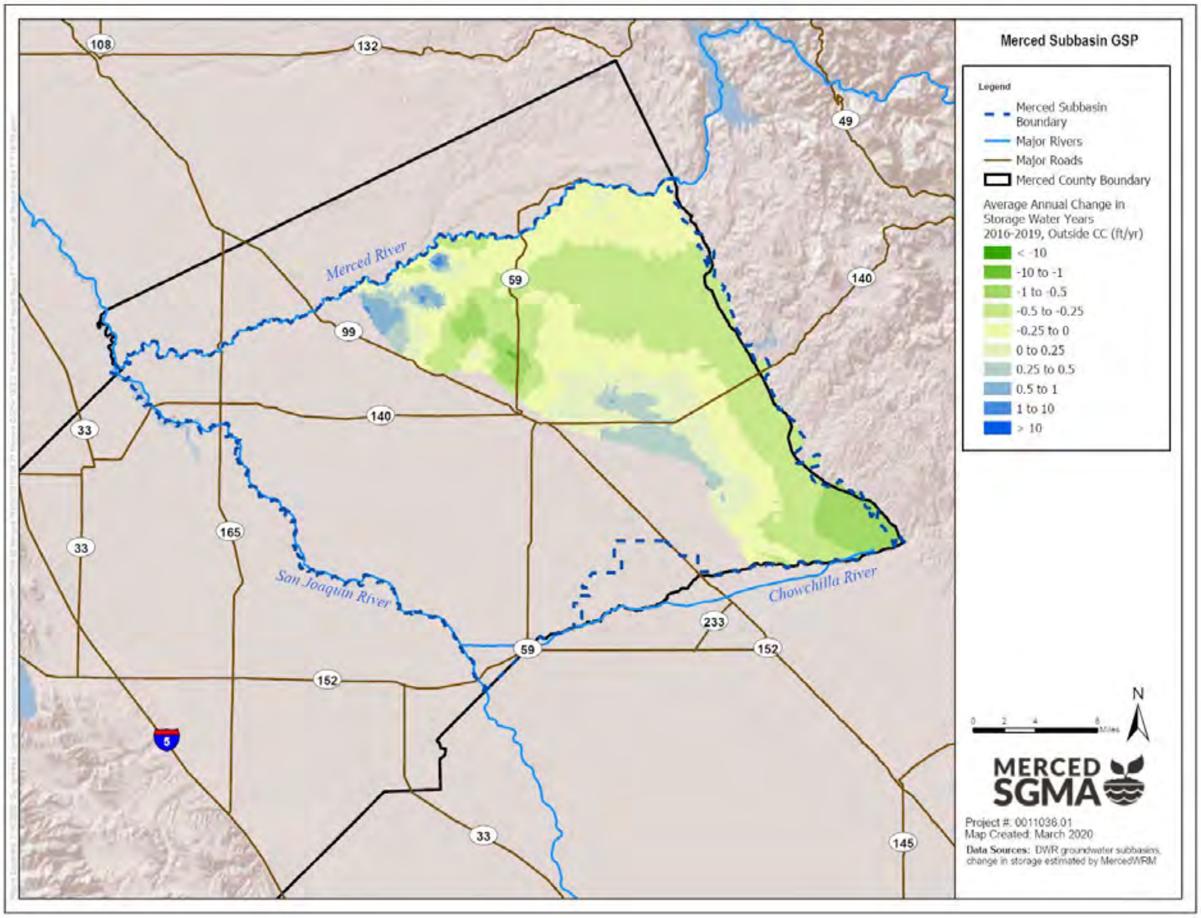


Figure 2-11: Change in Storage Water Year 2019 (AF), Above Corcoran Clay

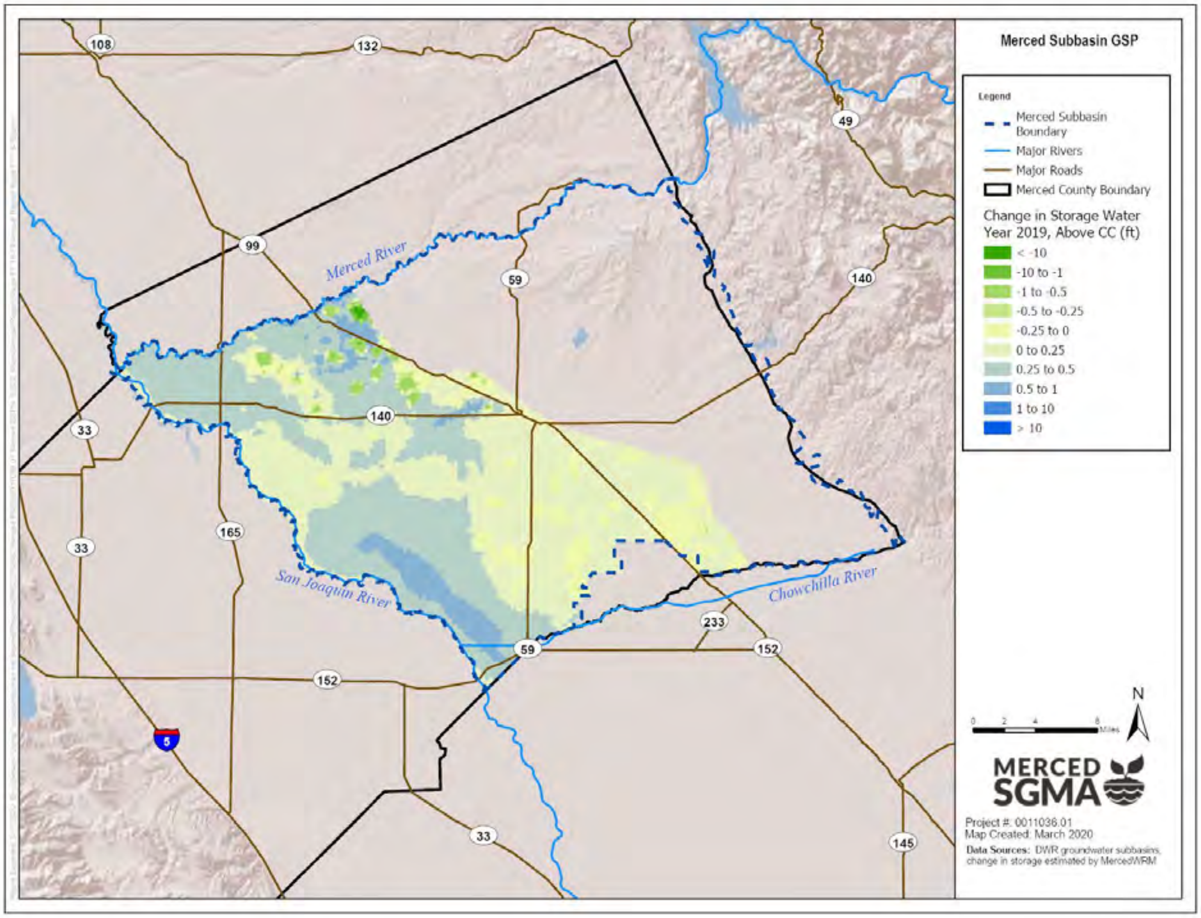


Figure 2-12: Change in Storage Water Year 2019 (AF), Below Corcoran Clay

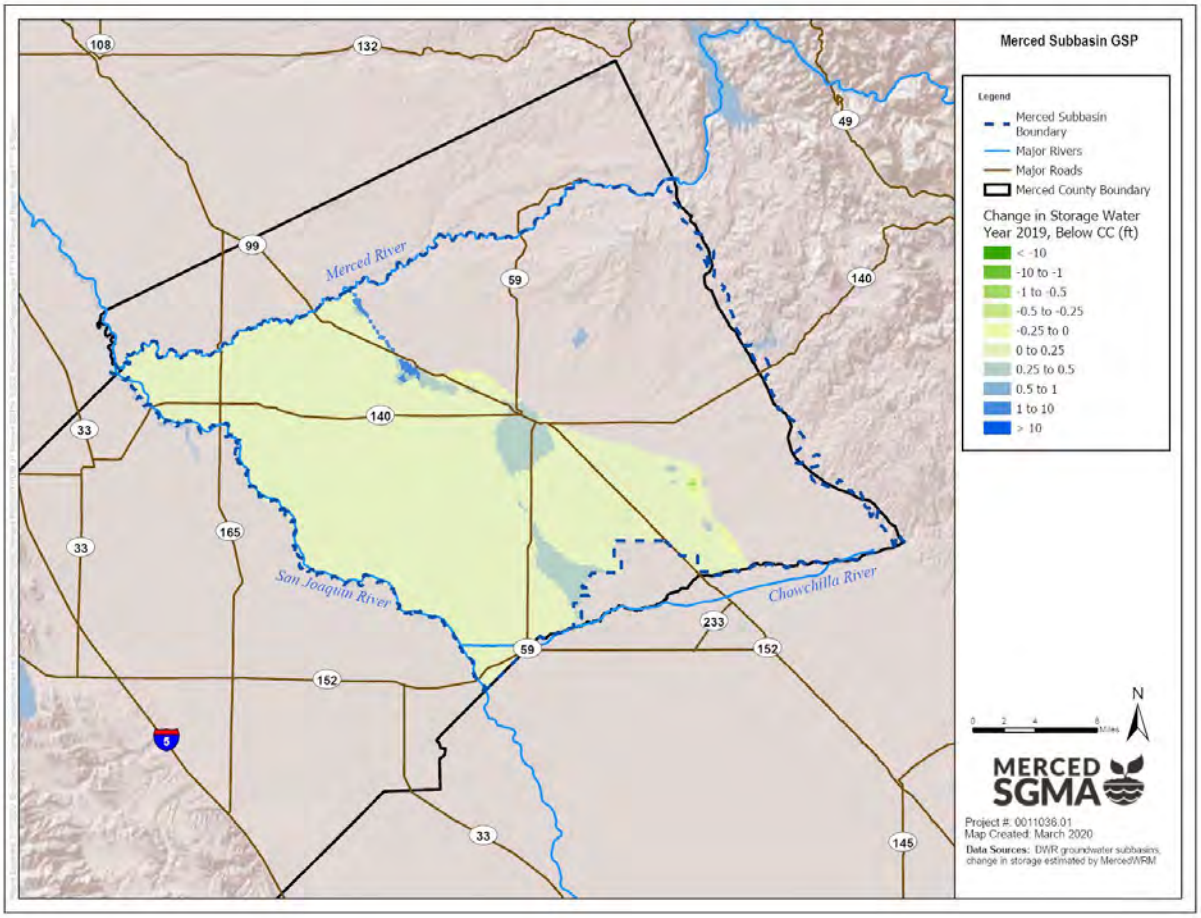
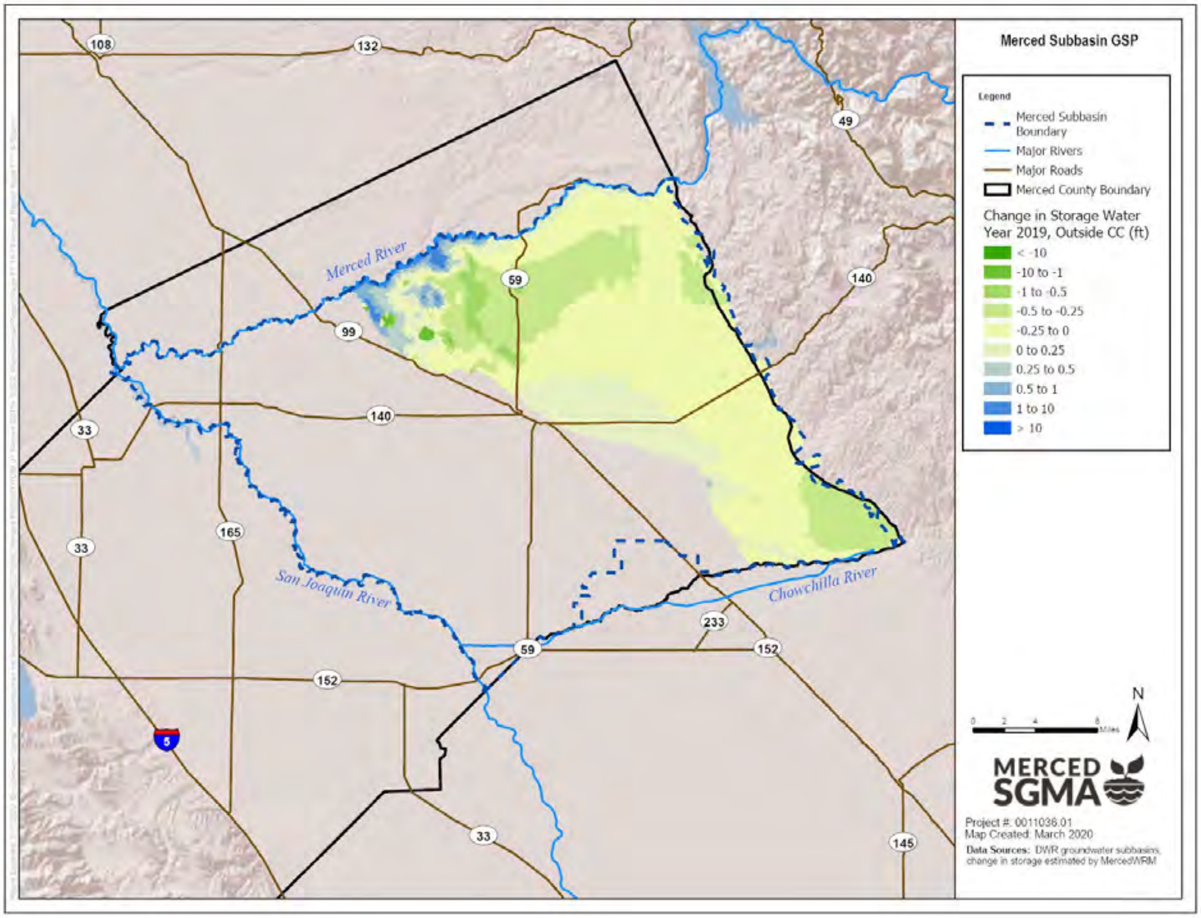


Figure 2-13: Change in Storage Water Year 2019 (AF), Outside Corcoran Clay



2.5.1 MercedWRM Update (Water Years 2016-2019)

The MercedWRM was originally developed and calibrated to model historical groundwater storage from water years 1996-2015. The model was updated for this annual report to reflect more recent data. Data from water years 2016-2019 were collected from the same public and private sources that had provided the historical data through 2015 used in the GSP. As a result of the model update, a new historical water budget was generated including updated estimates of change in groundwater storage.

The 2016-2019 continuation of the historical water budget is intended to verify and further evaluate the aquifer system under a variety of hydrological and anthropogenic conditions. This update is particularly critical to the management of the aquifer system as it reflects the post 2013-2015 drought conditions and operations of the Subbasin. The full annual groundwater budget for water years 1996-2019 is shown earlier in Figure 2-7.

<u>Data Sources</u>

Data were requested and received from the following entities in the Subbasin to complete the MercedWRM update:

Agricultural and Environmental Water Purveyors

- MID
- Stevinson Water District
- Merquin County Water District
- Turner Island Water District
- Lone Tree Mutual Water Company
- Merced National Wildlife Refuge

Municipal Water Purveyors

- City of Merced
- City of Atwater
- City of Livingston
- Le Grand Community Services District
- Planada Community Services District
- Winton Water and Sanitary District
- American Water, Meadowbrook

Additional publicly-available data were downloaded to complete the MercedWRM update:

State

- DWR Groundwater Information Center Interactive Map Application (GICIMA)
- DWR California Data Exchange Center (CDEC)

Federal

- United States Department of Agriculture National Agricultural Statistics Service (NRCS): CropScape
- United States Geological Survey (USGS)
- United States Census

Other

- Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) Climate Group, Oregon State University

Updated Components

The above data sources provided the necessary data to ensure the historical model run reflects the most recent conditions. The following components of the model were updated for the annual report. Additional information on implementation of model datasets and calibration can be found in Appendix D of the Merced GSP.

Surface Water Diversions and Deliveries: Monthly surface water diversions and deliveries were provided for October 2015 through September 2019 by MID, Turner Island Water District, Stevinson Water District, Merquin County Water District, and Lone Tree Mutual Water Company. MID deliveries were aggregated at the subregional level for both in- and out-of-district sales, whereas the other water agencies were summarized within their boundaries.

Groundwater Pumping: Groundwater extractions from October 2015 to September 2019 were provided by all agricultural and municipal entities listed in Section 2.2. Agency pumping by MID and TIWD were simulated using metered data at each production well whereas other agencies have pumping aggregated evenly across their institutional boundaries based on aggregate reported data. Pumping estimates were made for private agriculture and domestic wells based on land use type and population.

Population: City of Merced provided annual population from 2015 to 2019. The City of Atwater and City of Livingston populations were updated based on data publicly available from the US Census online database. Rural populations were extracted from US Census 2017 American Community Survey 5-year estimates Census Tract data and spatially assigned throughout the model by land use.

Land Use: Each element within the MercedWRM is comprised of some fraction of 14 land uses, including 11 agricultural crop categories, native vegetation, riparian vegetation, and urban. For the 2016-2019 update, the model utilizes annual data for each year based on the NRCS CropScape program which provides data throughout the model domain on a gridded resolution of 30 meters.

Precipitation: Monthly precipitation into the Subbasin and its watersheds was derived on a four-kilometer grid using the Precipitation-Elevation Regressions on Independent Slopes Model dataset available online from Oregon State University through a partnership the NRCS National Water and Climate Center.

Streamflow: Monthly inflow to the Merced Subbasin was downloaded for the San Joaquin River from the USGS and from CDEC for Merced River, Bear Creek, Owens Creek, and Mariposa Creek. Non-gauged tributaries into the Subbasin were estimated internally by the model using the Integrated Water Flow Model (IWFM) small-watershed package.

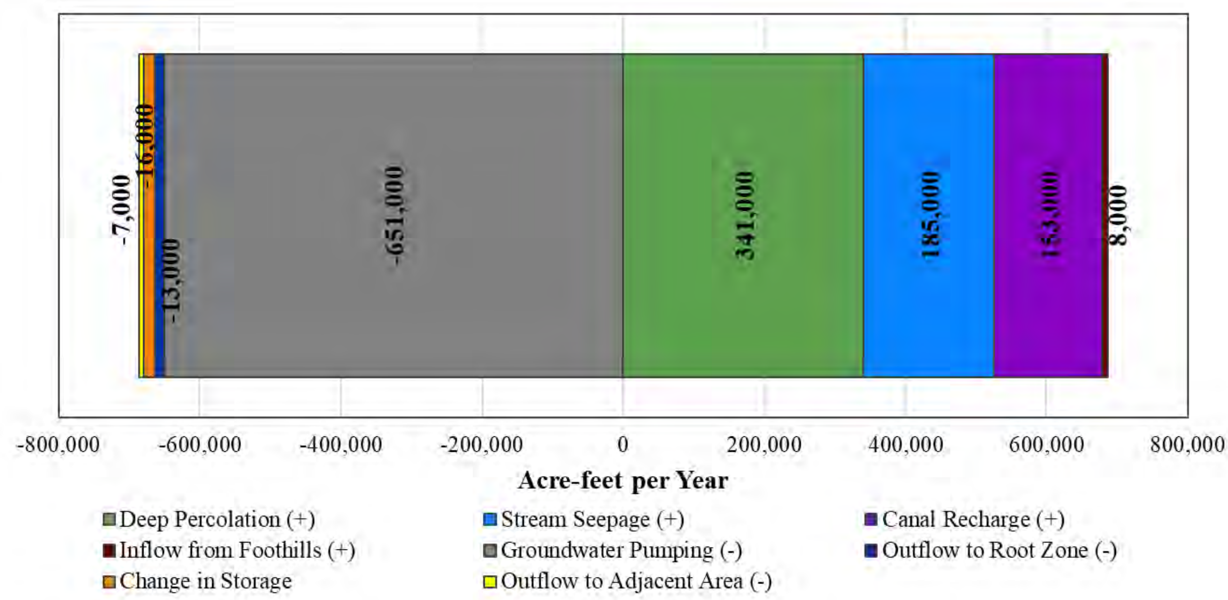
Boundary Conditions: Groundwater elevation contours were downloaded from DWR's GICIMA database for the spring and fall of the 2016 – 2019 water years and used to update the assumed groundwater elevation boundary conditions in the model. As groundwater level contours are only available in semiannual intervals, intermediary months were estimated though linear interpolation.

Note that the MercedWRM estimates MID canal recharge based on historical monthly diversions and the water year index. An in-depth analysis of MID operations and surficial water budgets will be developed later this year as part of MID's 2020 Agricultural Water Management Plan (AWMP), at which point the MercedWRM may be updated with further refined datasets.

Results

Evaluation of the 2016-2019 historical period (Figure 2-14) shows that in the most recent four-year period, the Merced Subbasin experienced, on average, 687,000 AF of inflows and 671,000 AF of outflow each year, leading to an annual increase in groundwater in storage of 16,000 AF. Deep percolation from the root-zone (341,000 AFY) is the largest contributor of groundwater inflow, followed by recharge from rivers, streams, and canals (338,000 AFY), and subsurface inflows from the Sierra Nevada foothills (8,000 AFY). On average, groundwater production (651,000 AFY) accounts for the greatest outflow from the Merced Subbasin, followed by outflow to the root-zone and net-subsurface flow to adjacent areas (20,000 AFY).

Figure 2-14: Average Annual Estimated Groundwater Budget 2016-2019, Merced Subbasin



2.6 Land Subsidence

This section provides maps of the most recent subsidence measurements taken in and around the Subbasin and compares them to the GSP's sustainable management criteria. Subsidence is measured at static GPS control points throughout the San Joaquin Valley monitored by the US Bureau of Reclamation (USBR) as part of the San Joaquin River Restoration Program. Measurements have been recorded biannually in July and December of each year to monitor ongoing subsidence since 2011. Figure 2-15 shows the total subsidence occurring from December 2015 to December 2019. Figure 2-16 shows the average subsidence occurring from December 2012 through December 2019. December 2012 is shown as the starting point rather than December 2011 when USBR monitoring began due to many additional data points added in December 2012 that were not recorded in December 2011.

Figure 2-15: Total Subsidence December 2015 – December 2019

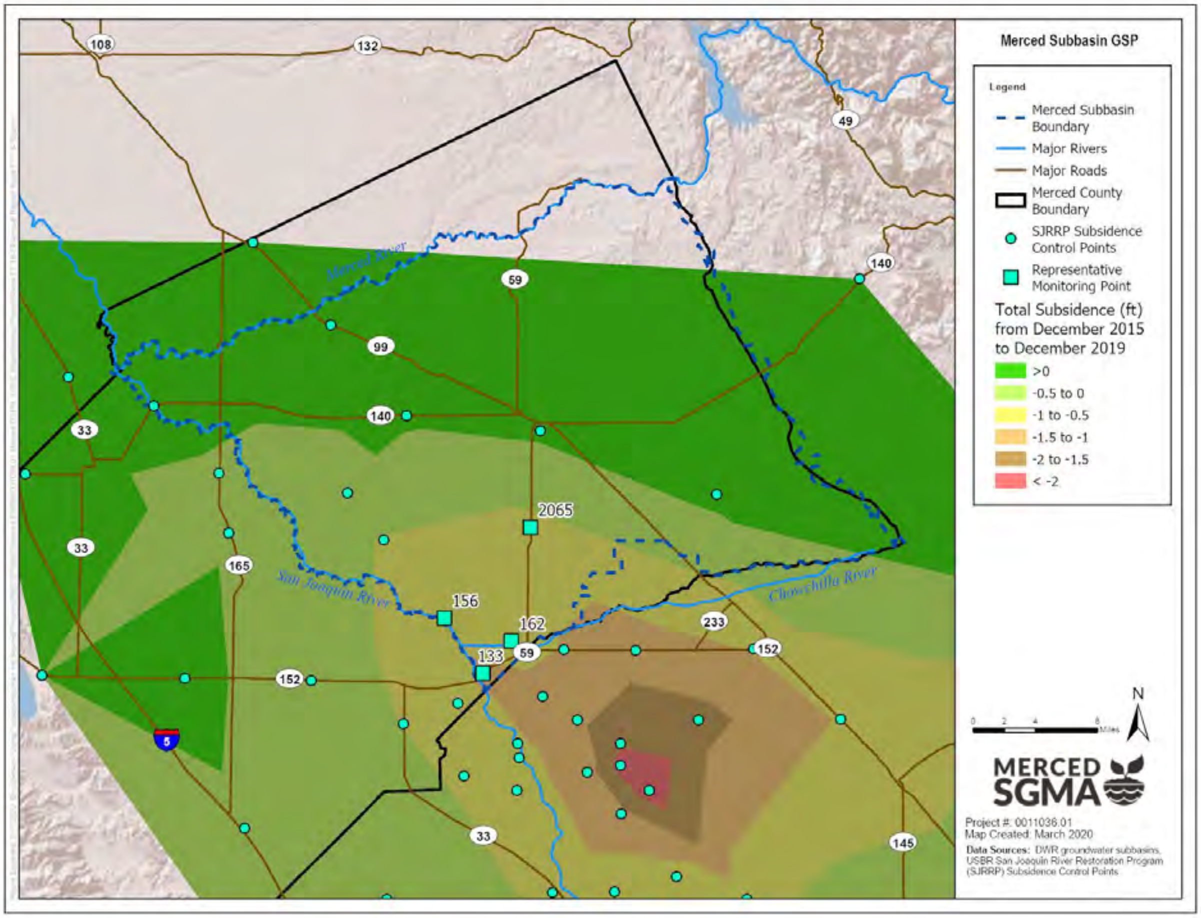
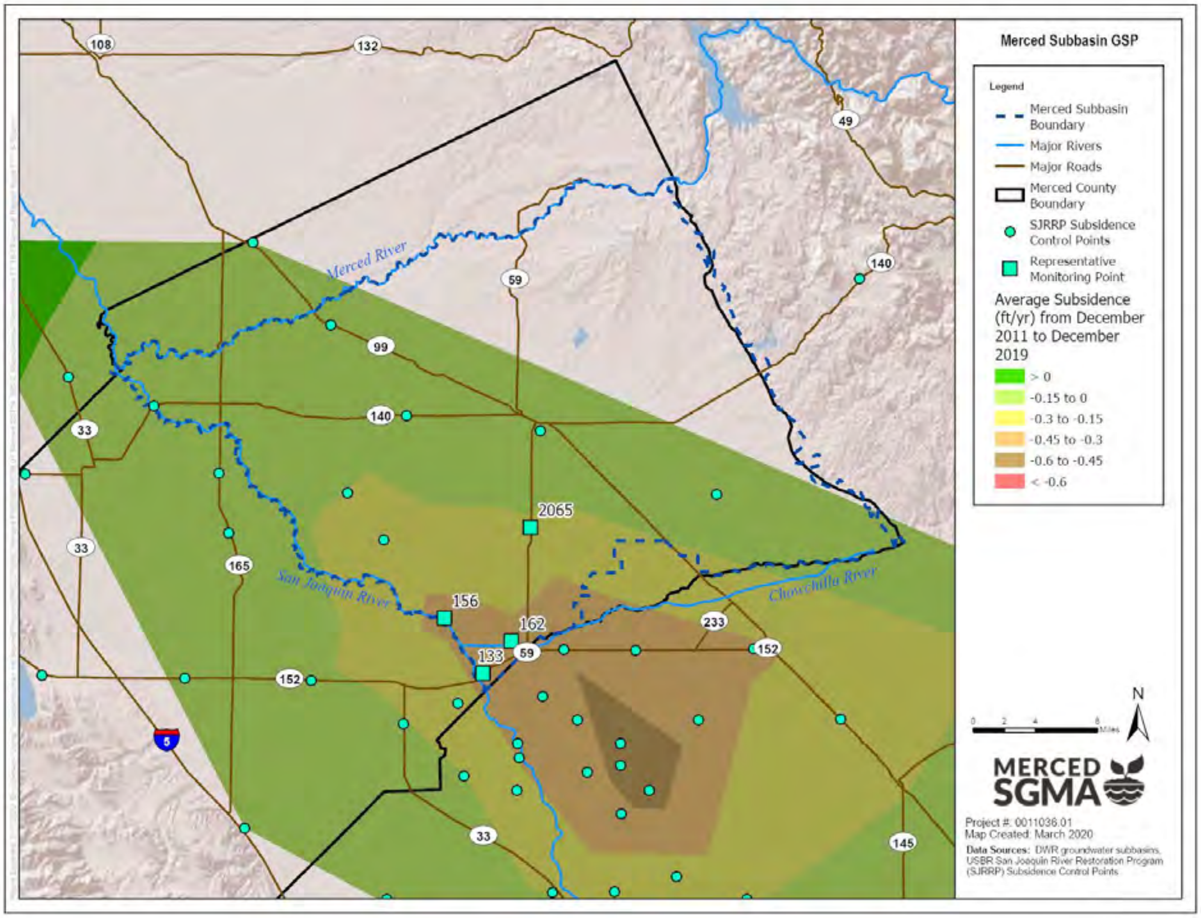


Figure 2-16: Average Subsidence Rate December 2011 – December 2019



In the GSP, the GSAs established a minimum threshold of -0.75 ft/year at four representative monitoring stations based on data review of subsidence between 2011 and 2018. The measurable objective and all interim milestones are -0.25 ft/year of subsidence. As shown in Table 2-8, subsidence values in the last four years have remained below the minimum threshold (i.e. the magnitude of subsidence is less than the minimum threshold). In four cases in the last four years, the magnitude of annual subsidence has been above (greater than) the long-term measurable objective (Stations 133 and 156 in 2015-2016 and 2017-18). Work is currently underway to better understand how to stabilize subsidence in the Subbasin.

Table 2-8: Subsidence at Representative Monitoring Stations

Point ID	Station Name	Subsidence (ft)				Minimum Threshold (ft/yr)	Measurable Objective (ft/yr)
		Dec 2015 - Dec 2016	Dec 2016 - Dec 2017	Dec 2017 - Dec 2018	Dec 2018 - Dec 2019		
133	H 1235 RESET	-0.44	-0.18	-0.30	-0.24	-0.75	-0.25
162	RBF 1057	-0.25	-0.07	-0.17	-0.10	-0.75	-0.25
2065	W 938 RESET	-0.16	-0.16	-0.17	-0.14	-0.75	-0.25
156	W 990 CADWR	-0.29	0.01	-0.32	-0.07	-0.75	-0.25

2.7 Groundwater Quality

In addition to comparing water quality monitoring to the GSP's interim milestones and other sustainable management criteria, this section provides a summary of ongoing water quality coordination activities being conducted by the GSAs.

2.7.1 Representative Monitoring

In the GSP, the GSAs established a minimum threshold of 1,000 mg/L of Total Dissolved Solids (TDS) at representative monitoring sites for the degraded water quality sustainability indicator. The measurable objective and all interim milestones were set at 500 mg/L TDS. Figure 2-17 through Figure 2-19 show the spatial distribution of TDS concentration measurements in the three principal aquifers based on TDS data reported in the Groundwater Ambient Monitoring & Assessment (GAMA) database within water years 2016-2019 for wells in the Merced Subbasin monitoring network. Figure 2-20 shows concentrations for which the principal aquifer is unknown due to a lack of well construction data (e.g. total well depth or screened interval). The GSP monitoring network includes both designated representative wells as well as any Public Water Supply (PWS) wells that report data to the Division of Drinking Water (DDW).

While elevated TDS concentrations (greater than 1,000 mg/L) did not show up in monitoring data for water years 2016-2019, the Merced GSP describes that there are pockets of the Subbasin known to have such elevated concentrations and 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 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.

Figure 2-17: Average TDS Concentration Water Years 2016-2019, Above Corcoran Clay Principal Aquifer

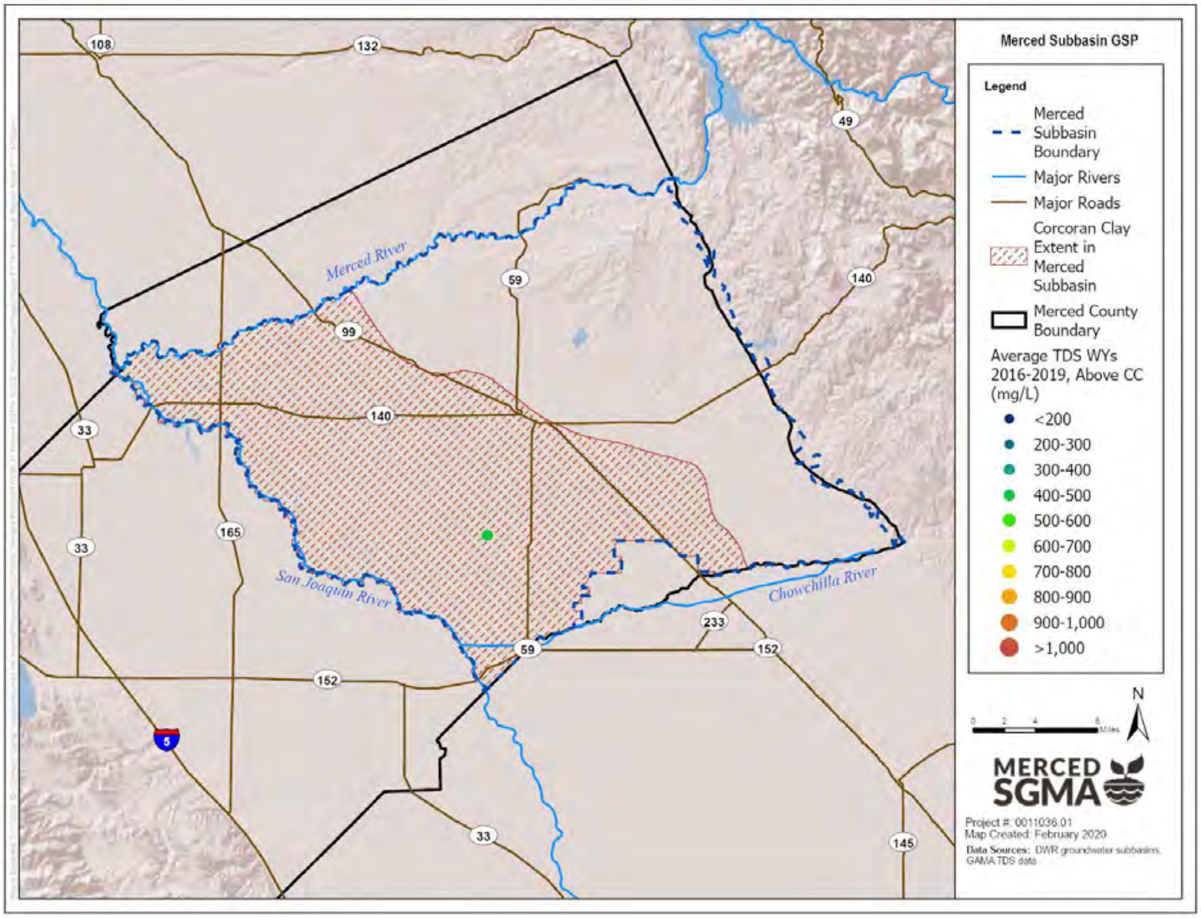


Figure 2-18: Average TDS Concentration Water Years 2016-2019, Below Corcoran Clay Principal Aquifer

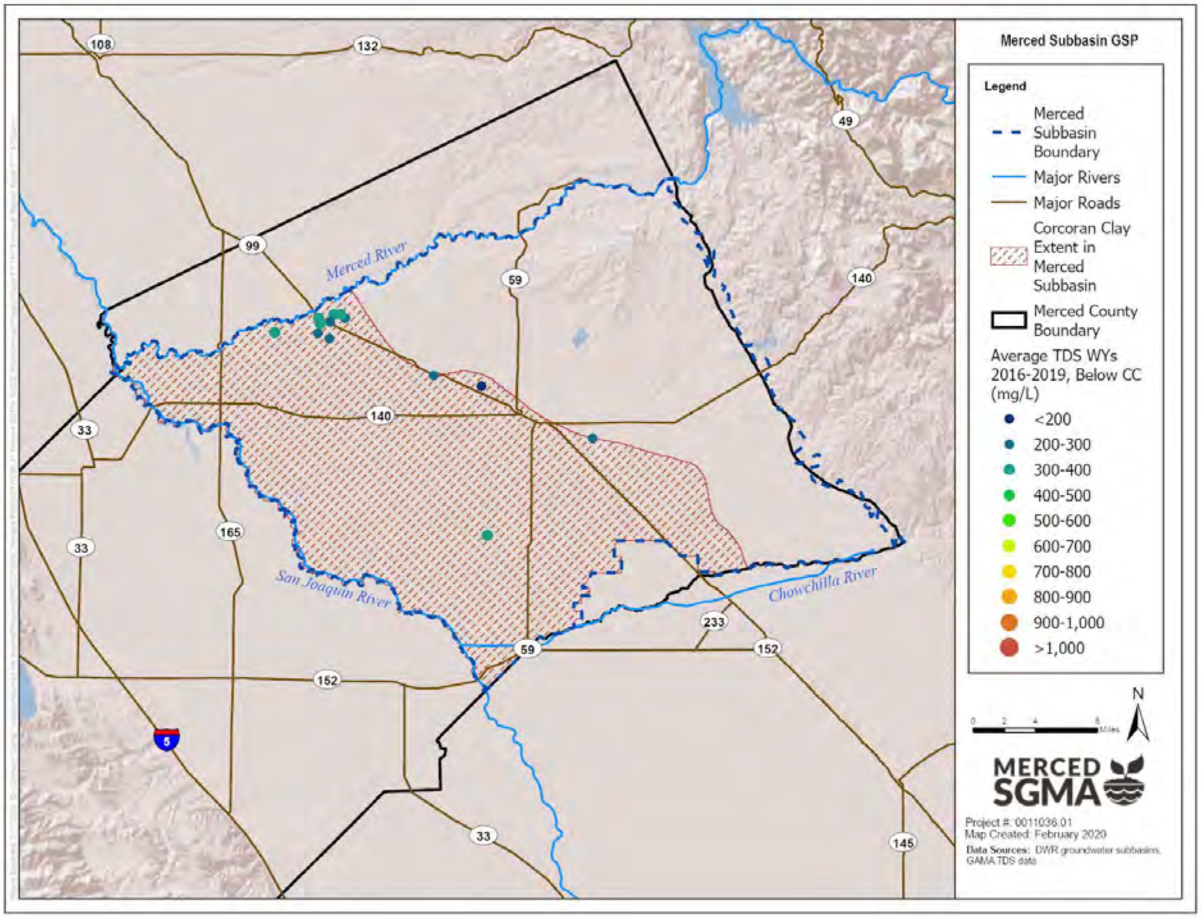


Figure 2-19: Average TDS Concentration Water Years 2016-2019, Outside Corcoran Clay Principal Aquifer

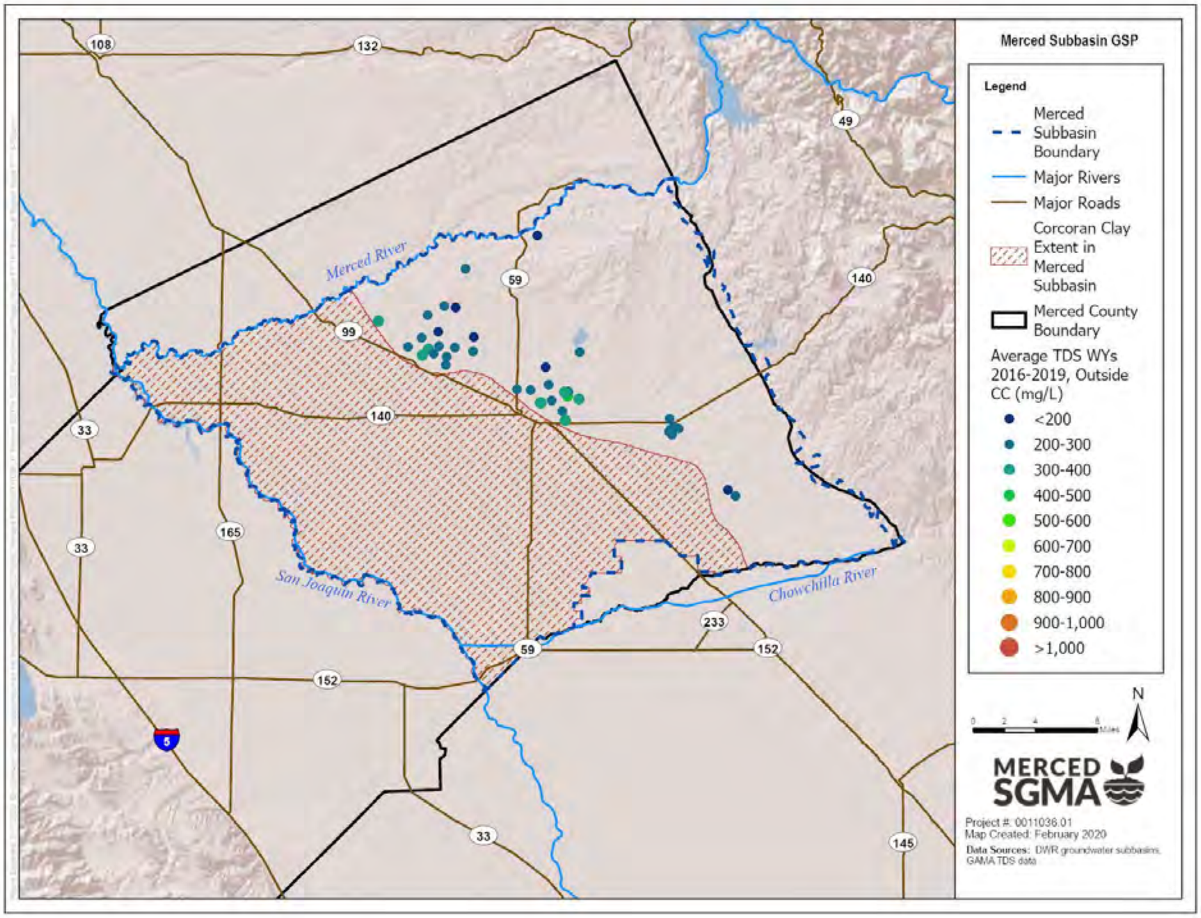
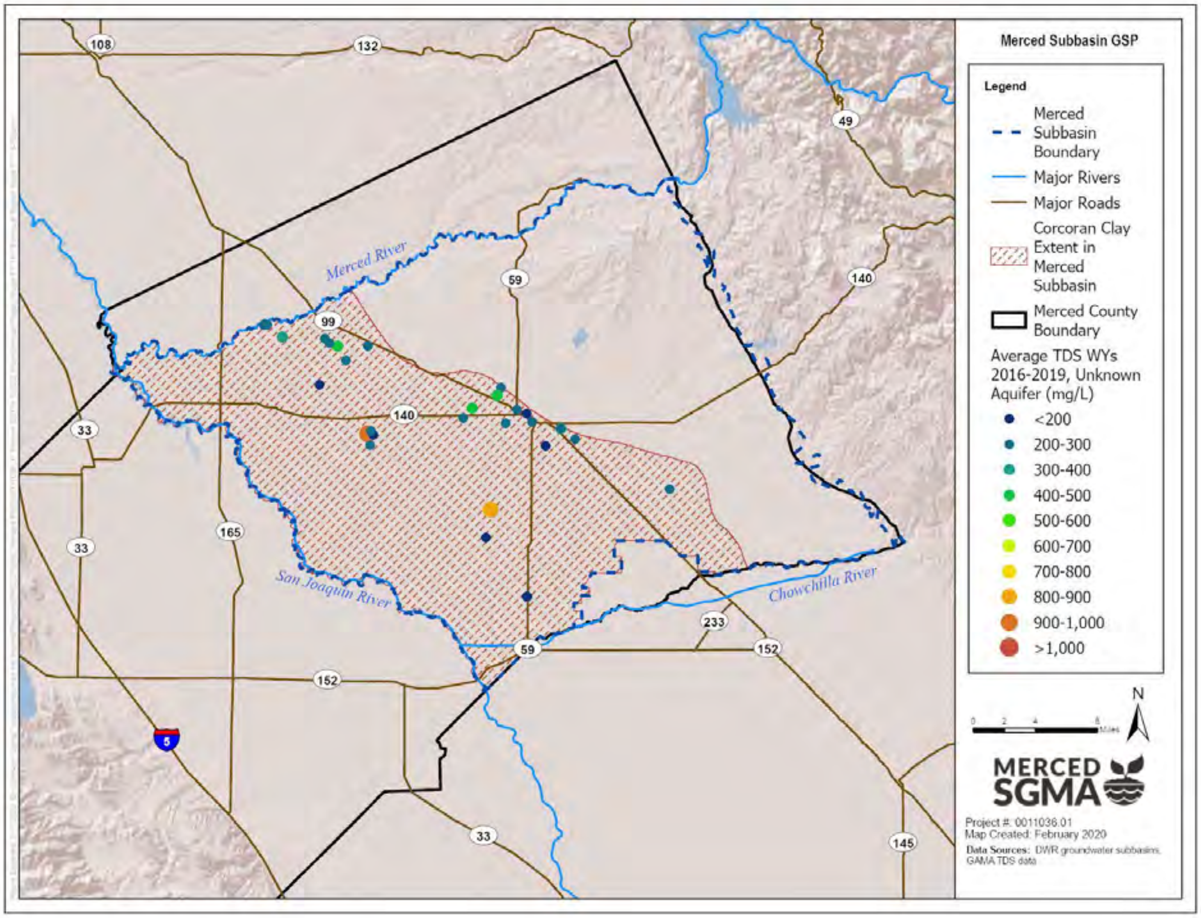


Figure 2-20: Average TDS Concentration Water Years 2016-2019, Unknown Principal Aquifer



The East San Joaquin Water Quality Coalition (ESJWQC) is a group of agricultural interests and growers formed to represent 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 Program (GQTMP) 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). There are five principal wells and 14 complementary wells in the Merced Subbasin that are designated as representative monitoring wells in the Merced GSP at which sustainable management criteria are established (shown in Table 2-9).

ESJWQC published a 2019 Annual Report for the GQTMP based on data collected at principal wells on October 30 and 31, 2018 (ESJWQC, 2019). Data were submitted to GAMA. TDS concentrations for Merced GSP representative wells are summarized in Table 2-9. None of the wells with reported data have TDS concentrations above the minimum threshold. One shows a TDS concentration that is above the measurable objective and interim milestones. Note that for the 14 complementary wells (identified with GQTMP Well ID beginning with "C"), only 6 had TDS data reported in GAMA for the reporting period.

Table 2-9: TDS Concentrations at Representative Monitoring Wells

GQTMP Well ID	GAMA Well ID	TDS (mg/L)	Date of Measurement(s)	Minimum Threshold (mg/L TDS)	Measurable Objective and Interim Milestones (mg/L TDS)	Principal Aquifer
P06	AGC100012331-ESJQC00006	240	10/31/2018	1,000	500	Outside Corcoran Clay
P07	AGC100012331-ESJQC00007	180	10/31/2018	1,000	500	Below Corcoran Clay
P08	AGC100012331-ESJQC00008	330	10/30/2018	1,000	500	Outside Corcoran Clay
P09	AGC100012331-ESJQC00009	410	10/30/2018	1,000	500	Below Corcoran Clay
P10	AGC100012331-ESJQC00010	890	10/30/2018	1,000	500	Below Corcoran Clay
C35	2400172-001			1,000	500	Above Corcoran Clay
C41	2400220-001			1,000	500	Above Corcoran Clay
C45	2400089-001			1,000	500	Above Corcoran Clay
C38	2410004-011	338	3/13/2017	1,000	500	Below Corcoran Clay
C44	2400218-001			1,000	500	Below Corcoran Clay
C40	2410001-006			1,000	500	Outside Corcoran Clay
C42	2400046-002	400	6/28/2016	1,000	500	Outside Corcoran Clay
C43	2410007-005	290, 280	4/26/2016, 4/9/2019	1,000	500	Outside Corcoran Clay
C46	2410007-002			1,000	500	Outside Corcoran Clay
C47	2400194-001			1,000	500	Outside Corcoran Clay
C39	2400119-001			1,000	500	Outside Corcoran Clay

GQTMP Well ID	GAMA Well ID	TDS (mg/L)	Date of Measurement(s)	Minimum Threshold (mg/L TDS)	Measurable Objective and Interim Milestones (mg/L TDS)	Principal Aquifer
C48	2410011-005	186, 200	8/23/2016, 7/30/2019	1,000	500	Outside Corcoran Clay
C49	2400172-012	199	9/22/2017	1,000	500	Unknown
C50	2400079-001	270	2/9/2017	1,000	500	Unknown

2.7.2 Water Quality Coordination Activities

In addition to monitoring for TDS (see Section 2.7.1 - Representative Monitoring), the GSAs will be conducting ongoing water quality coordination activities to address other water quality constituents. These activities include review of monitoring reports published by other monitoring programs as well as a review of data submitted by Department of Pesticide Regulation (DPR), Division of Drinking Water (DDW), Department of Toxic Substances Control (DTSC), and GeoTracker to the GAMA database. The purpose of these reviews is to review the status of constituent concentrations throughout the Subbasin with respect to typical indicators such as applicable maximum contaminant level (MCL)[1] or secondary maximum contaminant levels (SMCL)[2].

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. GAMA data for the Merced Subbasin contains wells monitored or regulated by the DDW, DPR, DWR, USGS, and environmental monitoring wells monitored by regulated facilities. The GSAs have collected information from GAMA and will use this information to assess whether there is a need for changes to existing sustainable management criteria or developing additional sustainable management criteria for water quality.

[1] MCLs are drinking water standards that are adopted as regulations and describe the highest level of a contaminant allowed in drinking water, based on health risks and also detectability, treatability, as well as the costs of treatment.
[2] Secondary MCLs are established by the USEPA and then adopted by the SWRCB. The secondary MCL is a Secondary Drinking Water Standard that is established for aesthetic reasons such as taste, odor, and color and is not based on public health concerns.

3. PLAN IMPLEMENTATION PROGRESS

3.1 Overview of Implementation Support Activities

This section of the Annual Report provides updates for interim milestones, projects, and management actions as available. The recently submitted GSP contents for Plan Implementation including implementation schedule, GSP implementation program management, Merced GSAs administration, and public outreach remain unchanged as of the submission of this first Annual Report.

3.2 Interim Milestones

Interim Milestones were identified in Chapter 3 (Sustainable Management Criteria) of the GSP for all Sustainability Indicators and provided in tabular form for Groundwater Elevations and Groundwater Quality Sustainability Indicators (see Tables 3-1 and 3-2 in GSP). These Interim Milestones are anticipated to be achieved over the course of GSP implementation in increments of five years, pursuant to the CCR definition "*Target values representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan*" [CCR Title 23, Division 2, §351(q)]. Progress toward achieving Interim Milestones since submitting the 2019 GSP are provided in Sections 2.1 (Groundwater Elevations), 2.6 (Land Subsidence), and 2.7 (Groundwater Quality). Further updates are expected in the first Five Year Report for the Merced Subbasin GSP, with potential status checks provided in future annual reporting.

3.3 Implementation of Projects

The GSP identifies 12 priority projects. These were selected for inclusion in the GSP based on their ability to address a list of priorities identified by the Stakeholder and Coordinating Committee members, and the public. These priorities are listed in Chapter 6 (Projects and Management Actions to Achieve Sustainability Goal) in the GSP. The priorities are:

- Project addresses Disadvantaged Communities (DACs) and or Severely Disadvantaged Communities (SDACs)
- Project addresses areas with known data gaps
- Project provides basinwide benefit (i.e., benefits all GSAs)
- Project addresses a subsidence area
- Project focuses on recharge
- Project focuses on conveyance
- Project addresses and or prioritizes drinking water
- Project addresses and or prioritizes water for habitat
- Project focuses on monitoring, reporting, and data modeling activities for data collection to be gathered in first 5 years
- Project provides incentives to reduce pumping and to capture surface water (e.g., including flood flows)
- Project is beyond planning phase
- Project already has a dedicated funding mechanism
- Project identified as priority project by at least one GSA

Table 3-1 is a summary of updated project information for priority projects since the 2019 GSP provided by project proponents.

Table 3-1 Description of Project Implementation Updates

Project Name	Project Update Description
Project 1: Planada Groundwater Recharge Basin Pilot Project	Testing for cone penetration tests has begun to delineate stratigraphic units and determine recharge basin potential. Anticipation of technical analysis completion in Spring 2020.
Project 2: El Nido Groundwater Monitoring Wells	Two wells below Corcoran clay were installed in February 2020 with an anticipated two more wells to be installed in April 2020. Technical Memo expected mid-2020.
Project 3: Meadowbrook Water System Intertie Feasibility Study	Progress made on first deliverable involving an evaluation of the needs and potential uses for the intertie, including emergency supply system redundancy, fire suppression, and future connections for project, anticipated completion of Feasibility Study in 2020.
Project 4: Merquin County Water District Recharge Basin	No update of information in 2019 GSP to report at this time.
Project 5: Merced Irrigation District to Lone Tree Mutual Water Company Conveyance Canal	Project timeline extended to early 2021. Currently proponents considering adjustments to total capacity to allow greater movement of brief flood flows and subsequent percolation.
Project 6: Merced IRWM Region Climate Change Modeling	No update of information in 2019 GSP to report at this time.
Project 7: Merced Region Water Use Efficiency Program	No update of information in 2019 GSP to report at this time.
Project 8: Merced Groundwater Subbasin LIDAR	No update of information in 2019 GSP to report at this time.
Project 9: Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD	Please see detailed update in text below.
Project 10: Vander Woude Dairy Offstream Temporary Storage	Change of expected completion date from May 2020 to May 2021.
Project 11: Mini-Big Conveyance Project	Combined with Project 9 Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD due to substantial overlap in scope.
Project 12: Streamlining Permitting for Replacing SubCorcoran Wells	No update of information in 2019 GSP to report at this time.

Project 11 Mini-Big Conveyance Project has been combined with Project 9 Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD due to substantial overlap in scope. GSP Project numbering for Project 9 will be retained for record keeping purposes. The following reflects the updated project information:

Project 9 Title: Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD

Description: Le Grand Athlone Water District (LGAWD) has hired Summers Engineering to provide a feasibility study for constructing a new conveyance inter-tie facility between Merced Irrigation District and Chowchilla Water District. The conveyance facility would connect MID's Booster 3 Lateral to the Chowchilla River with outlets at Deadman, Little Deadman, and Dutchman Creeks in the eastern portion of LGAWD. Updates on the development of this project as of the first Annual Report are as follows:

1. Full-day site visit of the MID lateral system and the three creeks within the LGAWD boundary.

2. Field day for reviewing potential canal alignments within the LGAWD boundary.
3. Review of an initial alignment and canal specifications with the LGAWD board of directors at their monthly public meetings.
4. Coordination with MID's hydrology and engineering team on local hydrology, daily operations, canal capacities, etc. to determine a feasible capacity for the new canal.
5. Newly constructed canal capacity target determined to be 200 cubic feet per second.
6. Feasibility Study updates will be provided for the LGAWD board, including at the March 2020 board meeting.

Public Noticing: Project proponents anticipate that public outreach may include potential public workshops and meetings, potential website presence or email announcements, along with other public notices for the workshops. Public noticing will also comply with requirements of the applicable permitting and regulatory processes.

Permitting and Regulatory Process: Project proponents anticipate that an initial study will be conducted for purposes of compliance with CEQA. The project will require the acquisition of land and easements. It is also anticipated that the project will be subject to potential County permits for encroachment, among other construction and building permits.

Time-Table for Initiation and Completion: The feasibility study was initiated in June 2019 and is expected to be complete in Spring 2020. It is anticipated that time will be needed for discussion and negotiations with MID. Implementing intertie system would likely begin in mid-2022, with the first year focused on acquiring permits. The project build out is anticipated to be completed within three years of acquiring permitting, bringing estimated end date of completed intertie system to approximately June 2026.

Expected Benefits and Evaluation: Enhanced conveyance and surface water availability, which is anticipated to reduce reliance on groundwater resources. This project will allow delivery of surface water to water users and to recharge the groundwater by percolating it in planned groundwater recharge basins. The project would provide for diversion of flood waters to the canal, reducing flooding and providing surface water to reduce groundwater overdraft in the area. The project would help alleviate drought impacts. Specifically, because in-lieu and direct groundwater recharge would elevate groundwater levels within the Merced and Chowchilla Subbasins, it would address the risk of not meeting existing drinking and agricultural water demands once the project is constructed. The project will improve groundwater conditions impacting the SDAC communities of Le Grand and Planada.

How Project Will Be Accomplished: This project builds off of previous study performed by Tolladay, Fremming & Parson for the USBR conducted in 2001. The feasibility study conducted within the Project 9 Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD will advance previous studies and further evaluate feasibility of conveyance system construction. The canal would start east of Le Grand and attach to MID's Booster Lateral 3. The canal would require capacity enhancements to the existing MID conveyance system. The conveyance system would serve the upper and middle portions of LGAWD, along with the eastern data gap areas of the Subbasin. The project would be comprised of three legs. The project would place in-lieu recharge at the head waters of the Subbasin. The system would intersect two areas conducive to recharge. This includes one recharge opportunity at Mariposa Creek and an additional portion of land about 200-500 ft. by approximately three miles long. The latter recharge option is comparable to a retention basin close by, which has proven successful. Constructing a single leg would feature a flow rate of 37 to 50 cfs per day (with maximum water at 27,000 to 35,000 AF). Practical consumption is 9,000 to 13,000 AF off-peak. Supply is estimated at 6,000 acres at 1.5 AF/acre. The project would supply surface water to LGAWD, Plainsburg Irrigation District, Sandy Mush Mutual Water Company and other lands currently without an adequate surface water supply.

Note from MID: Local project sponsors (e.g., Lone Tree Mutual Water Company, Le Grande-Athlone Water District, etc.) anticipate that surface water sourced from the Merced Irrigation District may be available through temporary water purchase and sale agreements and may serve as a water supply for the project(s). It is understood that the Board of Directors for the MID has and shall retain full and absolute discretion regarding whether and when it will enter into temporary water purchase and sale agreement(s), if any, and further, nothing contained in this document creates in any party or parties any right to water controlled by the MID whether it be surface water or groundwater. Any transferred water made available by MID shall be limited by the terms and conditions contained in any respective temporary water purchase and sale agreement.

Legal Authority: LGAWD under the Merced Subbasin GSA has authority per SGMA to develop and support projects for enhancing surface water supplies to reduce groundwater use.

Estimated Costs and Plans to Meet Costs: Costs for the feasibility study are anticipated to be $30,000. The preliminary cost estimate for the new facility is $29 million. Costs are anticipated to be met through grant funding and an improvement district(s) with LGAWD.

3.4 Implementation of Management Actions

The Merced Subbasin GSP includes two Management Actions. This has not changed as of the first Annual Reporting period. The two Management Actions are:

- Management Action 1: Water Allocation Framework
- Management Action 2: MSGSA Demand Reduction Program

Water Allocation Framework: An Ad Hoc Working Group was established with GSA staff to conduct discussions on the initial framework. GSA staff level discussions are ongoing. It is anticipated that allocation framework discussions at GSA Board and public meetings will occur starting in 2020.

MSGSA Demand Reduction Program: The MSGSA is initiating a demand reduction program in recognition of the need to reduce groundwater pumping in the basin. Development of this program is still in initial phases. Future implementation activities will include analysis, policies and procedures adoption, establishing monitoring and reporting tools, and conducting outreach.

3.5 Additional Implementation Support Activities

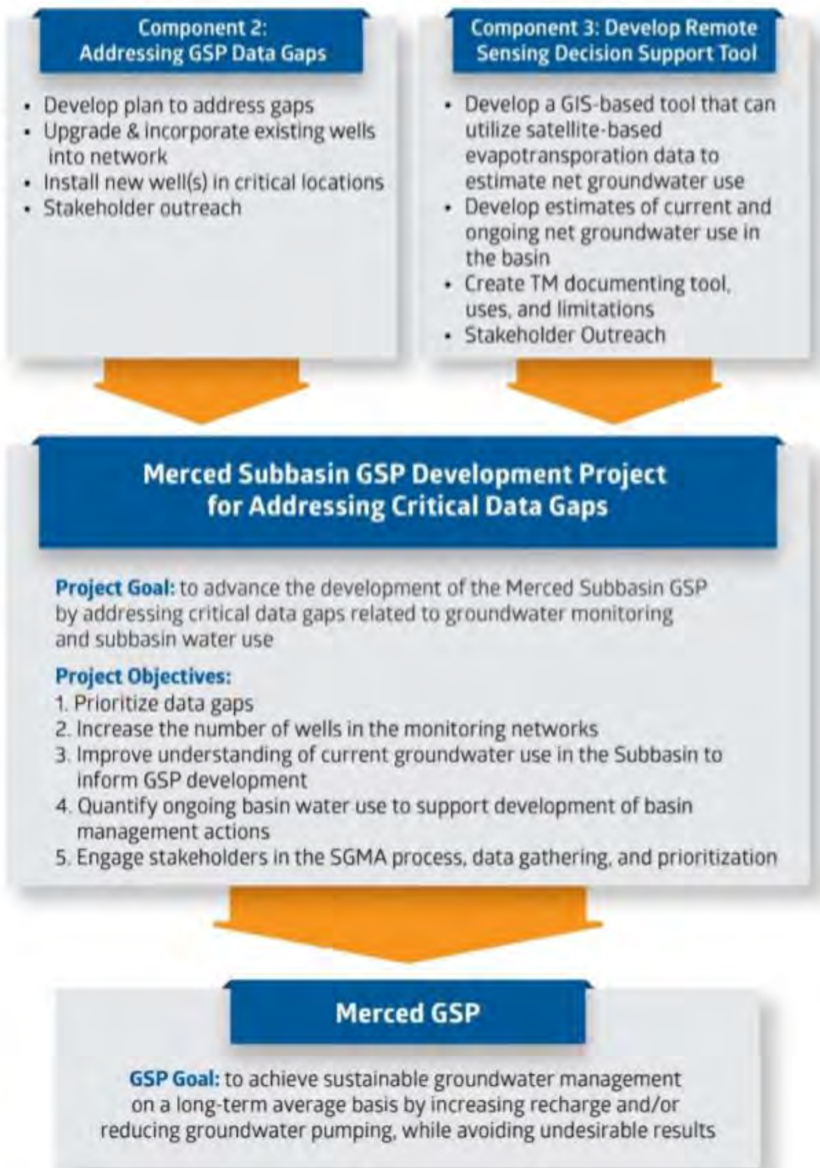
Additional activities have taken place within the first Annual Reporting period that contribute to the overall GSP implementation progress. These activities include work conducted on Flood-MAR and an application for grant funding under the Proposition 68 Sustainable Groundwater Management (SGM) Grant Program Planning Grant Round 3 solicitation process.

Flood-MAR: Flood-MAR stands for flood water managed aquifer recharge (MAR). It is an integrated resource management strategy that uses flood water resulting from precipitation for managed aquifer recharge on agricultural lands, refuges, floodplains, or flood bypasses. The MID has been working with DWR to evaluate opportunities to implement Flood-MAR projects and has hired consultants to conduct a feasibility study. As of early 2020, the consultant team has developed an integrated modeling tool using nine different models including a recharge optimization model (GRAT), a root zone model (IDC), and a groundwater model (FM2SIM) to evaluate impacts of implementing Flood-MAR as a strategy under 30 different climate scenarios. Early results indicate that climate has a significant impact on aquifer storage and that using only MID's existing conveyance system to practice Flood-MAR on lands within MID's boundaries may mitigate aquifer depletion by approximately 50,000 AFY on average (DWR, 2019).

Next steps for these activities will include refining model integration and continuing scenario analysis under various climate change conditions.

Proposition 68 SGM Grant Program Planning Grant: The Merced Subbasin submitted an application for the Proposition 68 SGM Grant Program Planning Grant and in March 2020 was included on DWR's final fund recipients list. The grant will provide $500,000 in funding to develop and implement a GSP Data Gaps Plan and to develop a remote sensing decision support tool to better quantify ongoing Subbasin groundwater use. Work on the Data Gaps Plan and remote sensing tool could begin as soon as Summer 2020. Please see Figure 3-1 from the Proposition 68 application, which highlights the two main components, goal, and objectives.

Figure 3-1 Advancing the Development of the Merced GSP Figure 5 from Merced Subbasin Proposition 68 SGM Planning Grant Application.



4. REFERENCES

DWR. (2019, October 9). Exploring Vulnerability and Flood Benefits; Merced River Basin Flood-MAR Reconnaissance Study (presentation). *2019 MIDH2O Symposium*.

DWR. (2020a). *Chronological Reconstructed Sacramento and San Joaquin Valley Water Year Hydrologic Classifications Indices.* Retrieved February 2020, from http://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST

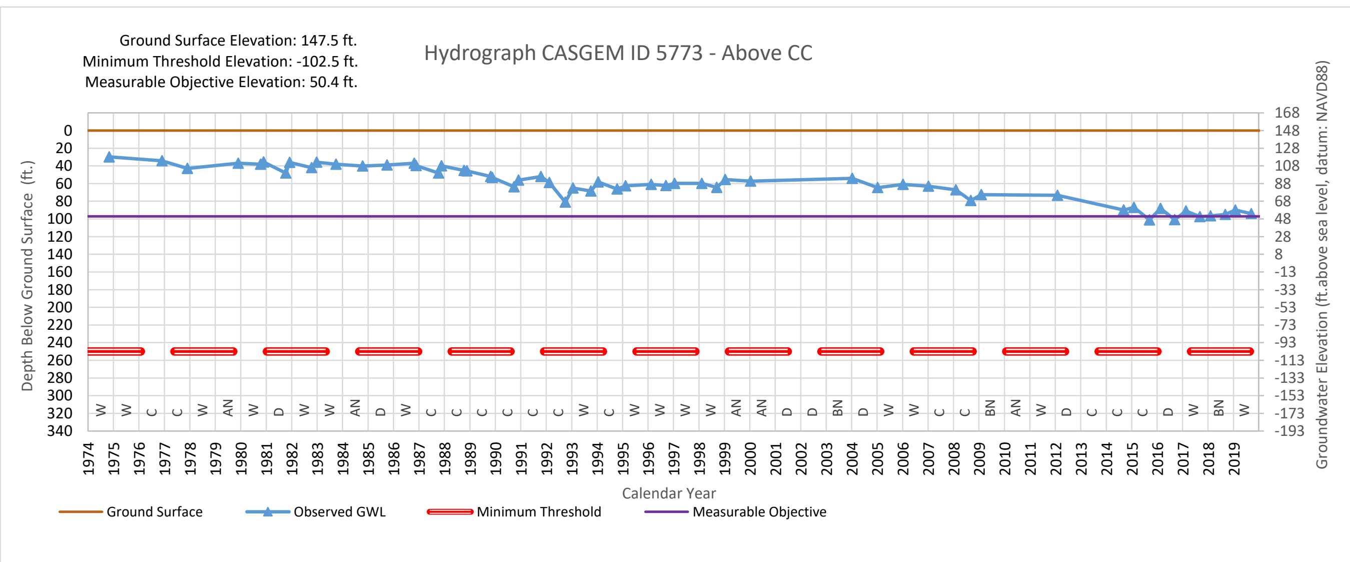
DWR. (2020b). *Water Supply Index (WSI) Forecasts: 2020 Water Year Hydrologic Classification Indicies.* Retrieved February 2020, from http://cdec.water.ca.gov/reportapp/javareports?name=WSI

ESJWQC. (2018, February). Groundwater Quality Trend Monitoring Workplan: Phase III. *Specific Network Wells*. East San Joaquin Water Quality Coalition. Retrieved from https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/water_quality/coalitions_submittals/east_sanjoaquin/ground_water/2018_0302_esj_gqtmp_ph3.pdf

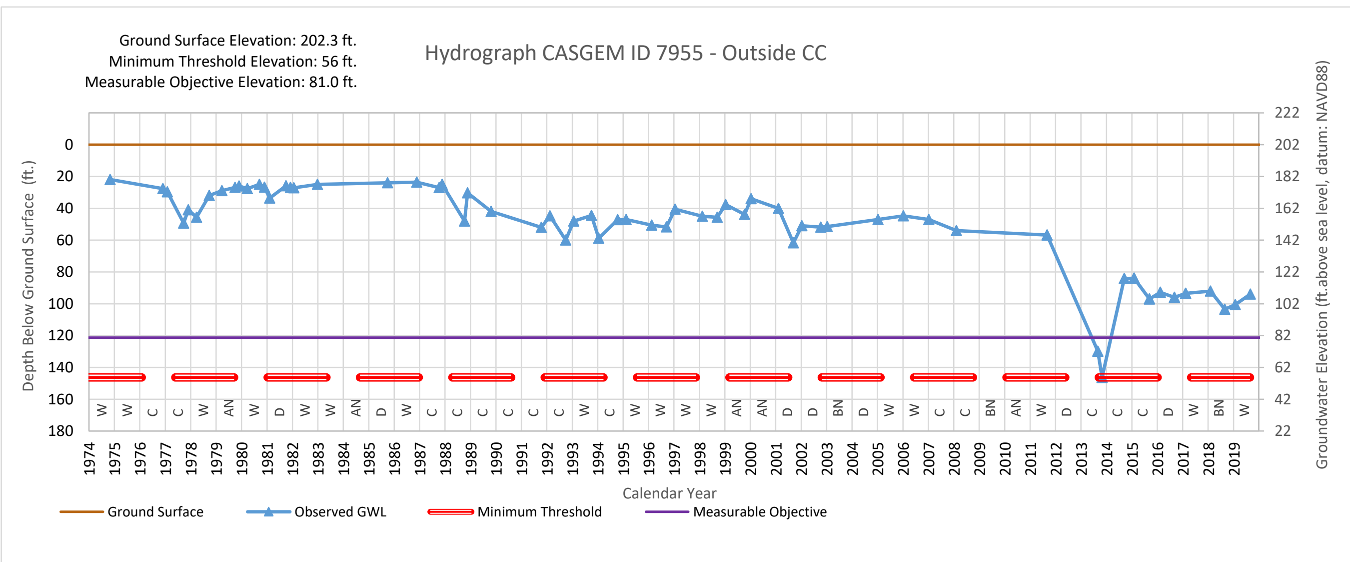
ESJWQC. (2019). *Groundwater Quality Trend Monitoring - 2019 Annual Report (Excerpts).* Retrieved from https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/water_quality/coalitions_submittals/east_sanjoaquin/ground_water/2019_0501_esj_gqtmp_amr.pdf

MIUGSA, MSGSA, & TIWD GSA-1. (2019). *Merced Groundwater Subbasin Groundwater Sustainability Plan.*

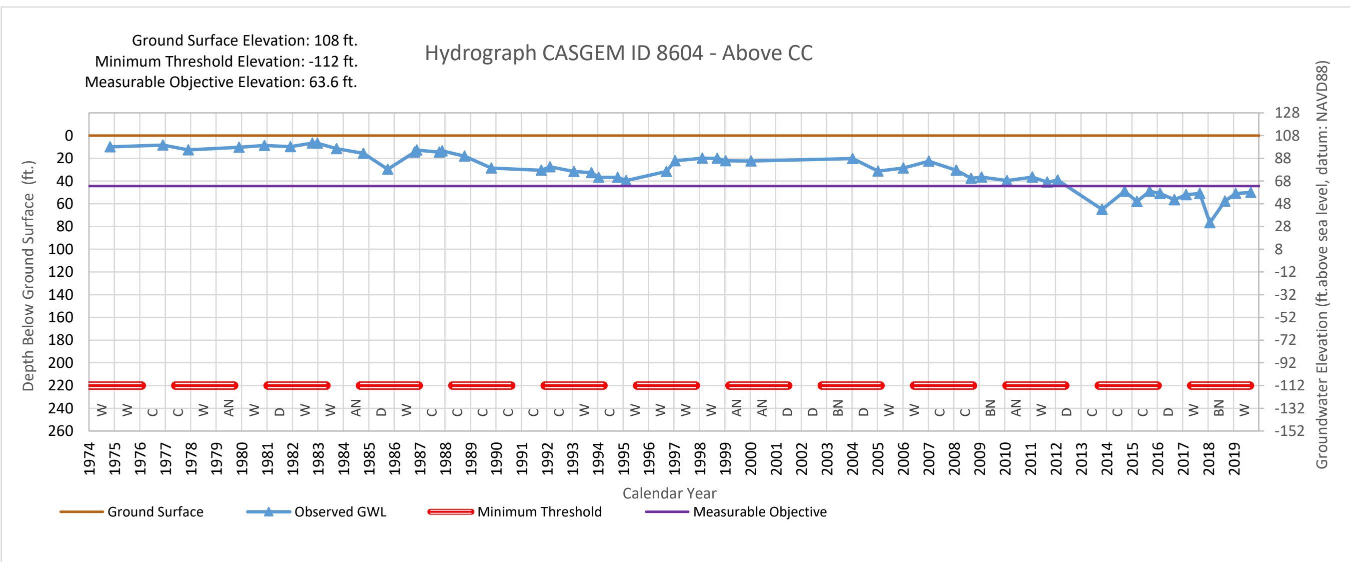
APPENDIX A: HYDROGRAPHS



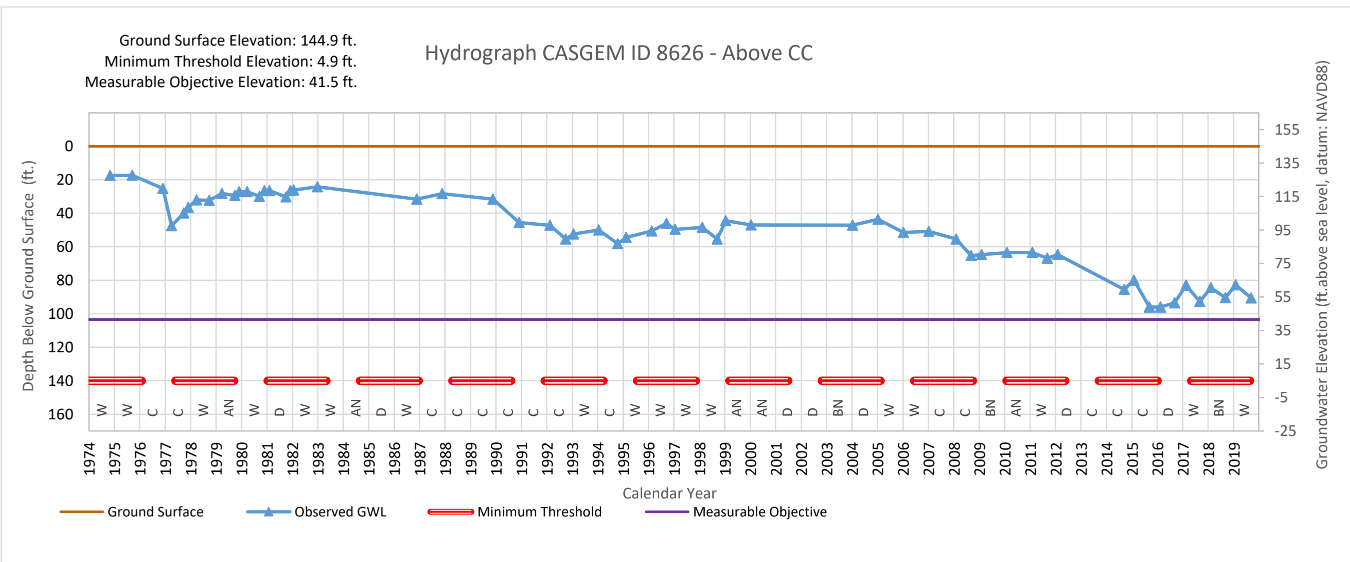
Ground Surface Elevation: 147.5 ft.
Minimum Threshold Elevation: -102.5 ft.
Measurable Objective Elevation: 50.4 ft.
Hydrograph CASGEM ID 5773 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

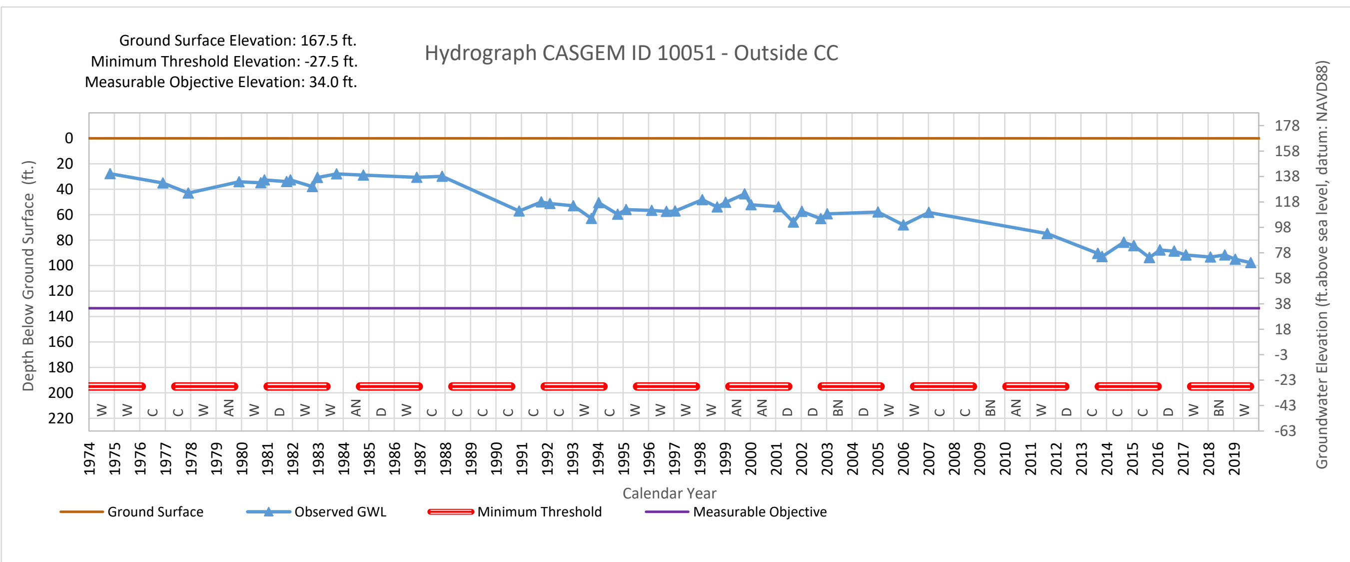


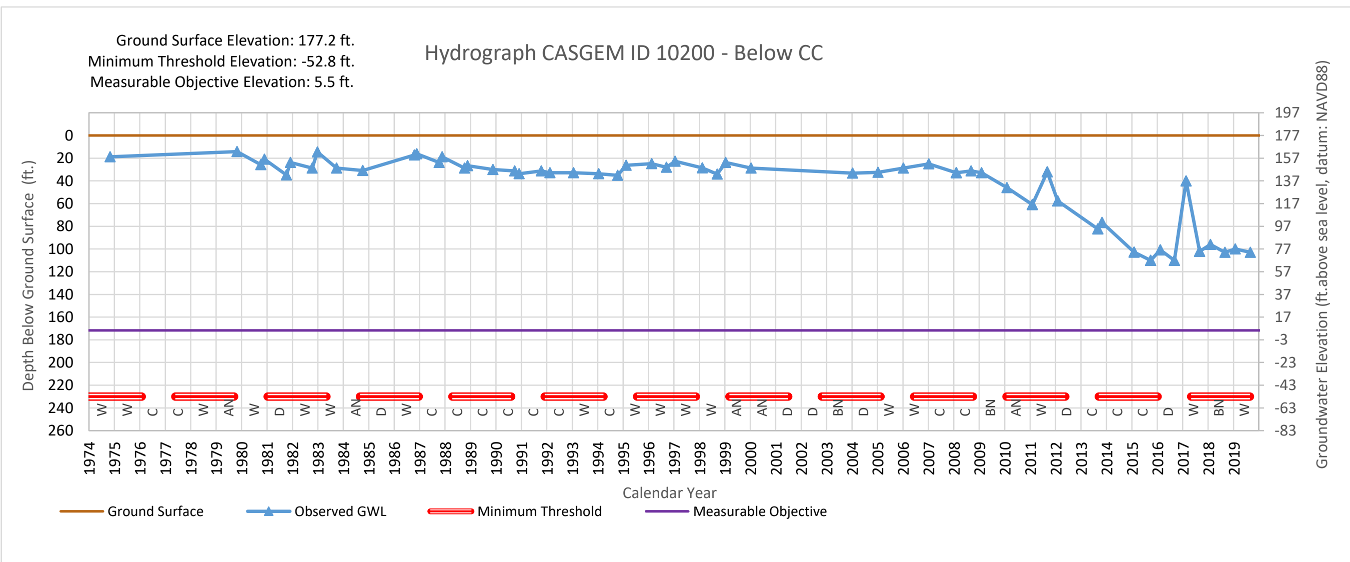
Ground Surface Elevation: 202.3 ft.
Minimum Threshold Elevation: 56 ft.
Measurable Objective Elevation: 81.0 ft.
Hydrograph CASGEM ID 7955 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



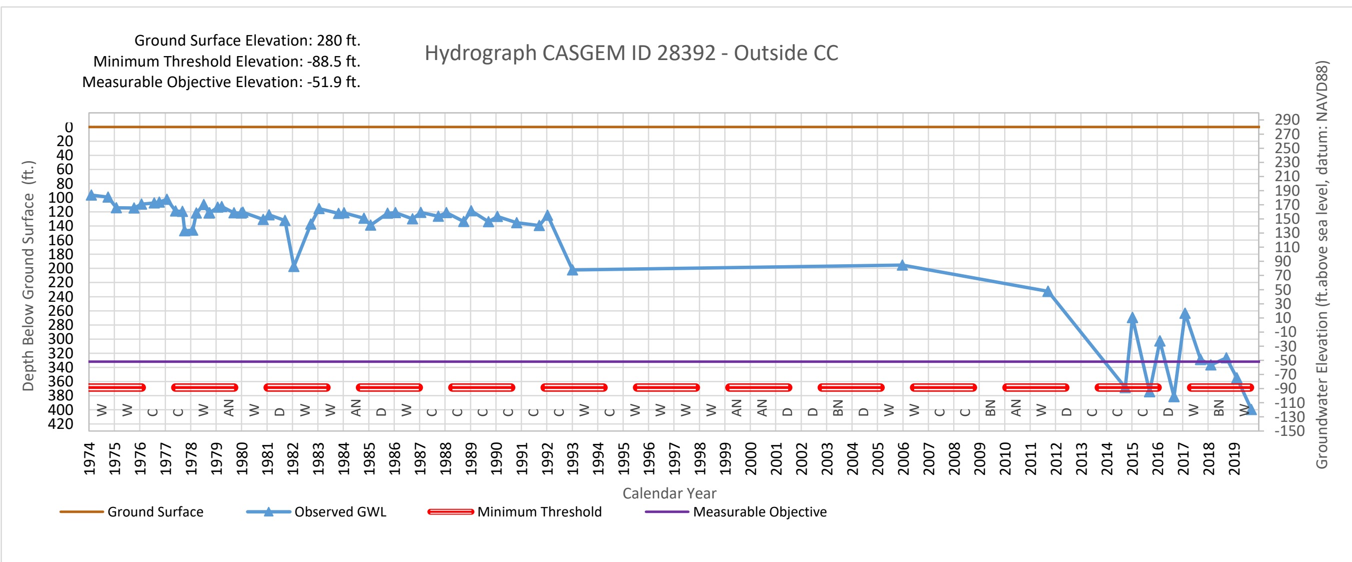
Ground Surface Elevation: 108 ft.
Minimum Threshold Elevation: -112 ft.
Measurable Objective Elevation: 63.6 ft.
Hydrograph CASGEM ID 8604 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

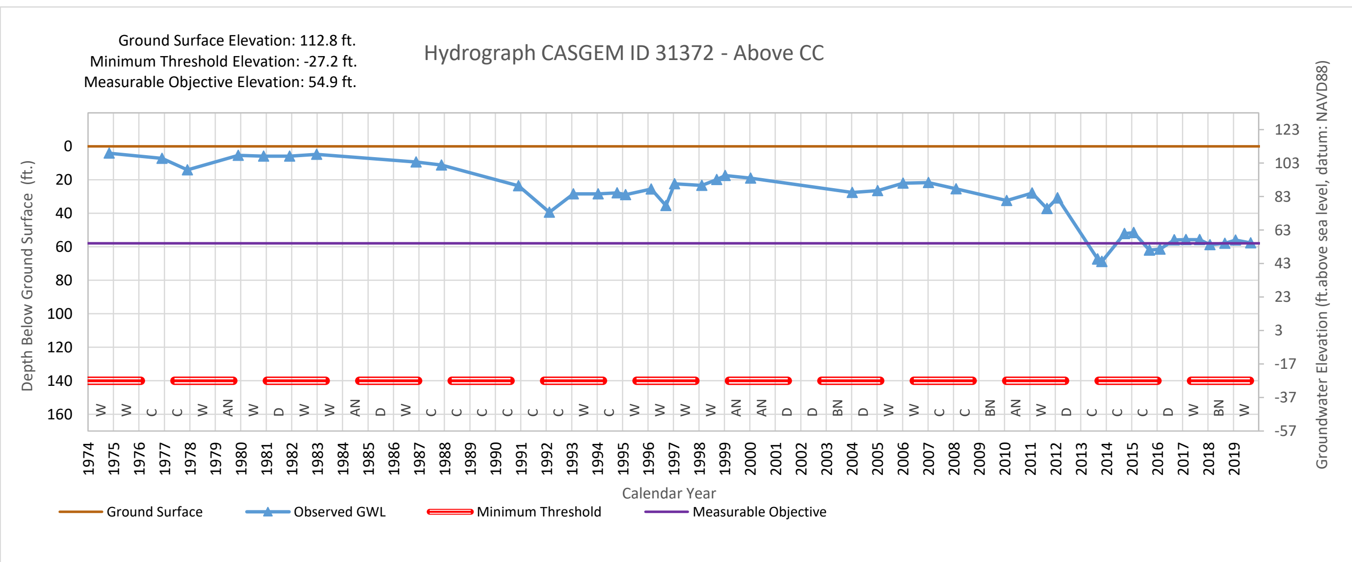

Ground Surface Elevation: 144.9 ft.
Minimum Threshold Elevation: 4.9 ft.
Measurable Objective Elevation: 41.5 ft.
Hydrograph CASGEM ID 8626 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective


Ground Surface Elevation: 167.5 ft.
Minimum Threshold Elevation: -27.5 ft.
Measurable Objective Elevation: 34.0 ft.
Hydrograph CASGEM ID 10051 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

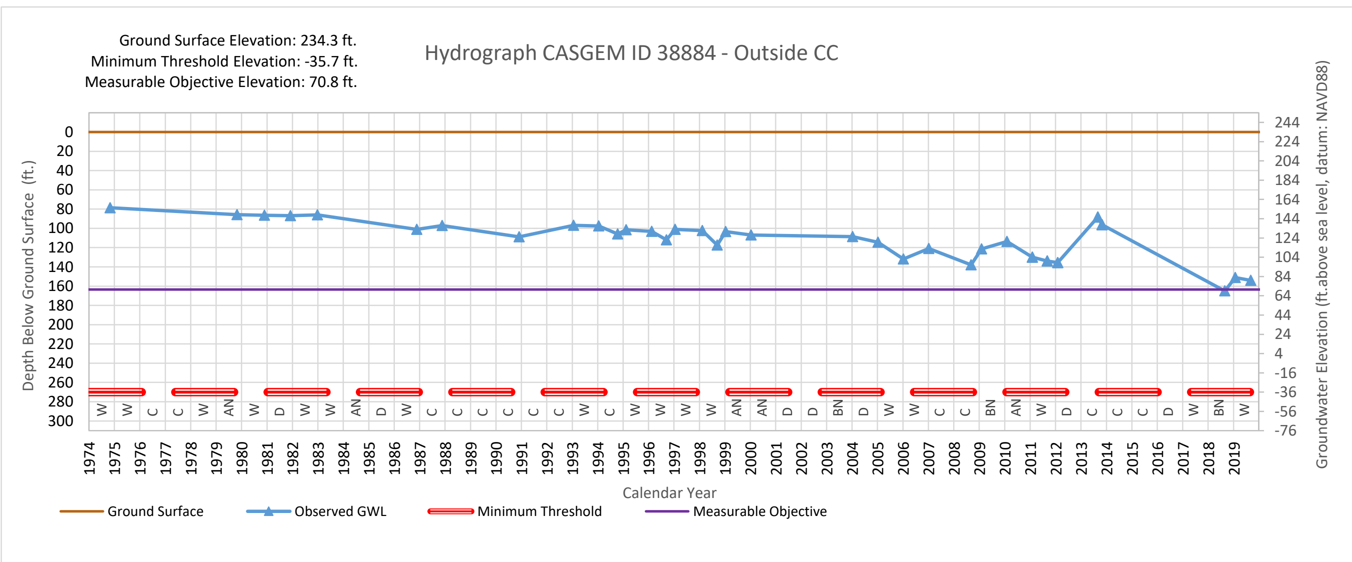


Ground Surface Elevation: 177.2 ft.
Minimum Threshold Elevation: -52.8 ft.
Measurable Objective Elevation: 5.5 ft.
Hydrograph CASGEM ID 10200 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

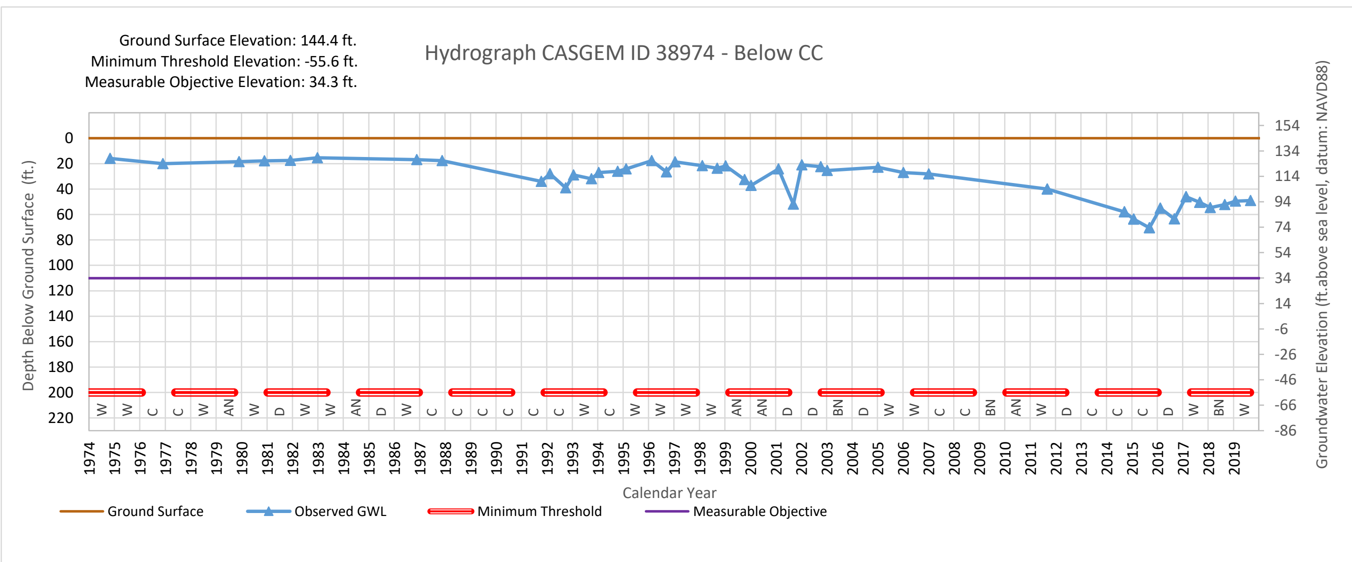

Ground Surface Elevation: 280 ft.
Minimum Threshold Elevation: -88.5 ft.
Measurable Objective Elevation: -51.9 ft.
Hydrograph CASGEM ID 28392 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



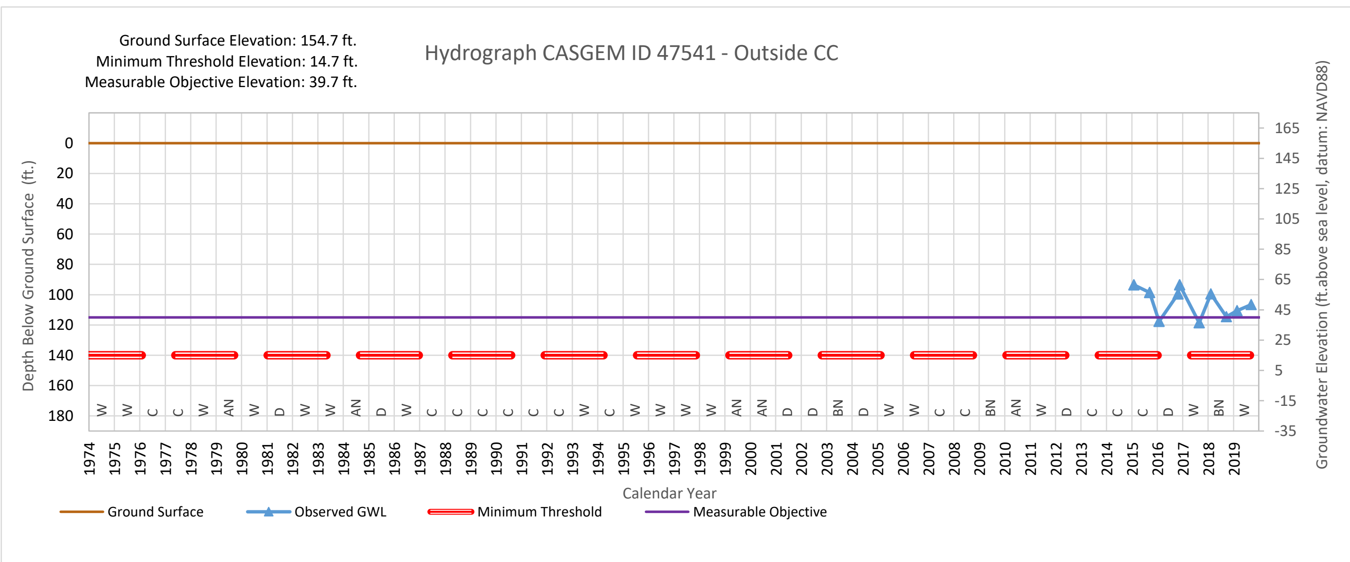
Ground Surface Elevation: 112.8 ft.
Minimum Threshold Elevation: -27.2 ft.
Measurable Objective Elevation: 54.9 ft.
Hydrograph CASGEM ID 31372 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



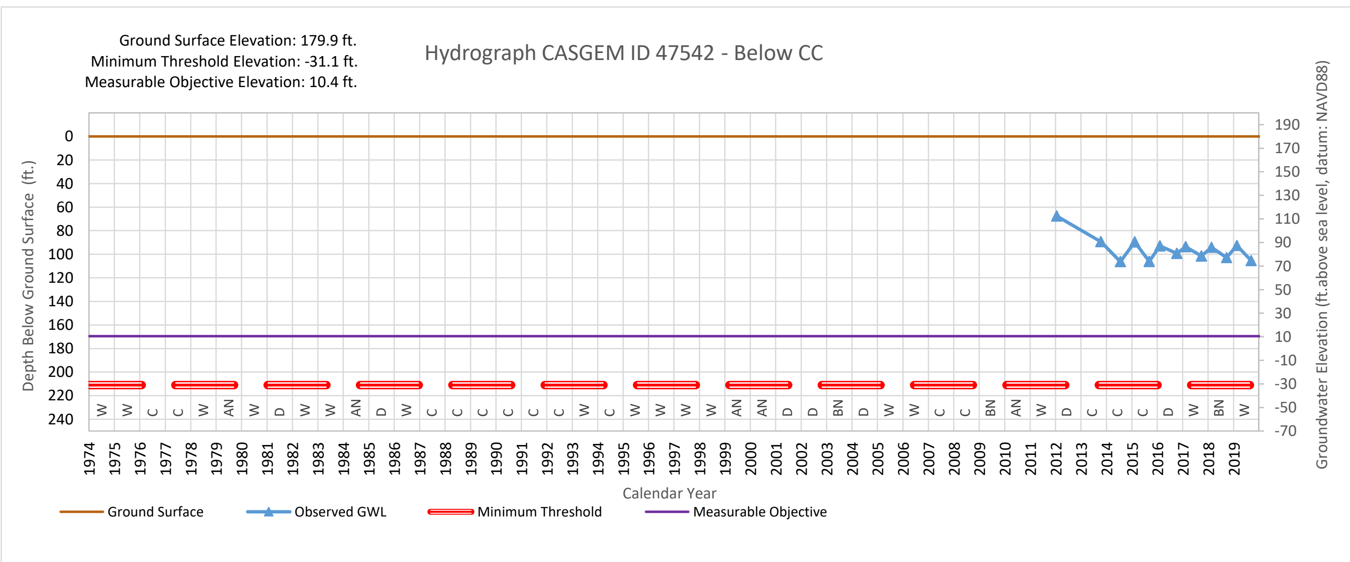
Ground Surface Elevation: 234.3 ft.
Minimum Threshold Elevation: -35.7 ft.
Measurable Objective Elevation: 70.8 ft.
Hydrograph CASGEM ID 38884 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

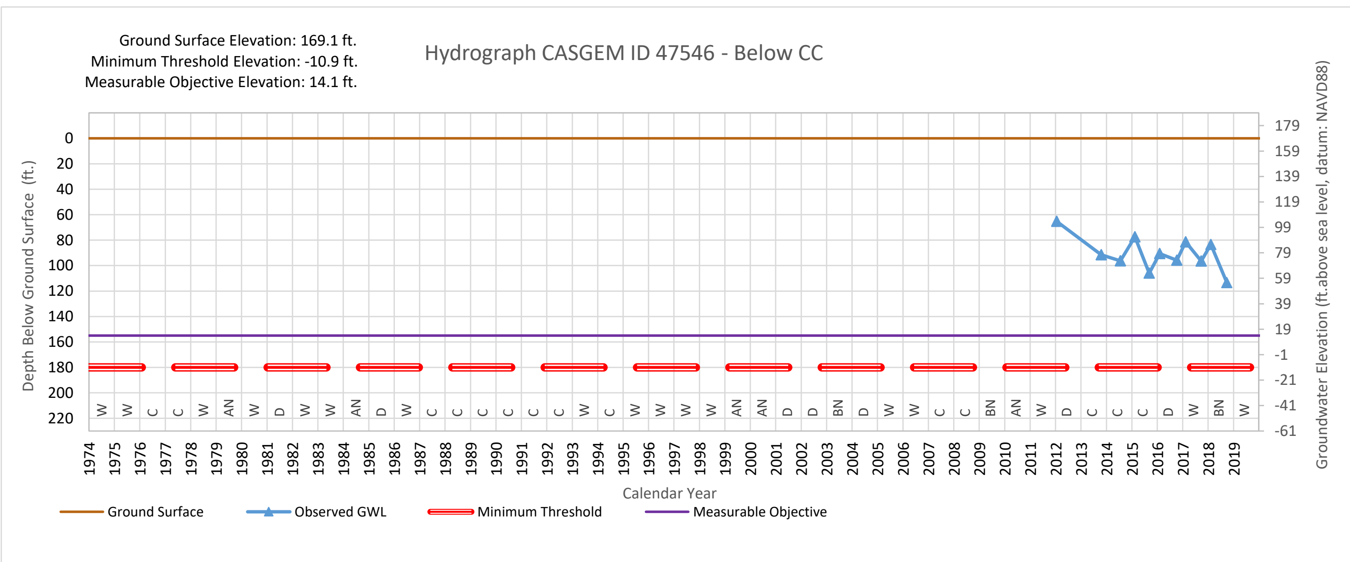


Ground Surface Elevation: 144.4 ft.
Minimum Threshold Elevation: -55.6 ft.
Measurable Objective Elevation: 34.3 ft.
Hydrograph CASGEM ID 38974 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

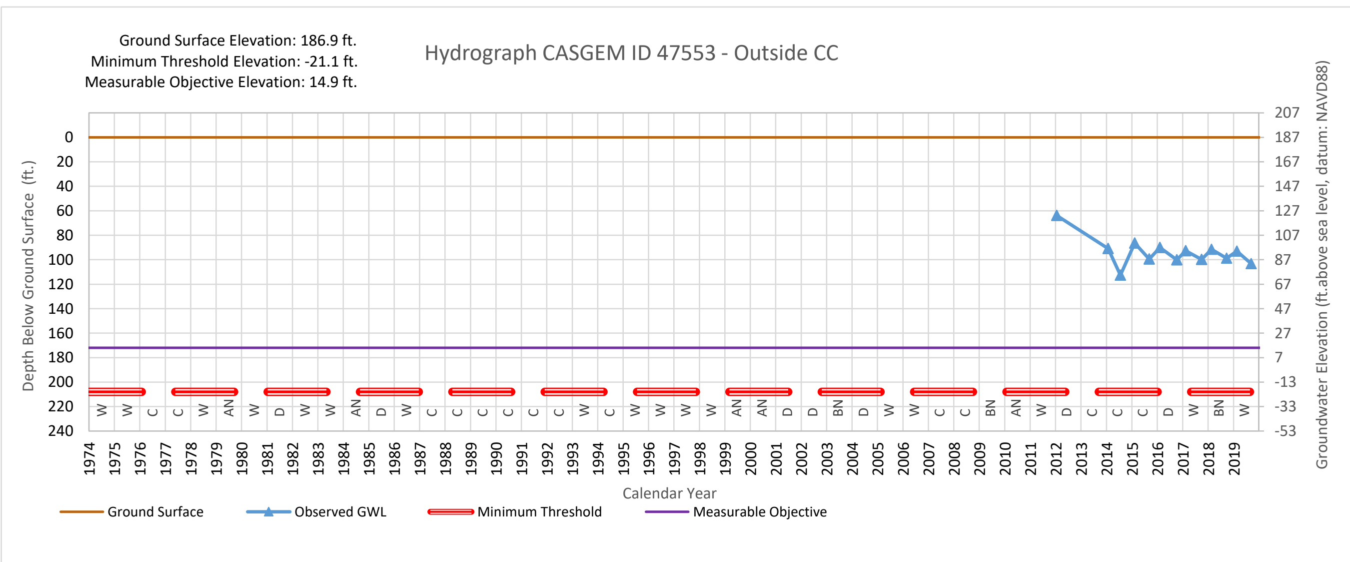


Ground Surface Elevation: 154.7 ft.
Minimum Threshold Elevation: 14.7 ft.
Measurable Objective Elevation: 39.7 ft.
Hydrograph CASGEM ID 47541 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

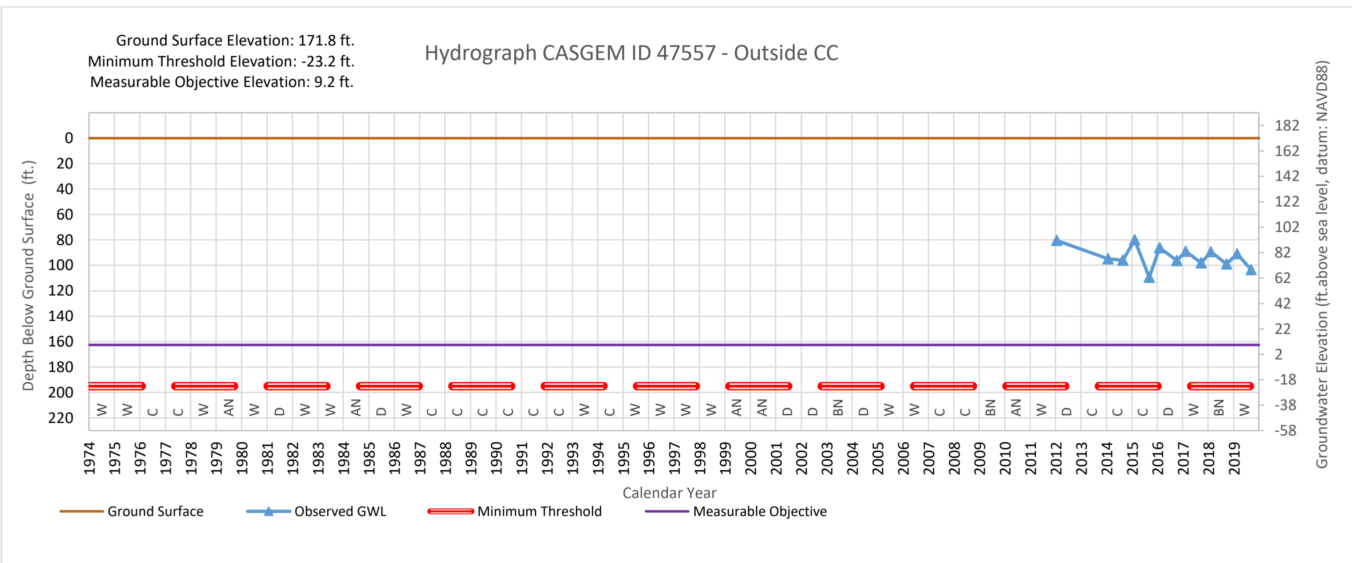

Ground Surface Elevation: 179.9 ft.
Minimum Threshold Elevation: -31.1 ft.
Measurable Objective Elevation: 10.4 ft.
Hydrograph CASGEM ID 47542 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



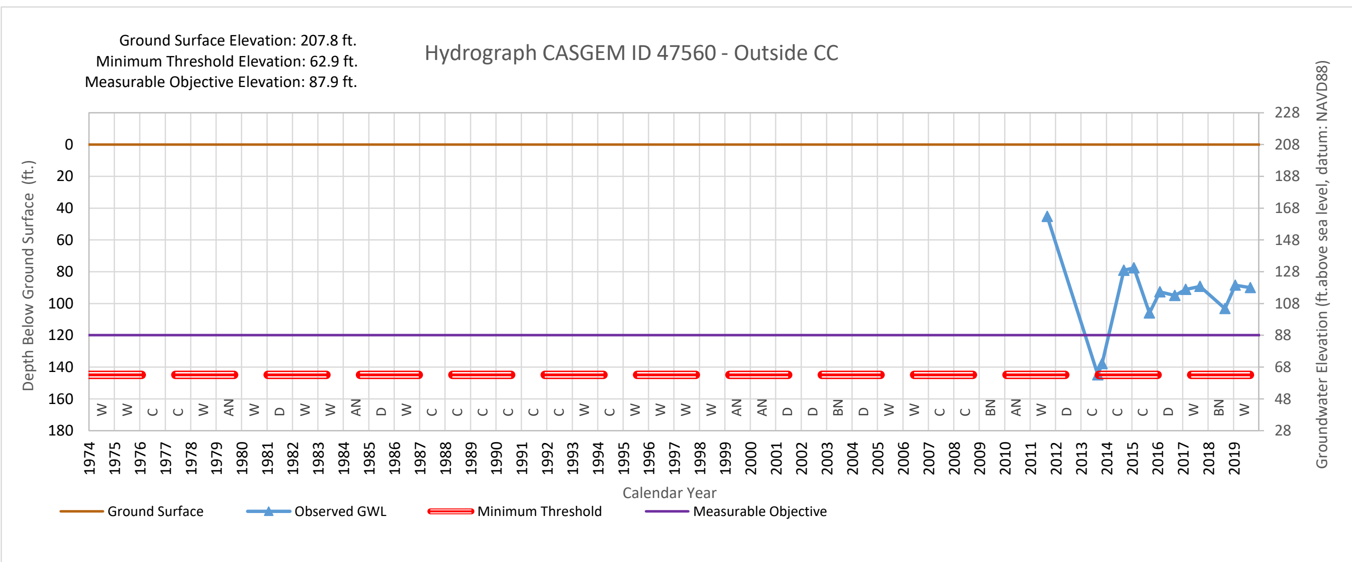
Ground Surface Elevation: 169.1 ft.
Minimum Threshold Elevation: -10.9 ft.
Measurable Objective Elevation: 14.1 ft.
Hydrograph CASGEM ID 47546 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
W W C C W AN W D W W AN D W C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



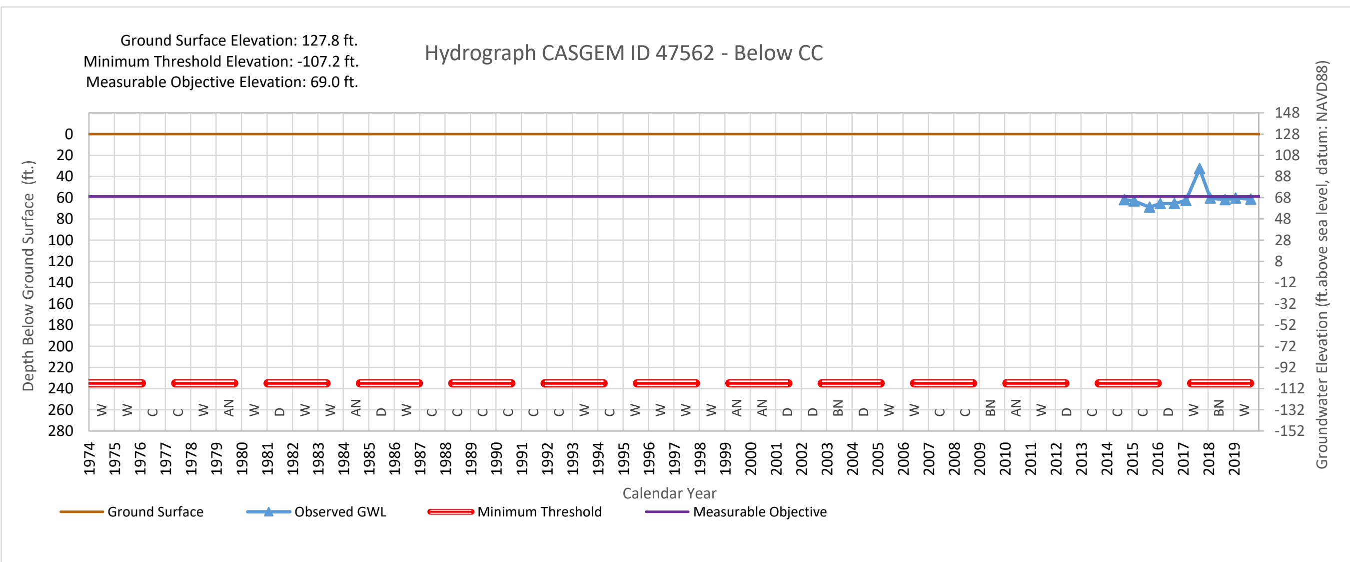
Ground Surface Elevation: 186.9 ft.
Minimum Threshold Elevation: -21.1 ft.
Measurable Objective Elevation: 14.9 ft.
Hydrograph CASGEM ID 47553 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

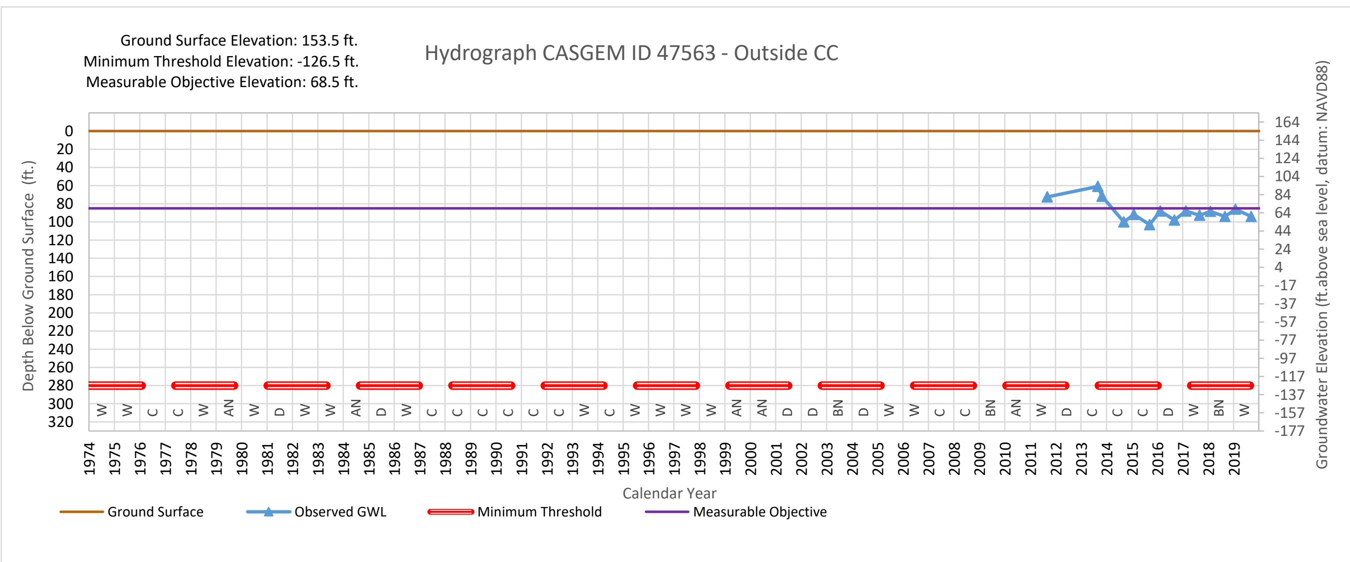


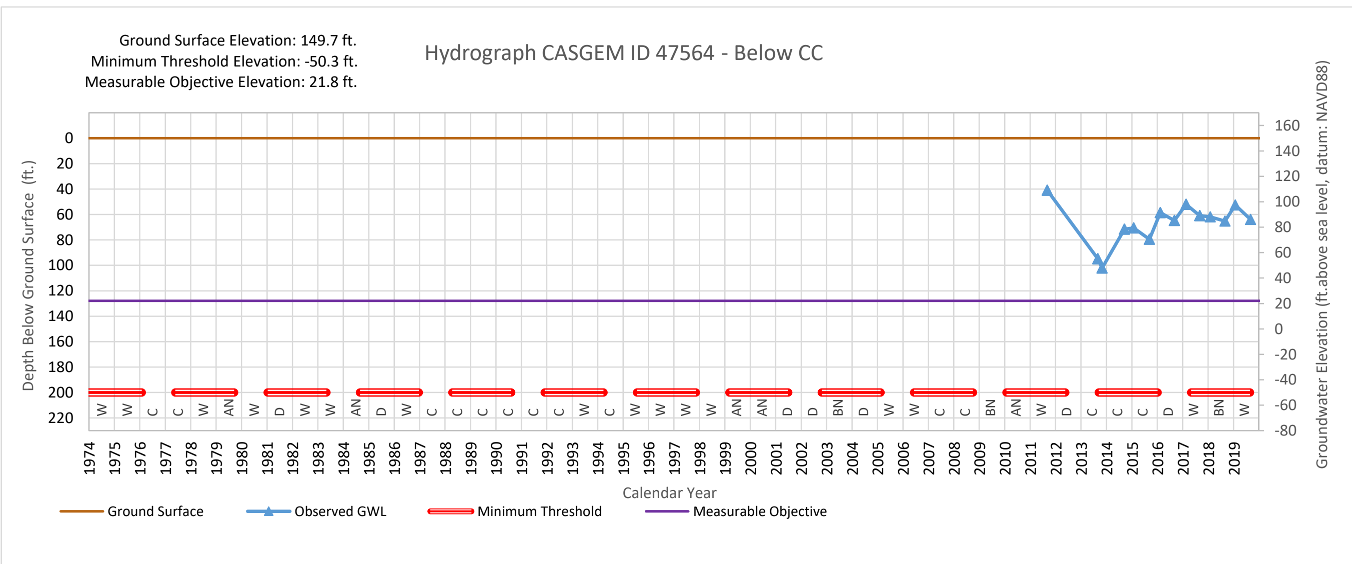
Ground Surface Elevation: 171.8 ft.
Minimum Threshold Elevation: -23.2 ft.
Measurable Objective Elevation: 9.2 ft.
Hydrograph CASGEM ID 47557 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



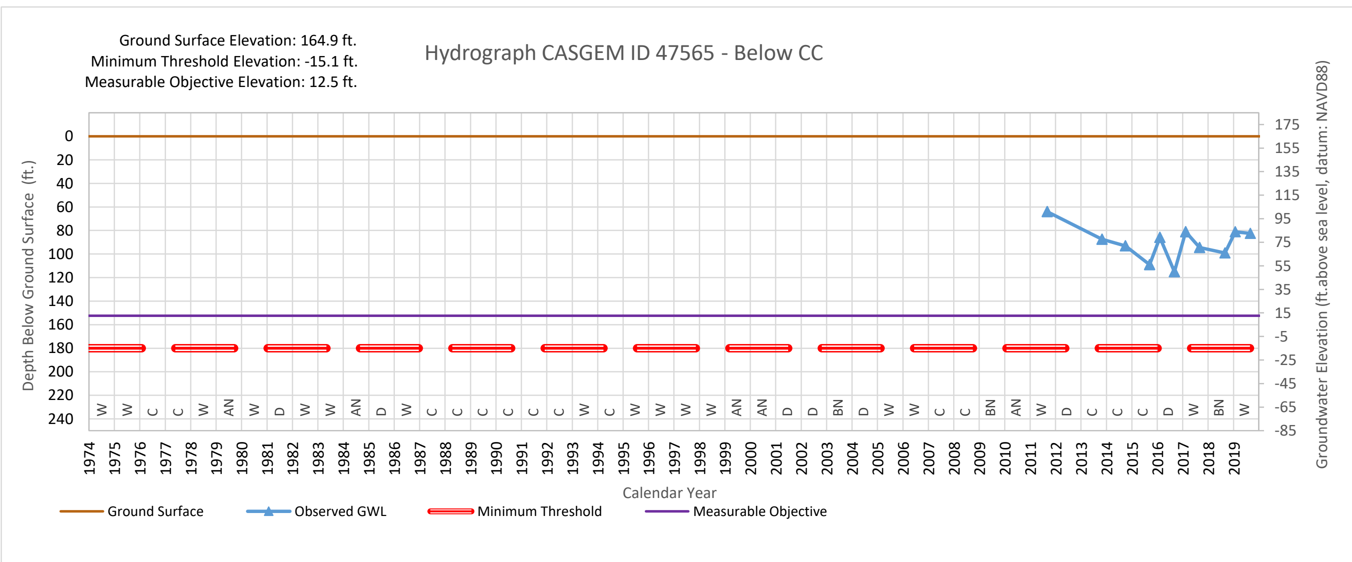
Ground Surface Elevation: 207.8 ft.
Minimum Threshold Elevation: 62.9 ft.
Measurable Objective Elevation: 87.9 ft.
Hydrograph CASGEM ID 47560 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective


Ground Surface Elevation: 127.8 ft.
Minimum Threshold Elevation: -107.2 ft.
Measurable Objective Elevation: 69.0 ft.
Hydrograph CASGEM ID 47562 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

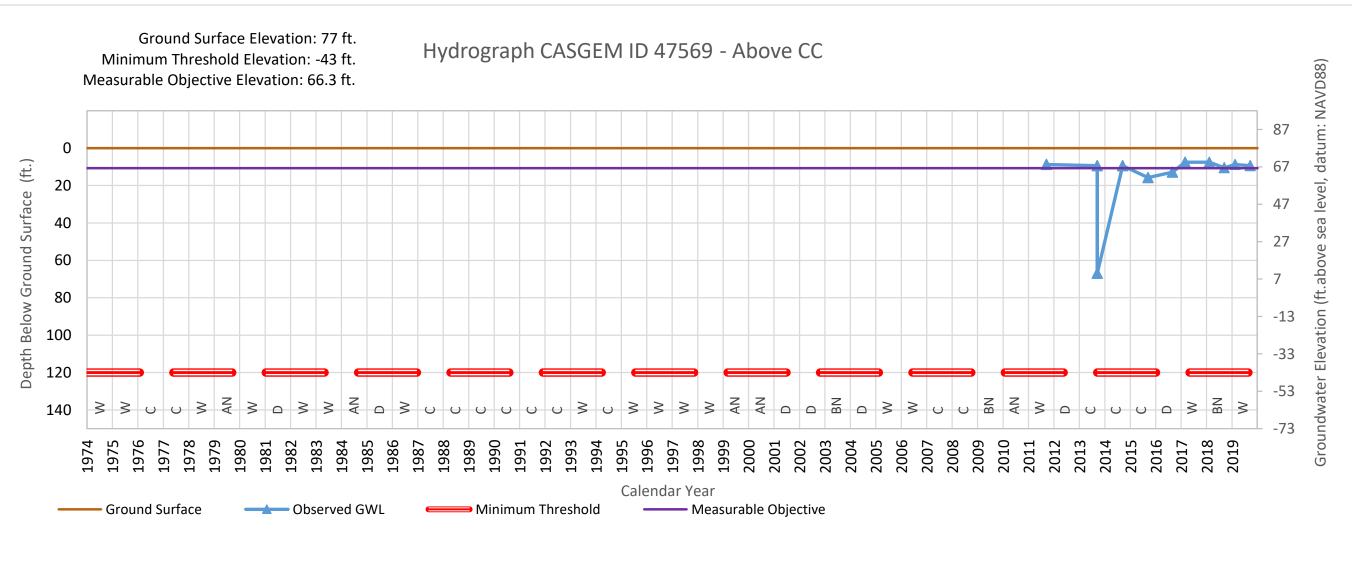

Ground Surface Elevation: 153.5 ft.
Minimum Threshold Elevation: -126.5 ft.
Measurable Objective Elevation: 68.5 ft.
Hydrograph CASGEM ID 47563 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



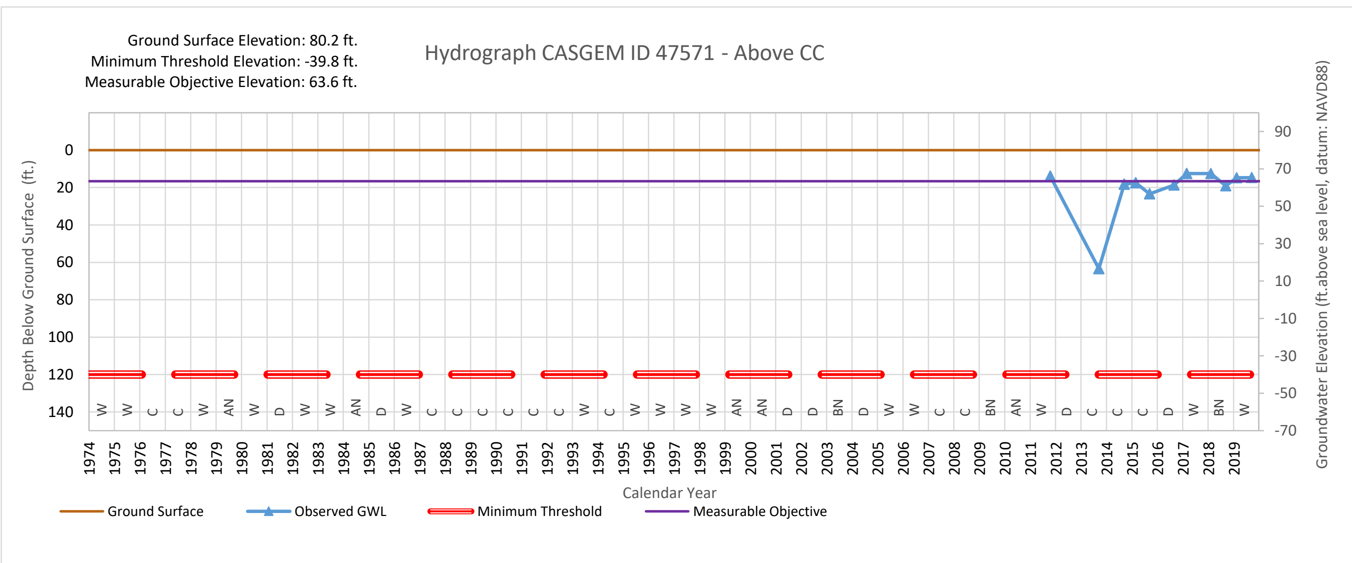
Ground Surface Elevation: 149.7 ft.
Minimum Threshold Elevation: -50.3 ft.
Measurable Objective Elevation: 21.8 ft.
Hydrograph CASGEM ID 47564 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



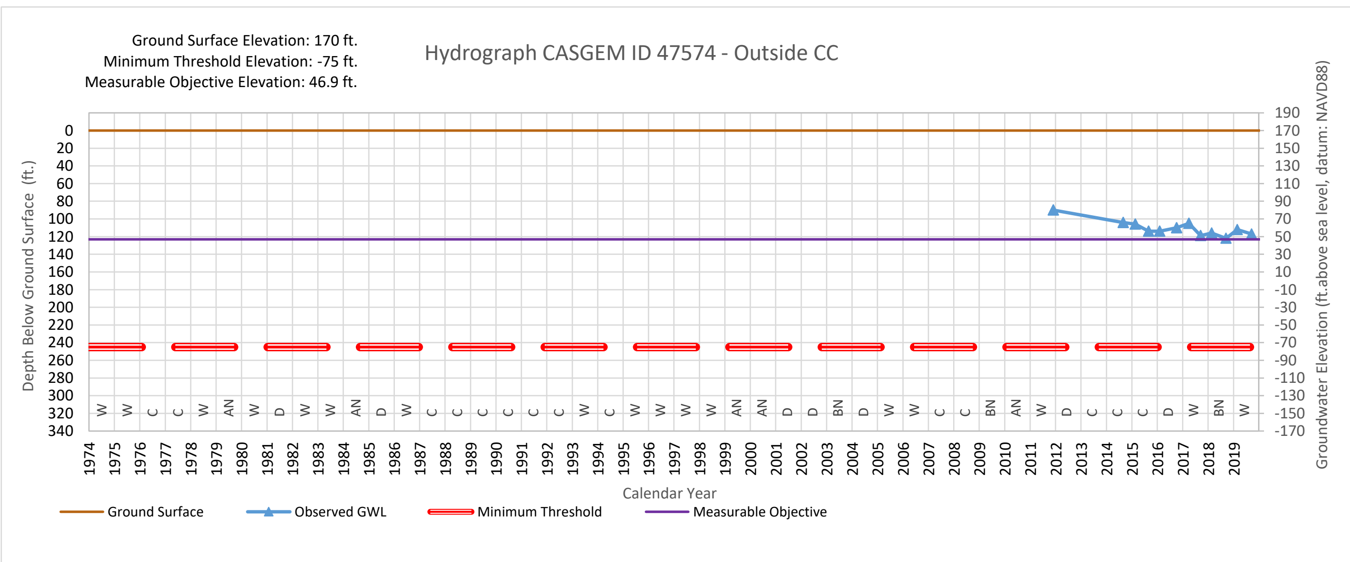
Ground Surface Elevation: 164.9 ft.
Minimum Threshold Elevation: -15.1 ft.
Measurable Objective Elevation: 12.5 ft.
Hydrograph CASGEM ID 47565 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



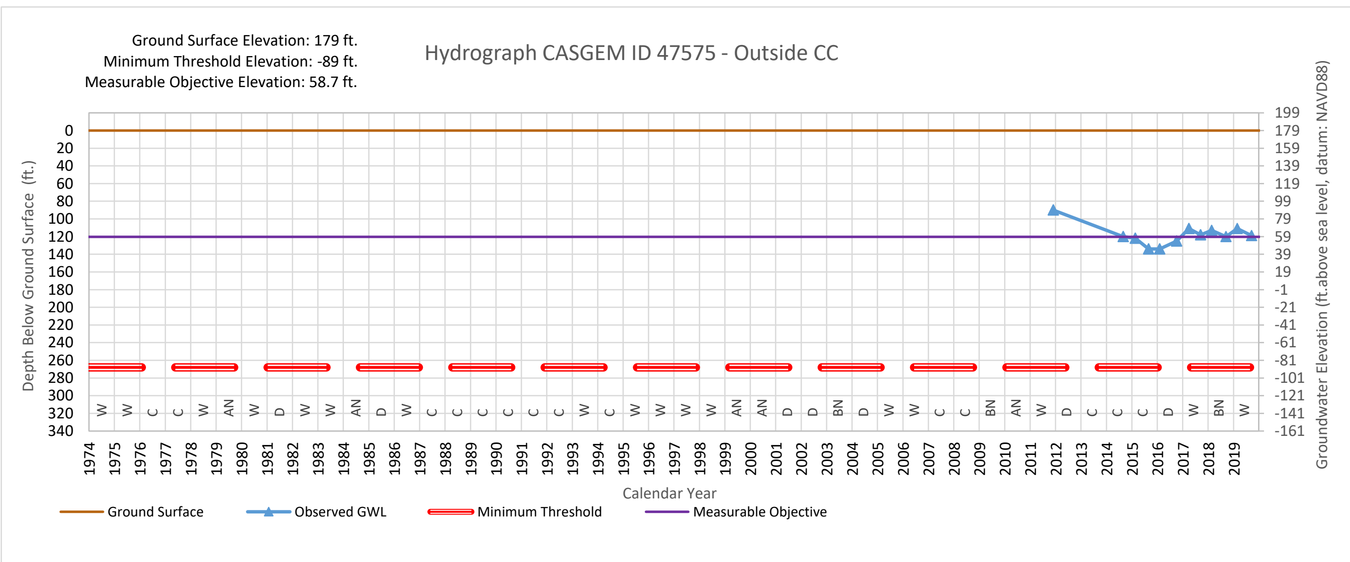
Ground Surface Elevation: 77 ft.
Minimum Threshold Elevation: -43 ft.
Measurable Objective Elevation: 66.3 ft.
Hydrograph CASGEM ID 47569 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



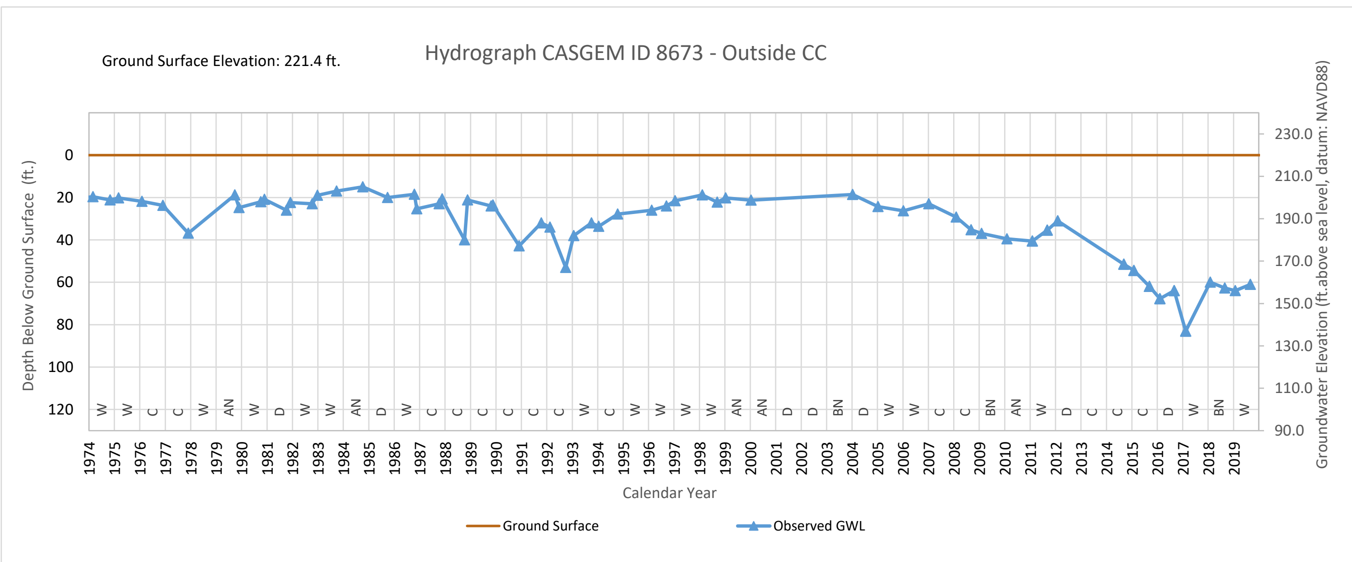
Ground Surface Elevation: 80.2 ft.
Minimum Threshold Elevation: -39.8 ft.
Measurable Objective Elevation: 63.6 ft.
Hydrograph CASGEM ID 47571 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



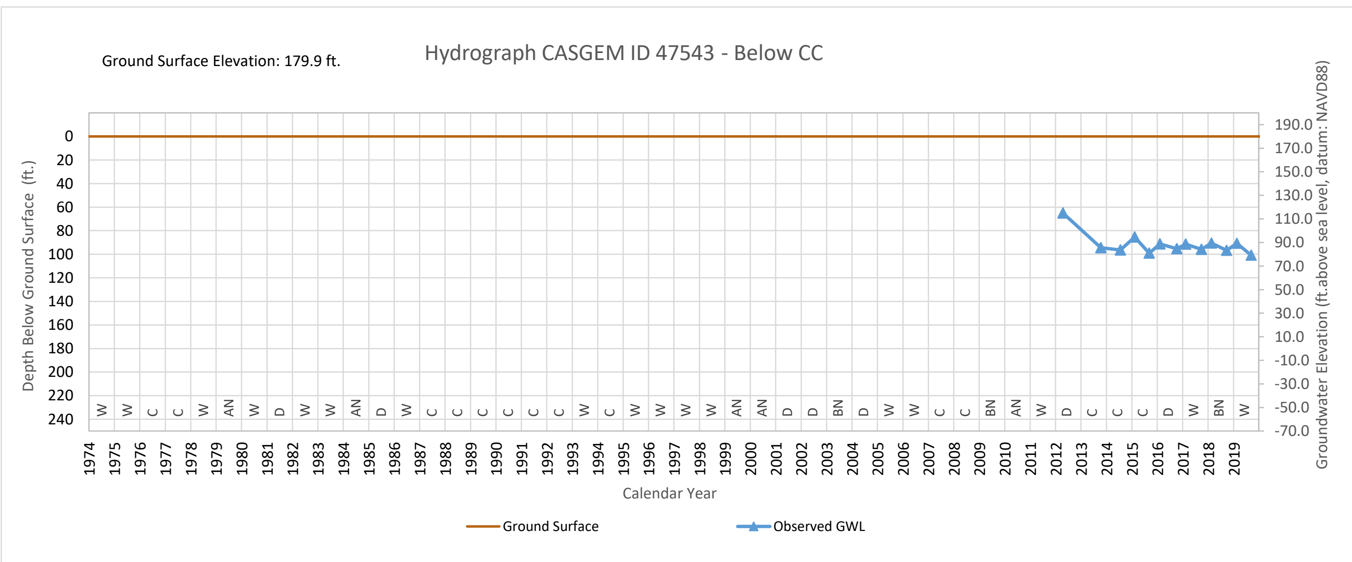
Ground Surface Elevation: 170 ft.
Minimum Threshold Elevation: -75 ft.
Measurable Objective Elevation: 46.9 ft.
Hydrograph CASGEM ID 47574 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective

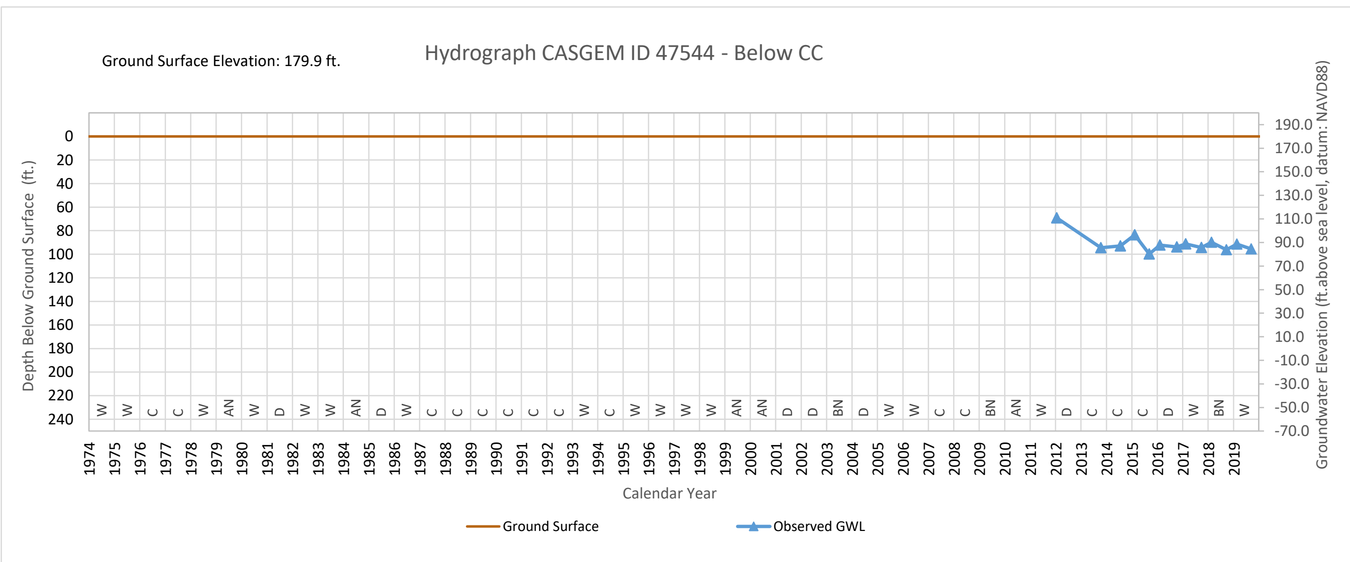


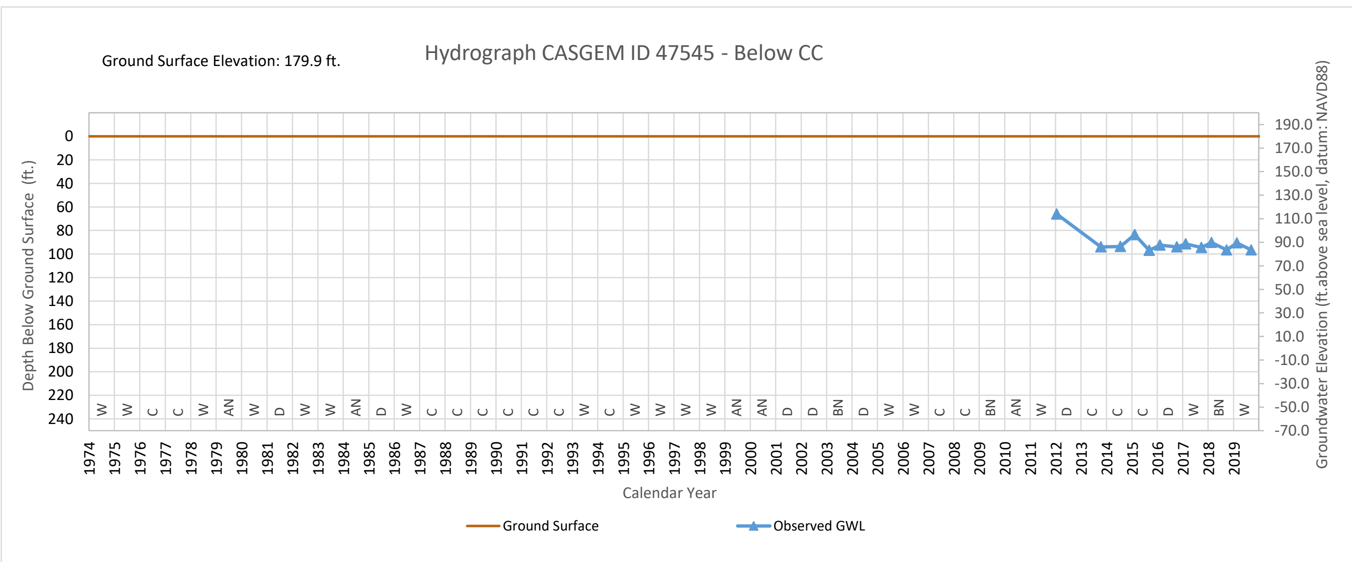
Ground Surface Elevation: 179 ft.
Minimum Threshold Elevation: -89 ft.
Measurable Objective Elevation: 58.7 ft.
Hydrograph CASGEM ID 47575 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective



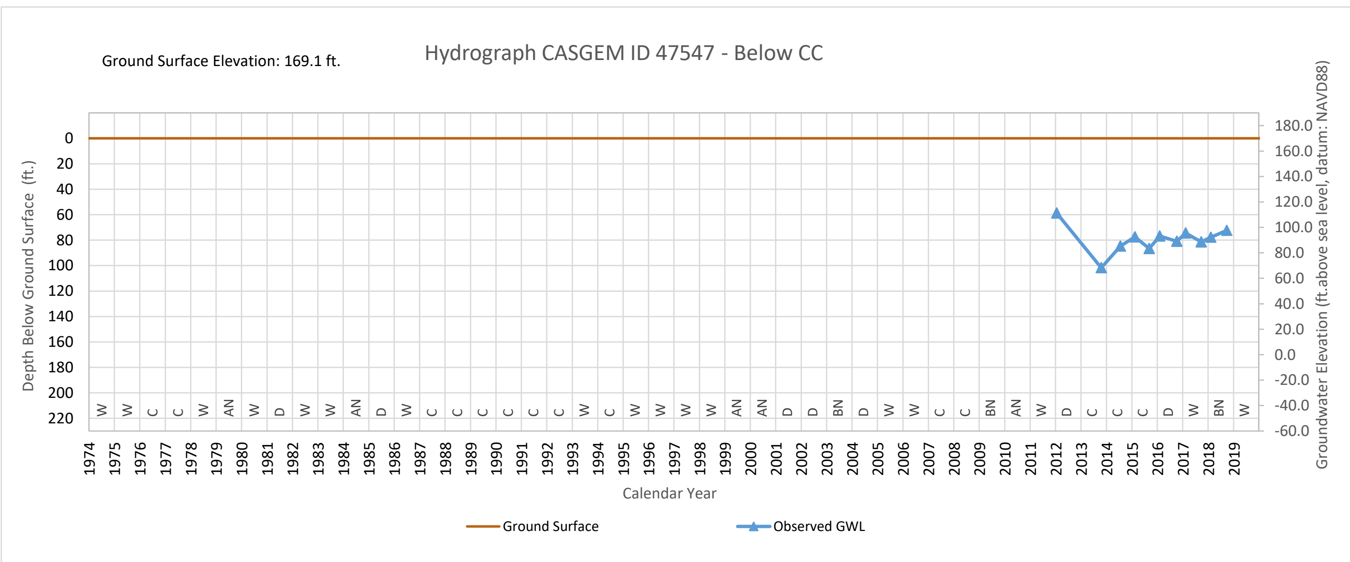
Ground Surface Elevation: 221.4 ft.
Hydrograph CASGEM ID 8673 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL


Ground Surface Elevation: 179.9 ft.
Hydrograph CASGEM ID 47543 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL

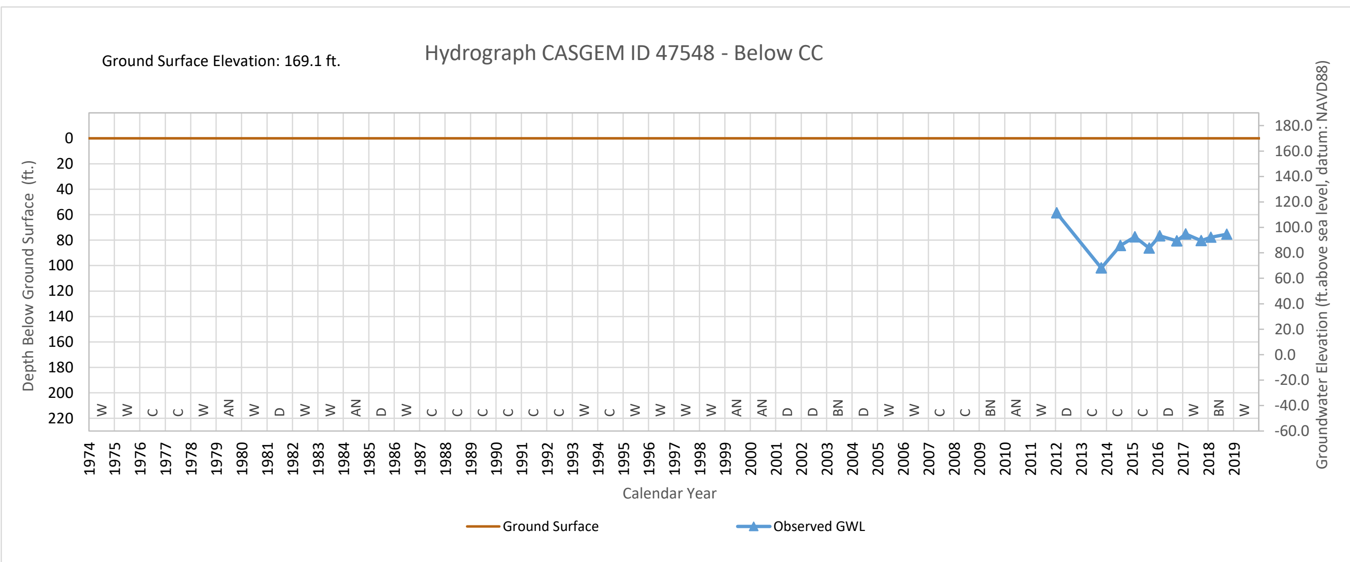

Ground Surface Elevation: 179.9 ft.
Hydrograph CASGEM ID 47544 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL



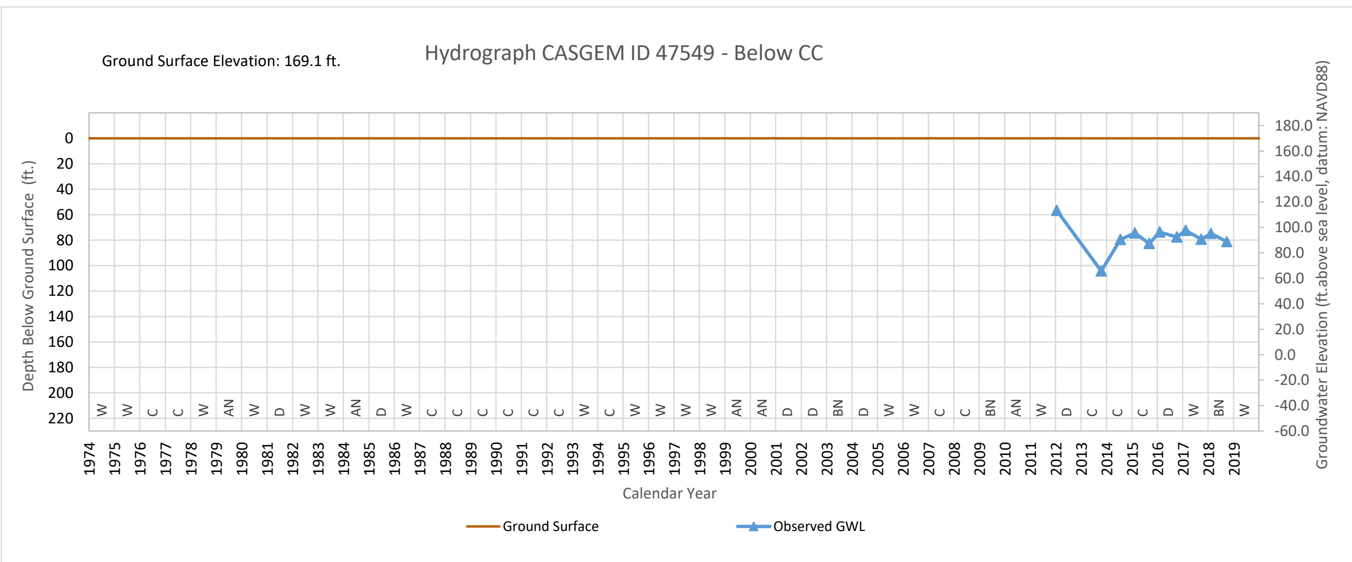
Ground Surface Elevation: 179.9 ft.
Hydrograph CASGEM ID 47545 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL

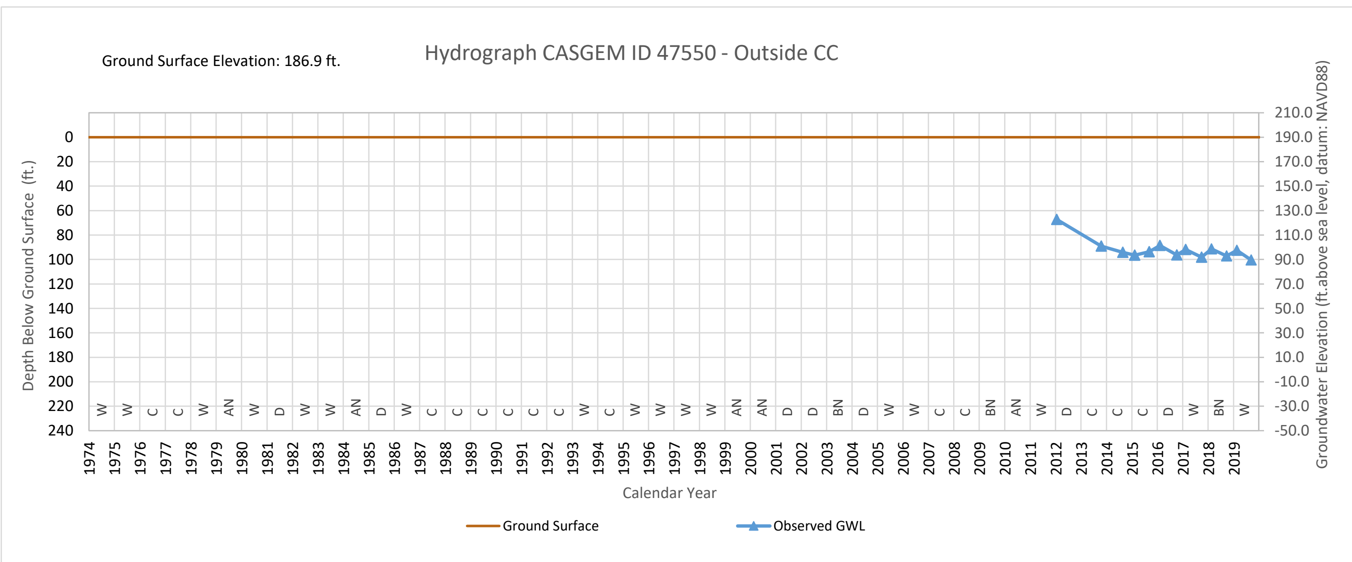


Ground Surface Elevation: 169.1 ft.
Hydrograph CASGEM ID 47547 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
W W C C W AN W D W W AN D W C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W
Ground Surface
Observed GWL

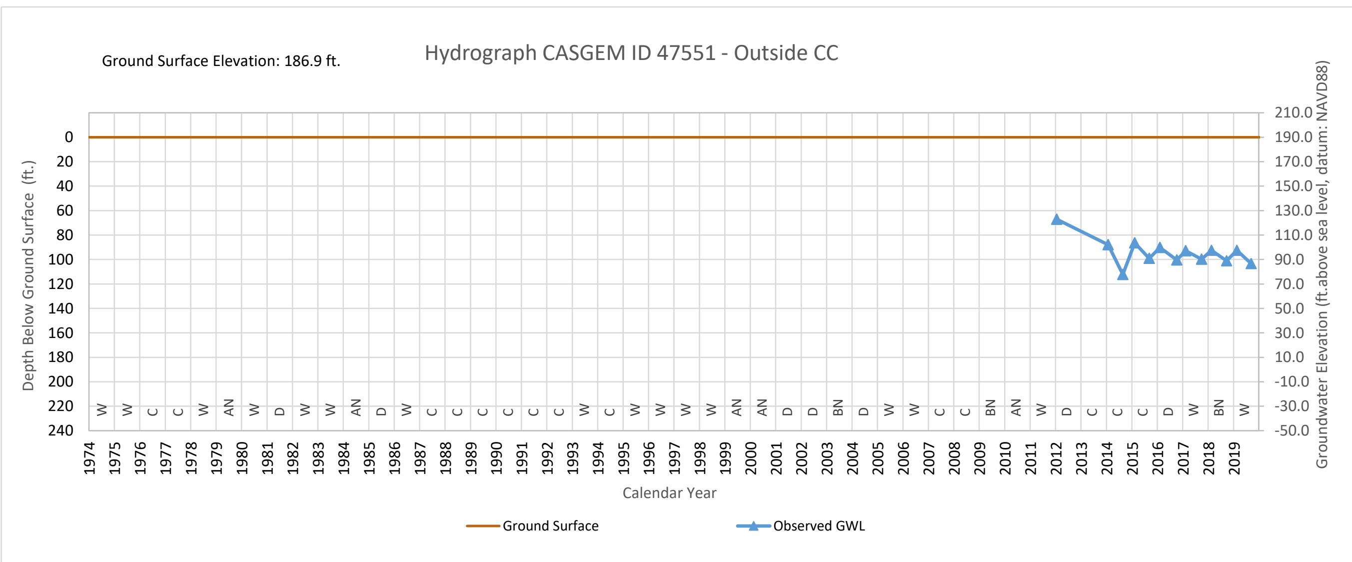


Ground Surface Elevation: 169.1 ft.
Hydrograph CASGEM ID 47548 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
W W C C W AN W D W W AN D W C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W
Ground Surface
Observed GWL

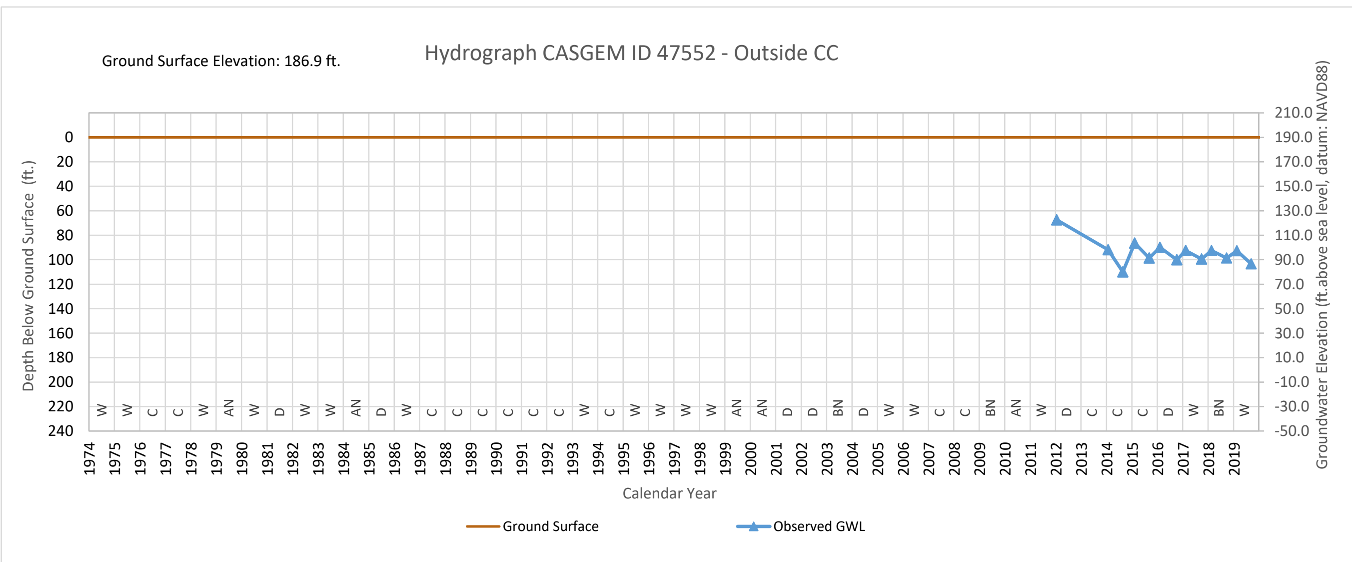

Ground Surface Elevation: 169.1 ft.
Hydrograph CASGEM ID 47549 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL



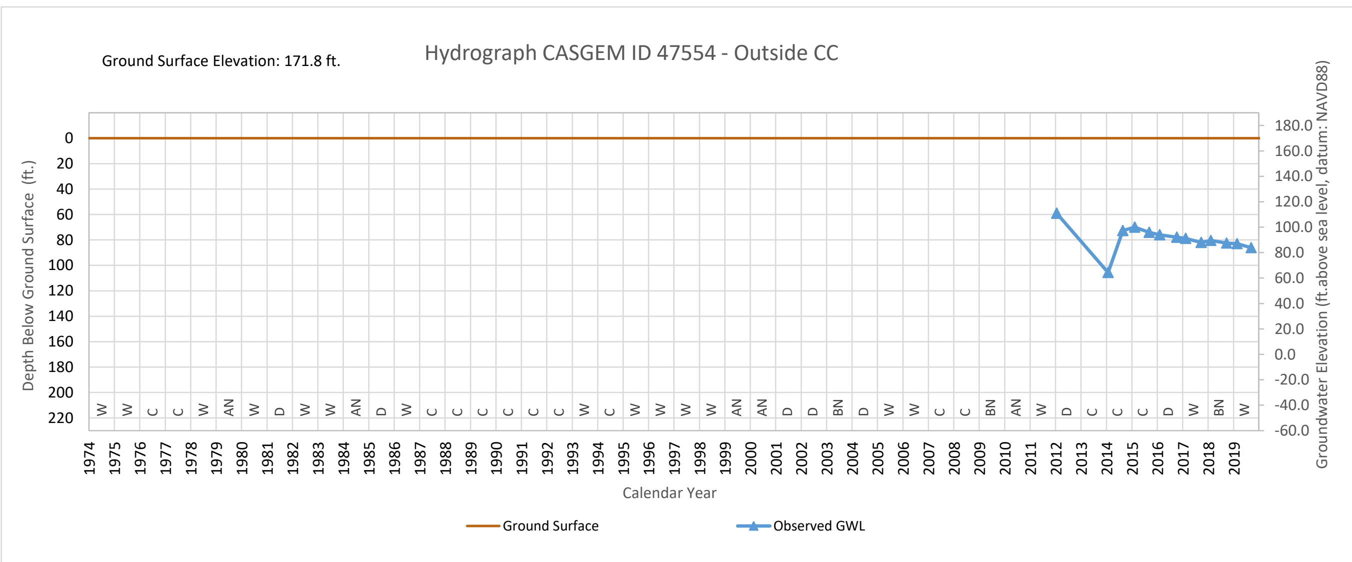
Ground Surface Elevation: 186.9 ft.
Hydrograph CASGEM ID 47550 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL



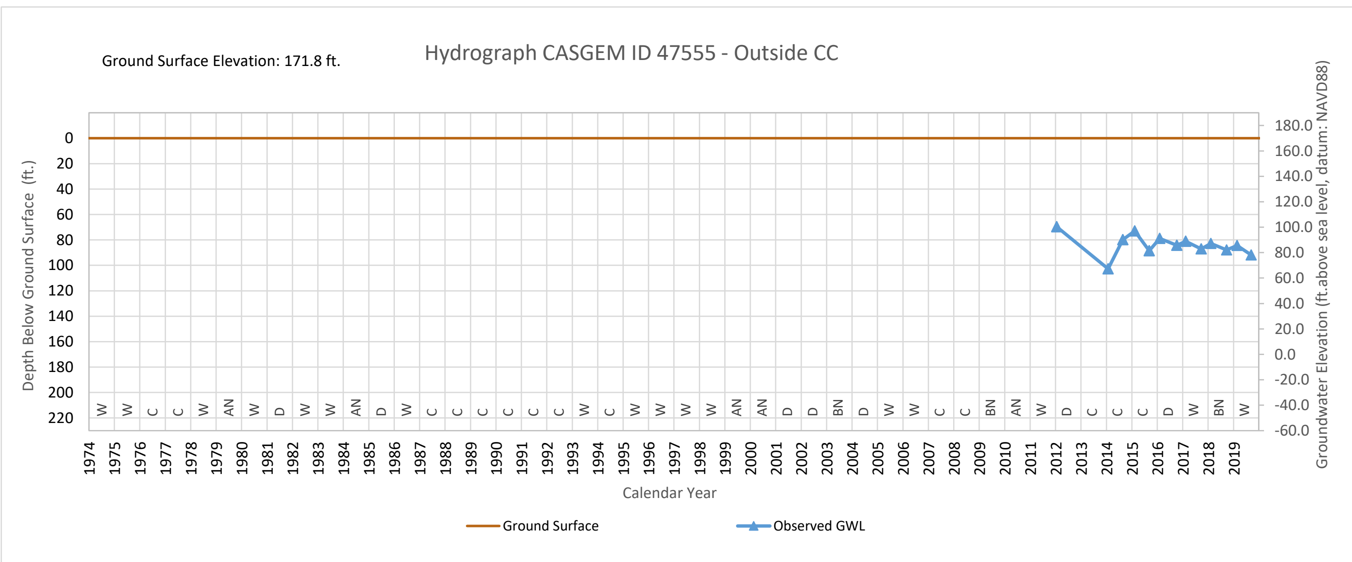
Ground Surface Elevation: 186.9 ft.
Hydrograph CASGEM ID 47551 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL

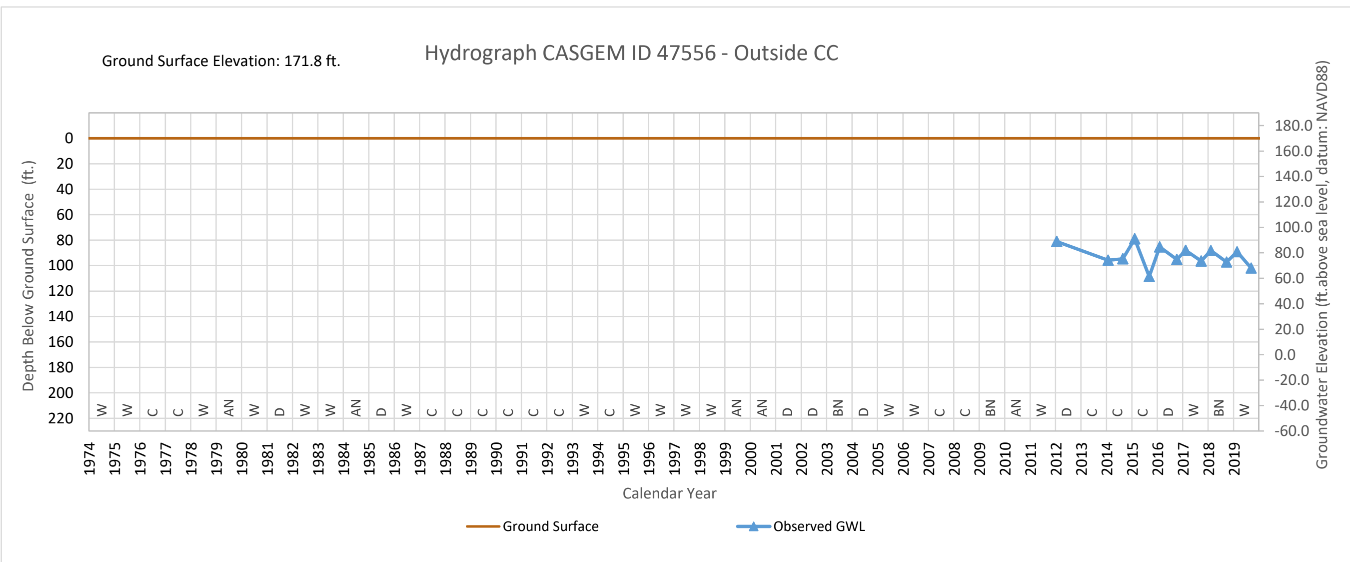


Ground Surface Elevation: 186.9 ft.
Hydrograph CASGEM ID 47552 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL

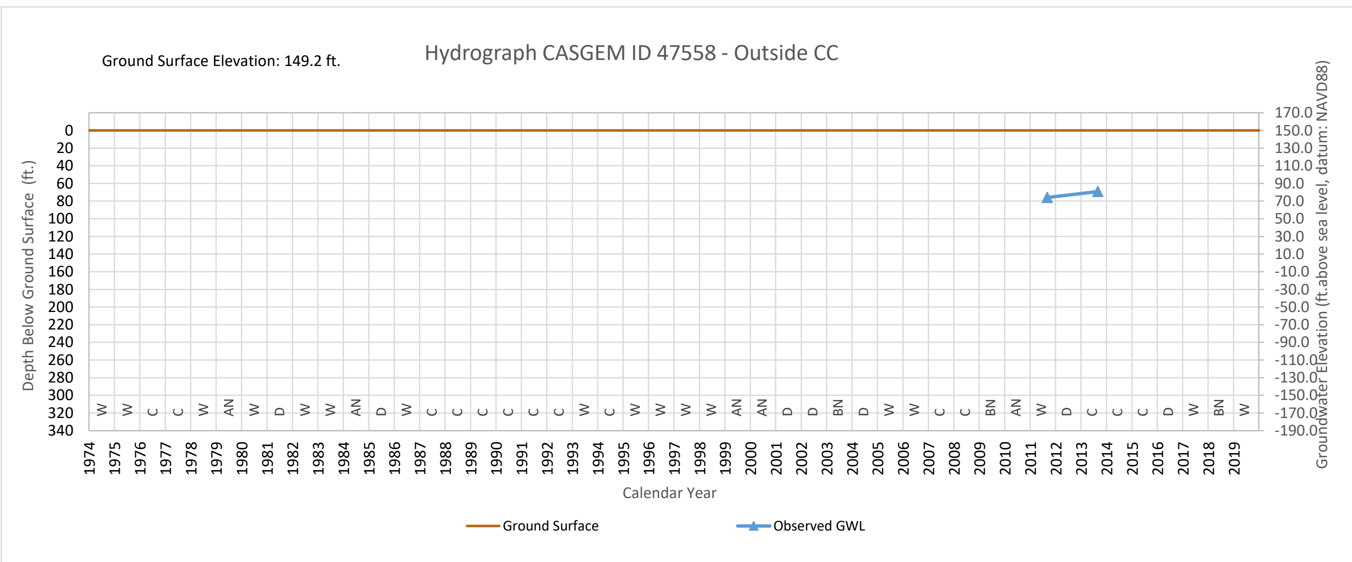


Ground Surface Elevation: 171.8 ft.
Hydrograph CASGEM ID 47554 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL

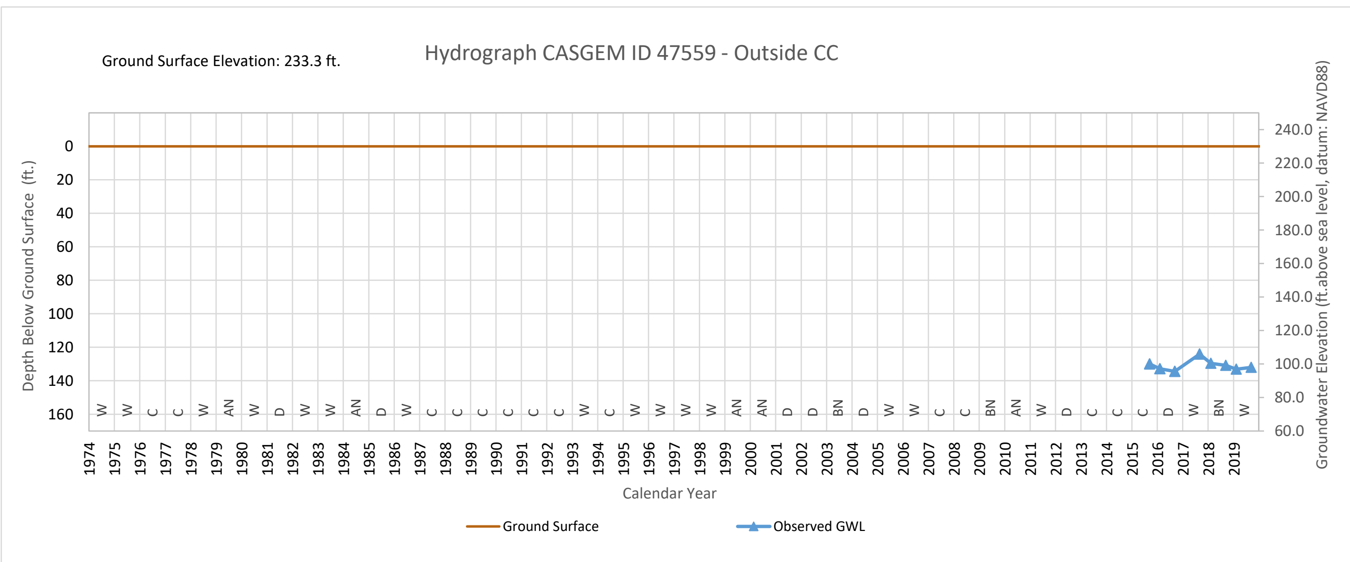

Ground Surface Elevation: 171.8 ft.
Hydrograph CASGEM ID 47555 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL



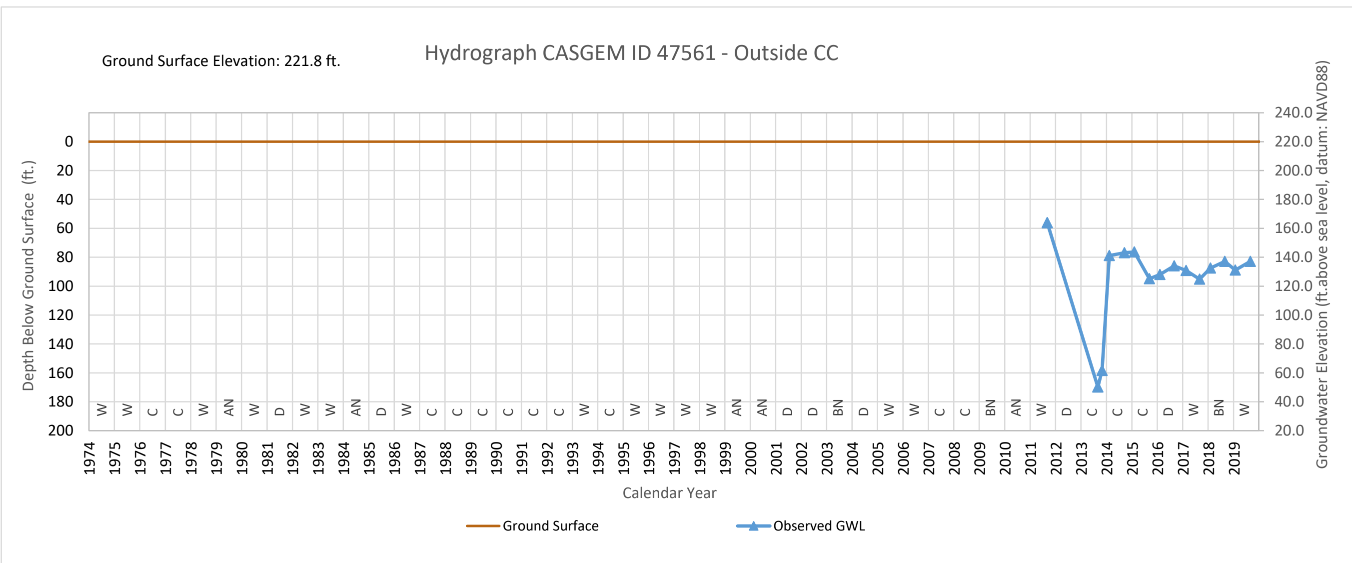
Ground Surface Elevation: 171.8 ft.
Hydrograph CASGEM ID 47556 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL



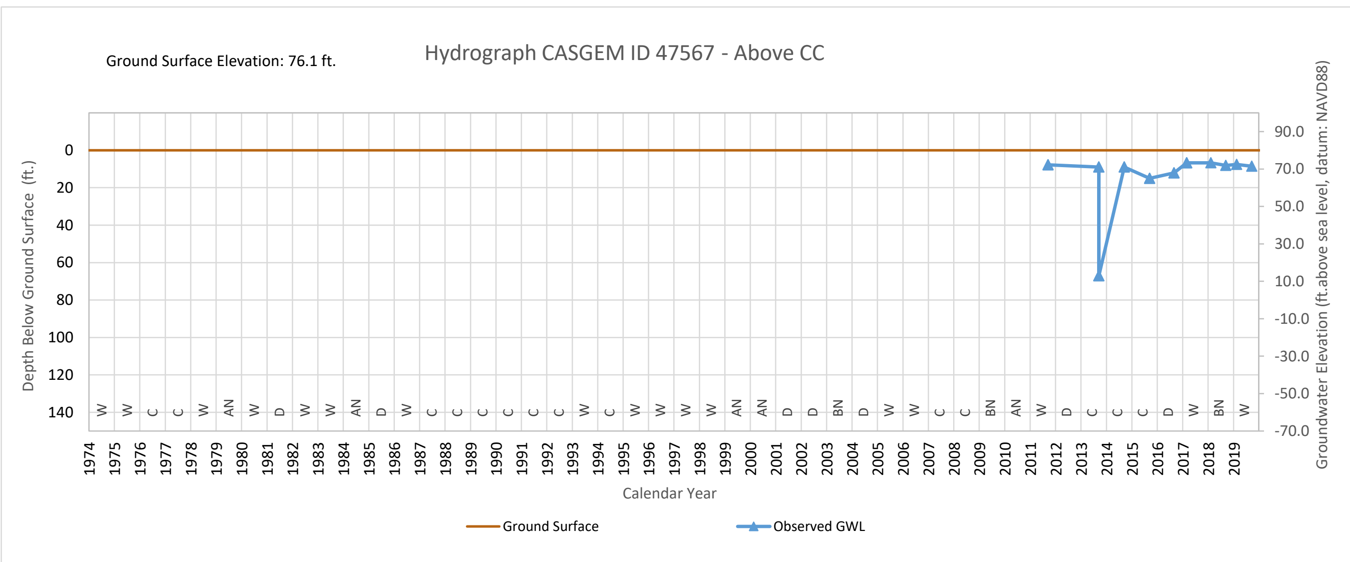
Ground Surface Elevation: 149.2 ft.
Hydrograph CASGEM ID 47558 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
W W C C W AN W D W W AN D W C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W
Ground Surface
Observed GWL



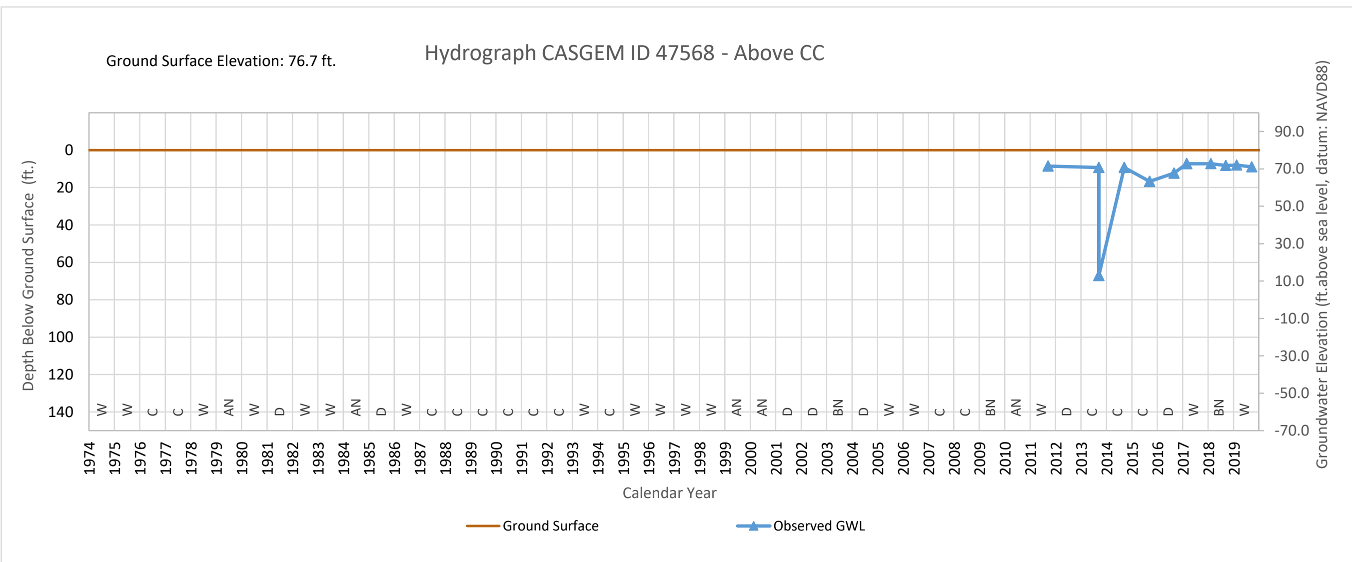
Ground Surface Elevation: 233.3 ft.
Hydrograph CASGEM ID 47559 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL



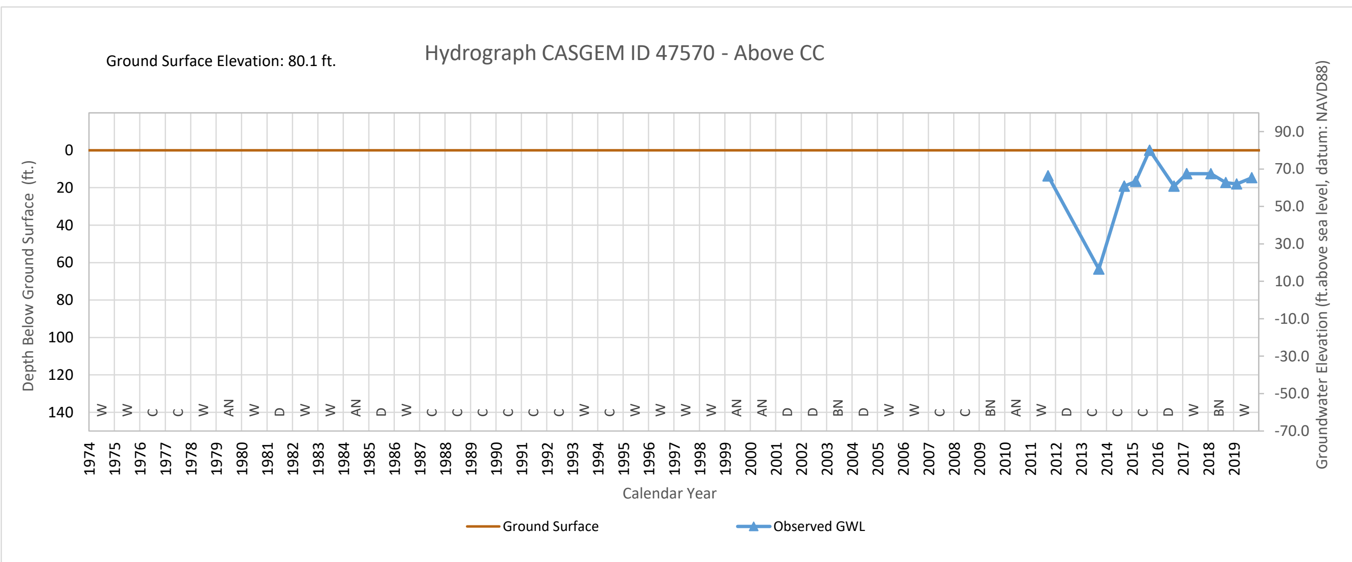
Ground Surface Elevation: 221.8 ft.
Hydrograph CASGEM ID 47561 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
W W C C W AN W D W W AN D W C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W
Ground Surface
Observed GWL



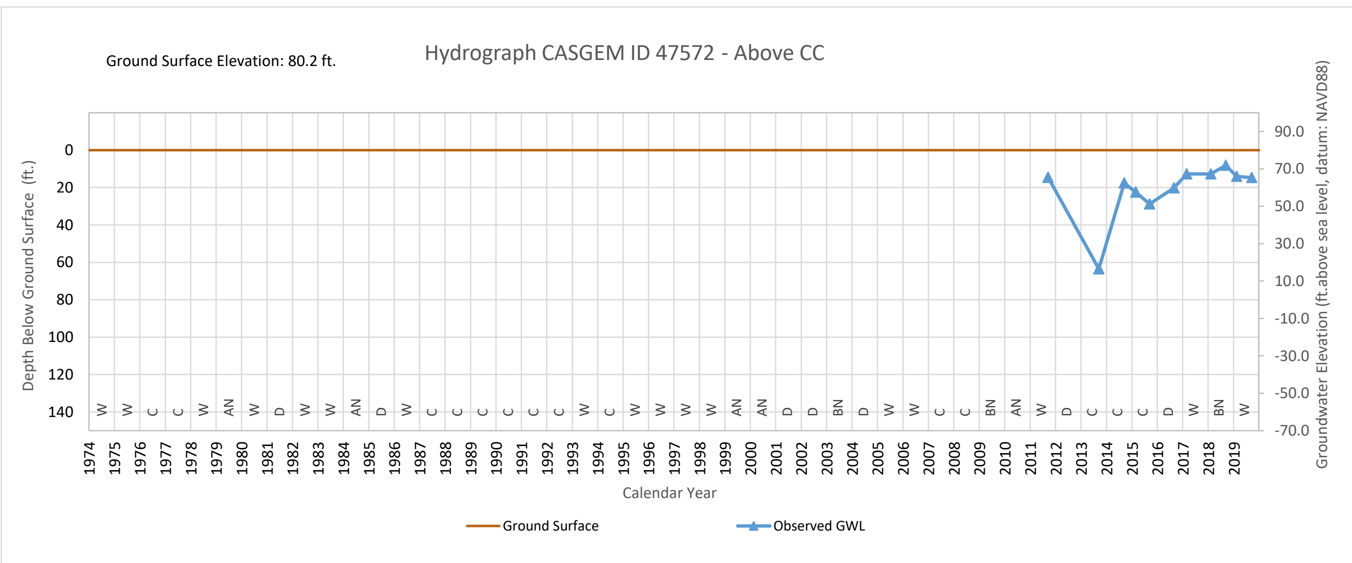
Ground Surface Elevation: 76.1 ft.
Hydrograph CASGEM ID 47567 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL

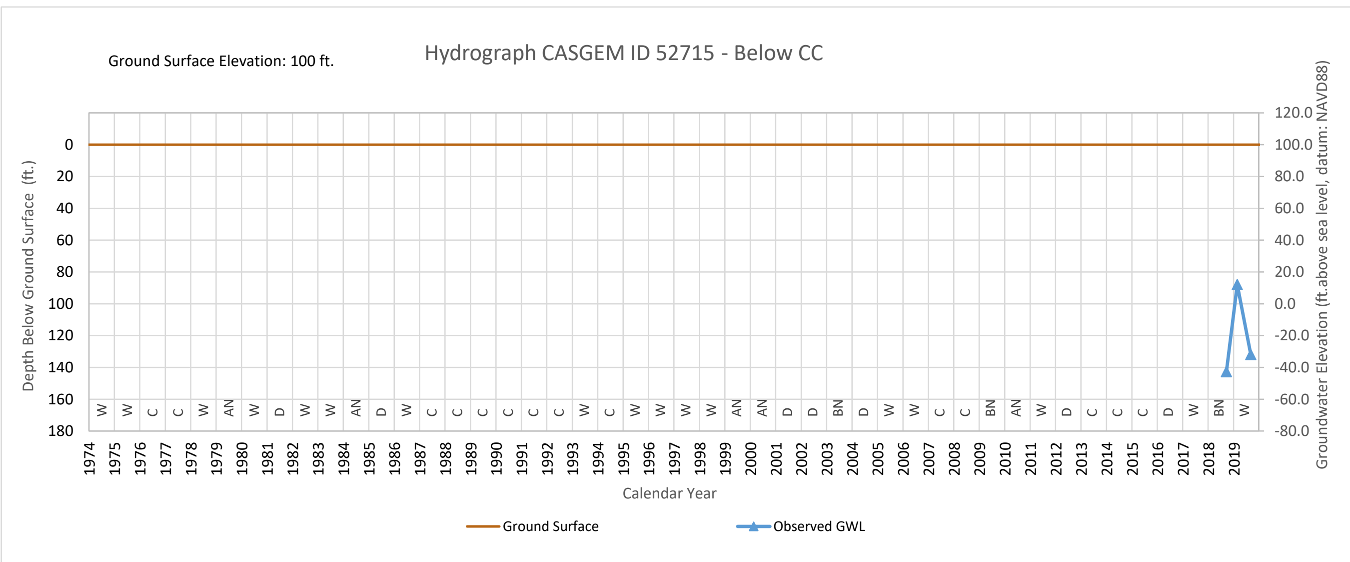


Ground Surface Elevation: 76.7 ft.
Hydrograph CASGEM ID 47568 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
W W C C W AN W D W W AN D W C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W

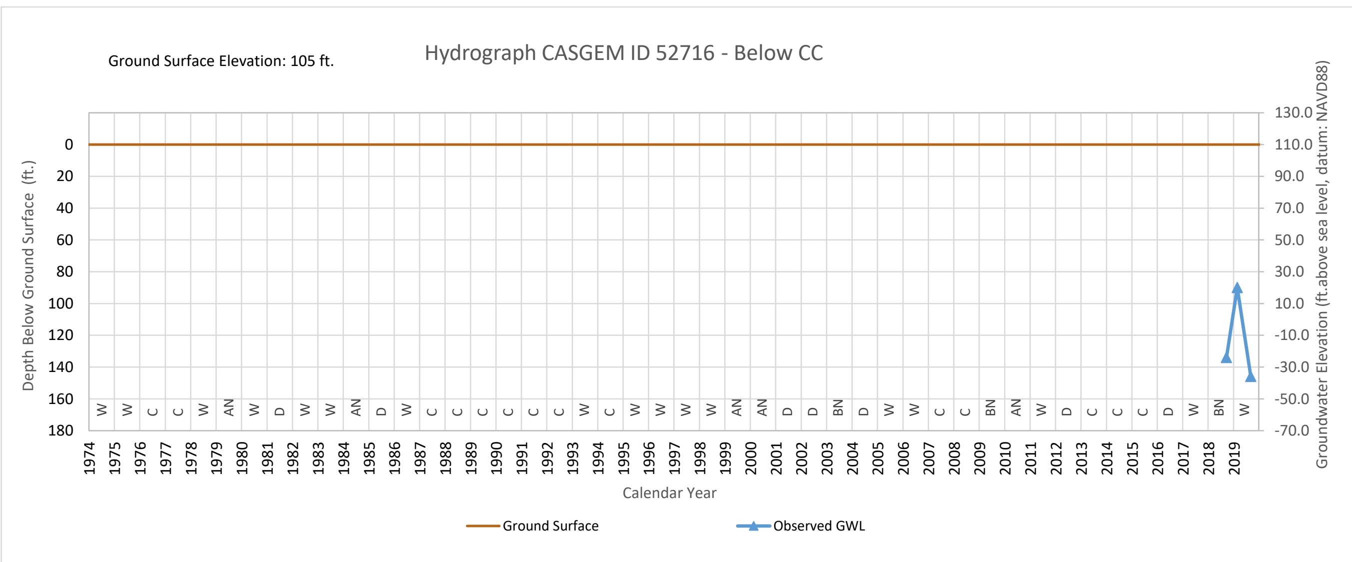


Ground Surface Elevation: 80.1 ft.
Hydrograph CASGEM ID 47570 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL


Ground Surface Elevation: 80.2 ft.
Hydrograph CASGEM ID 47572 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL



Ground Surface Elevation: 100 ft.
Hydrograph CASGEM ID 52715 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
0
20
40
60
80
100
120
140
160
180
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
W W C C W AN W D W W AN D W C C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Ground Surface
Observed GWL

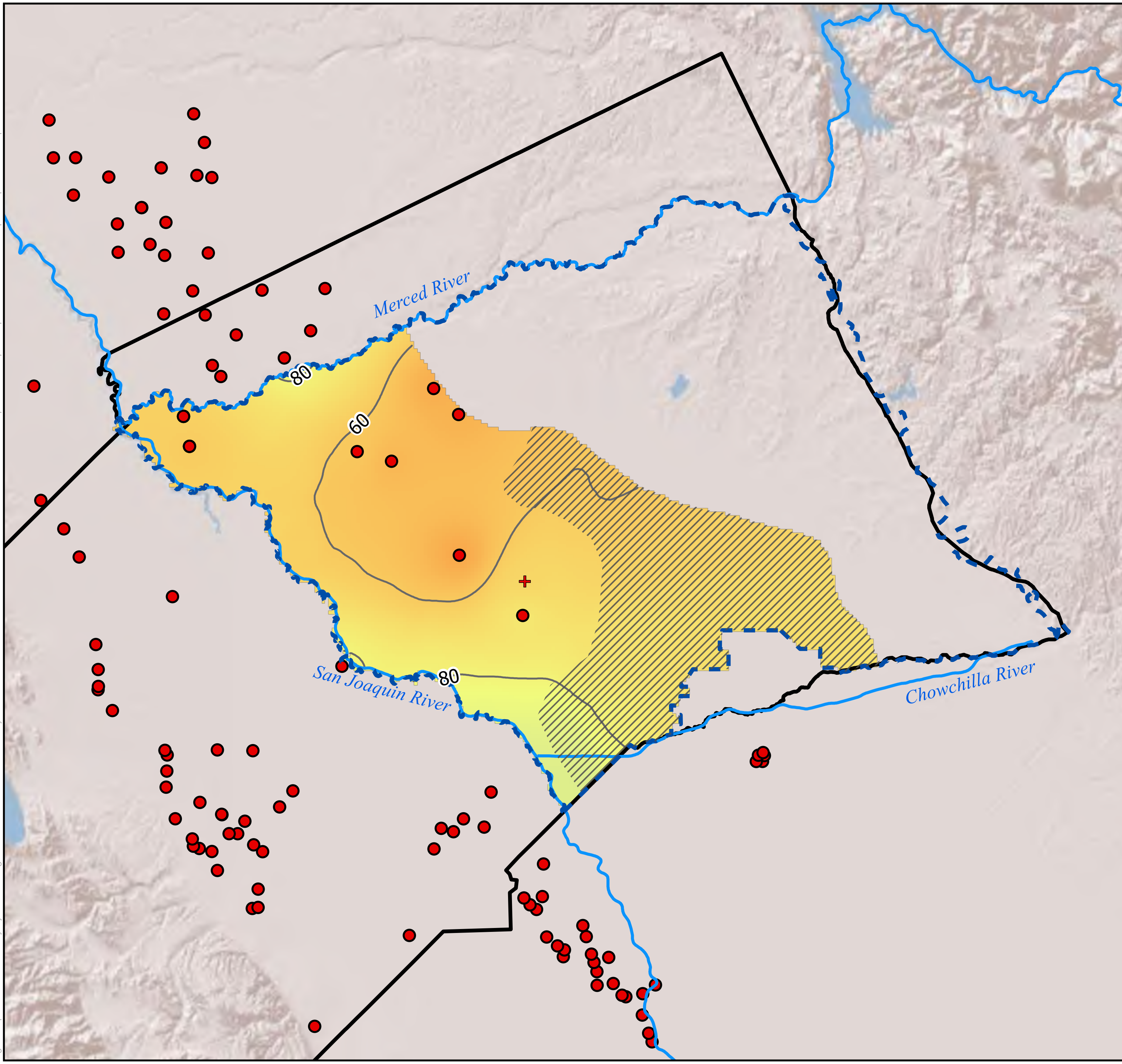


Ground Surface Elevation: 105 ft.
Hydrograph CASGEM ID 52716 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL

APPENDIX B: GROUNDWATER LEVEL CONTOUR MAPS

Merced Subbasin GSP

Fall 2015



Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

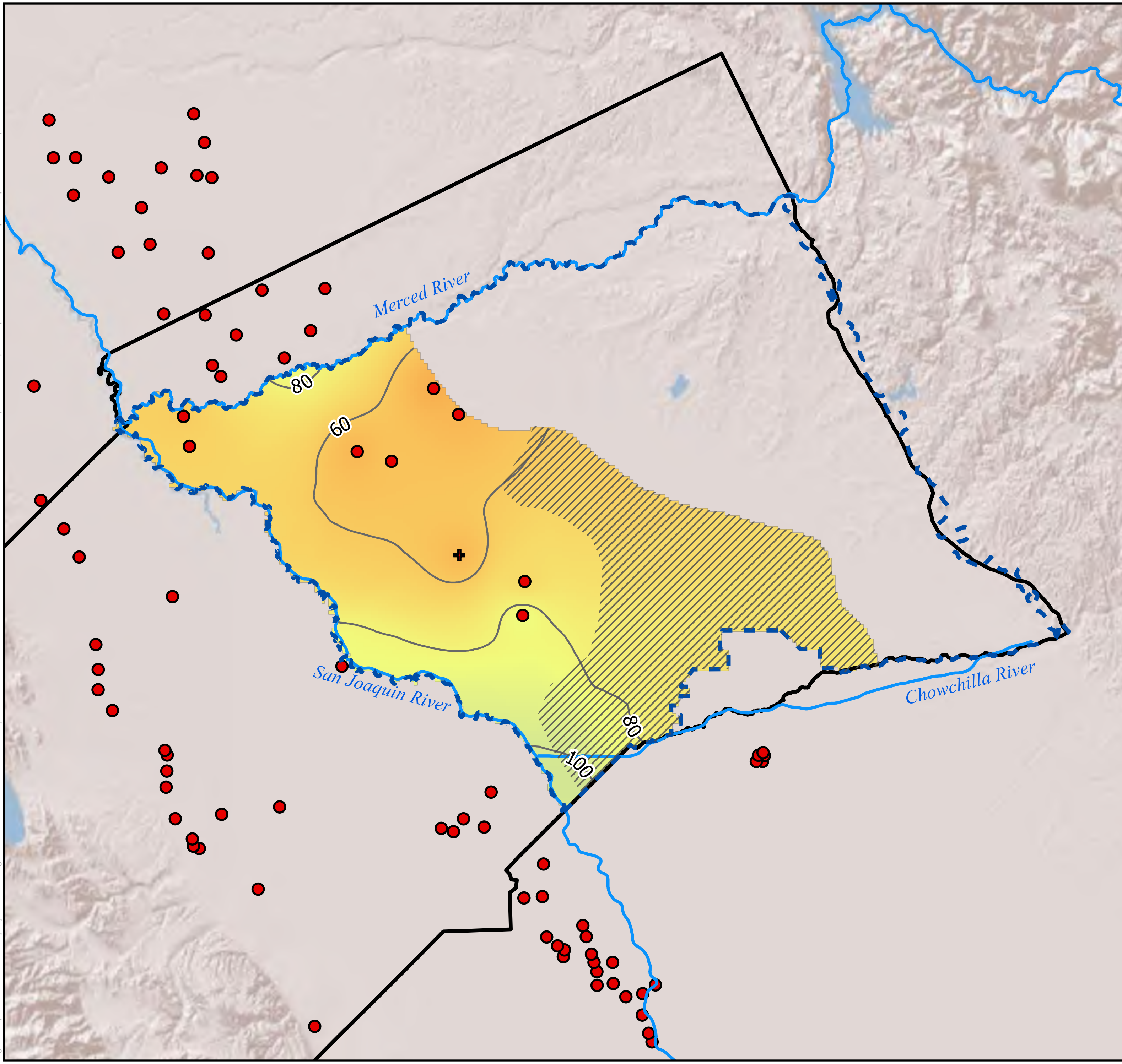
0 2 4 8 Miles

N

MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells



Merced Subbasin GSP

Fall 2016

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

0 2 4 8 Miles

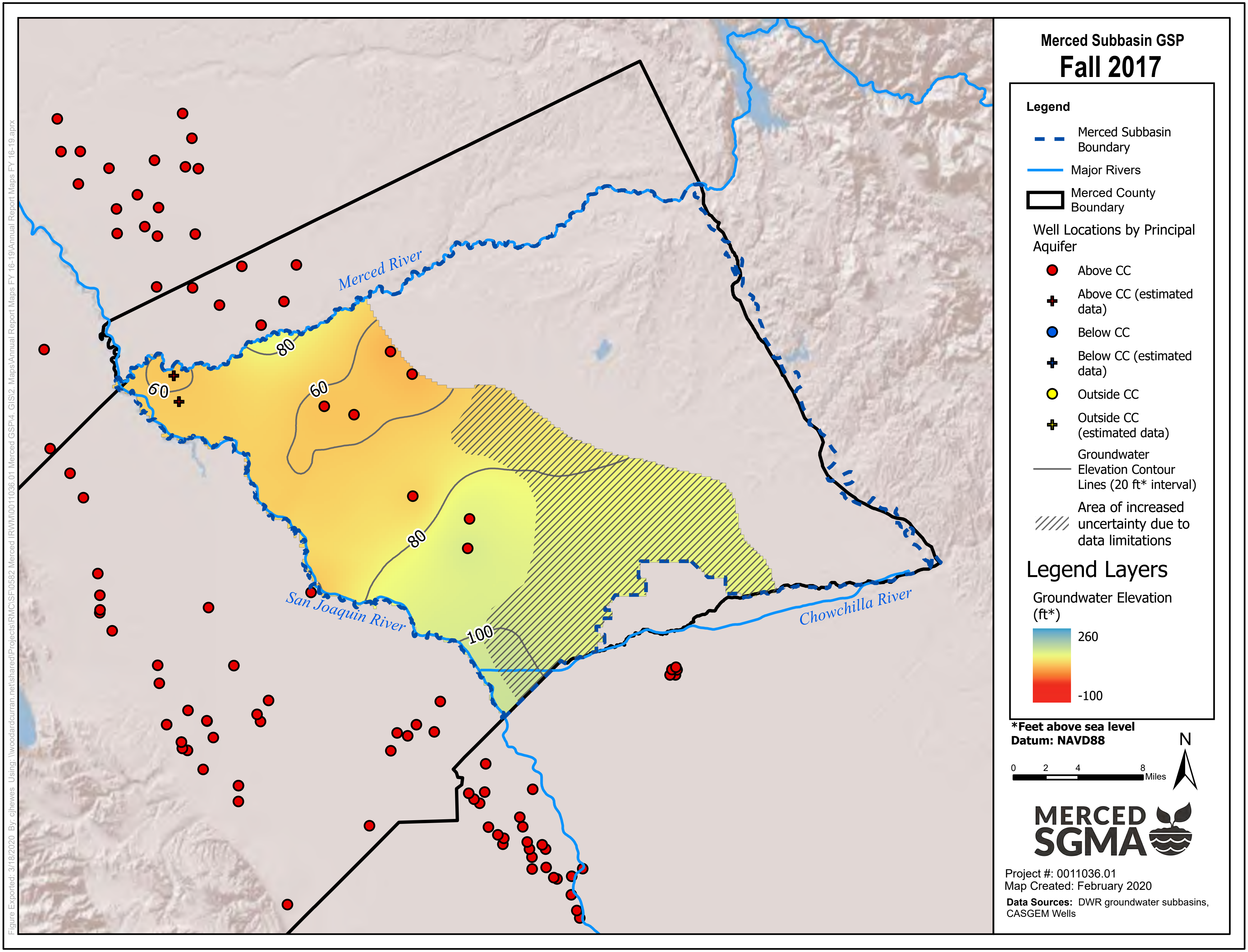
N

MERCED SGMA

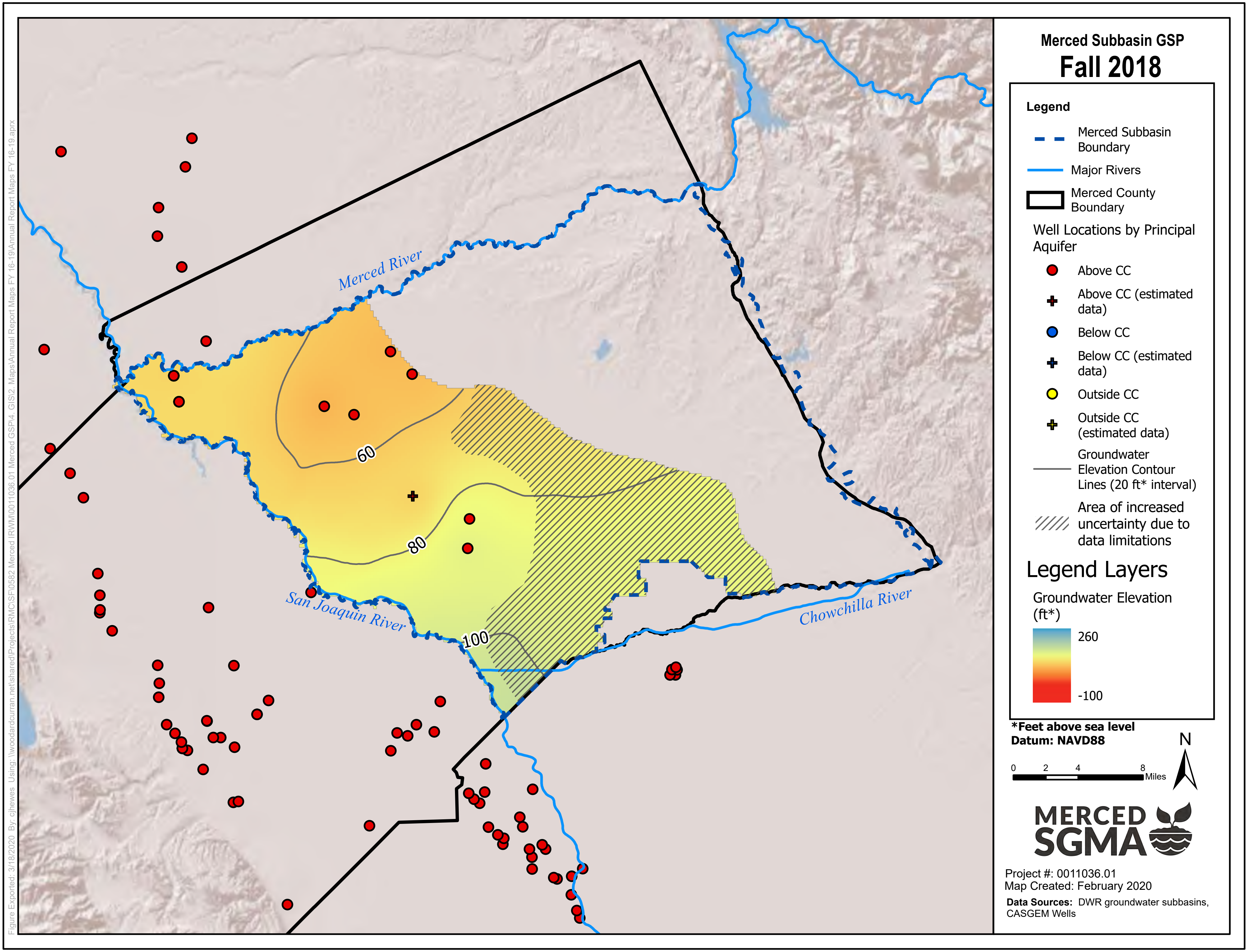
Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells

Figure Exported: 3/18/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4_GIS\2_Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx



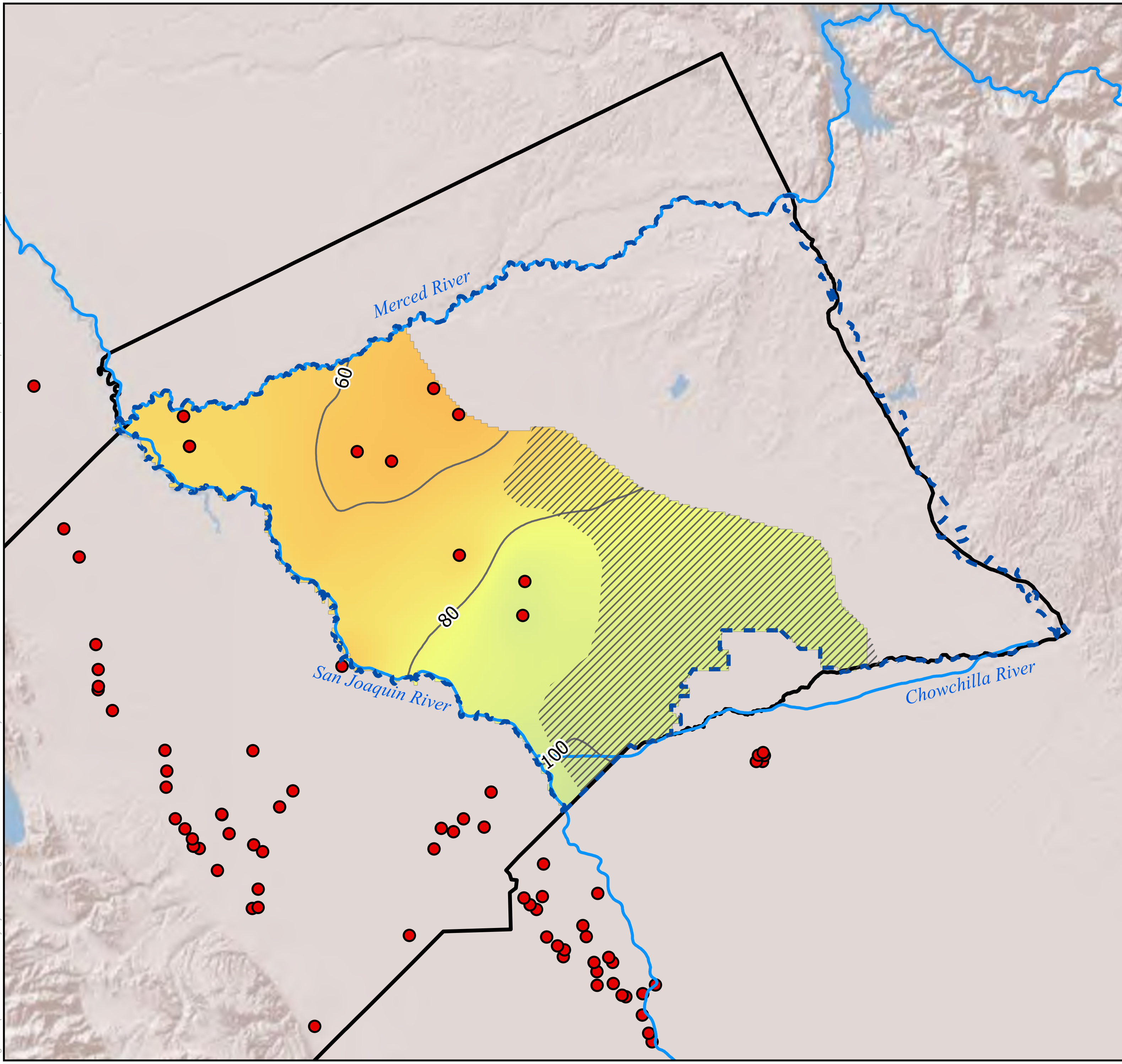
Merced Subbasin GSP
Fall 2017
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Legend Layers
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
0 2 4 8 Miles
N
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
60
80
100
Figure Exported: 3/18/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4_GIS\2_Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx



Merced River
San Joaquin River
Chowchilla River
60
80
100
Merced Subbasin GSP
Fall 2018
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Legend Layers
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Figure Exported: 3/18/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx

Merced Subbasin GSP

Fall 2019



Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

N

0 2 4 8 Miles

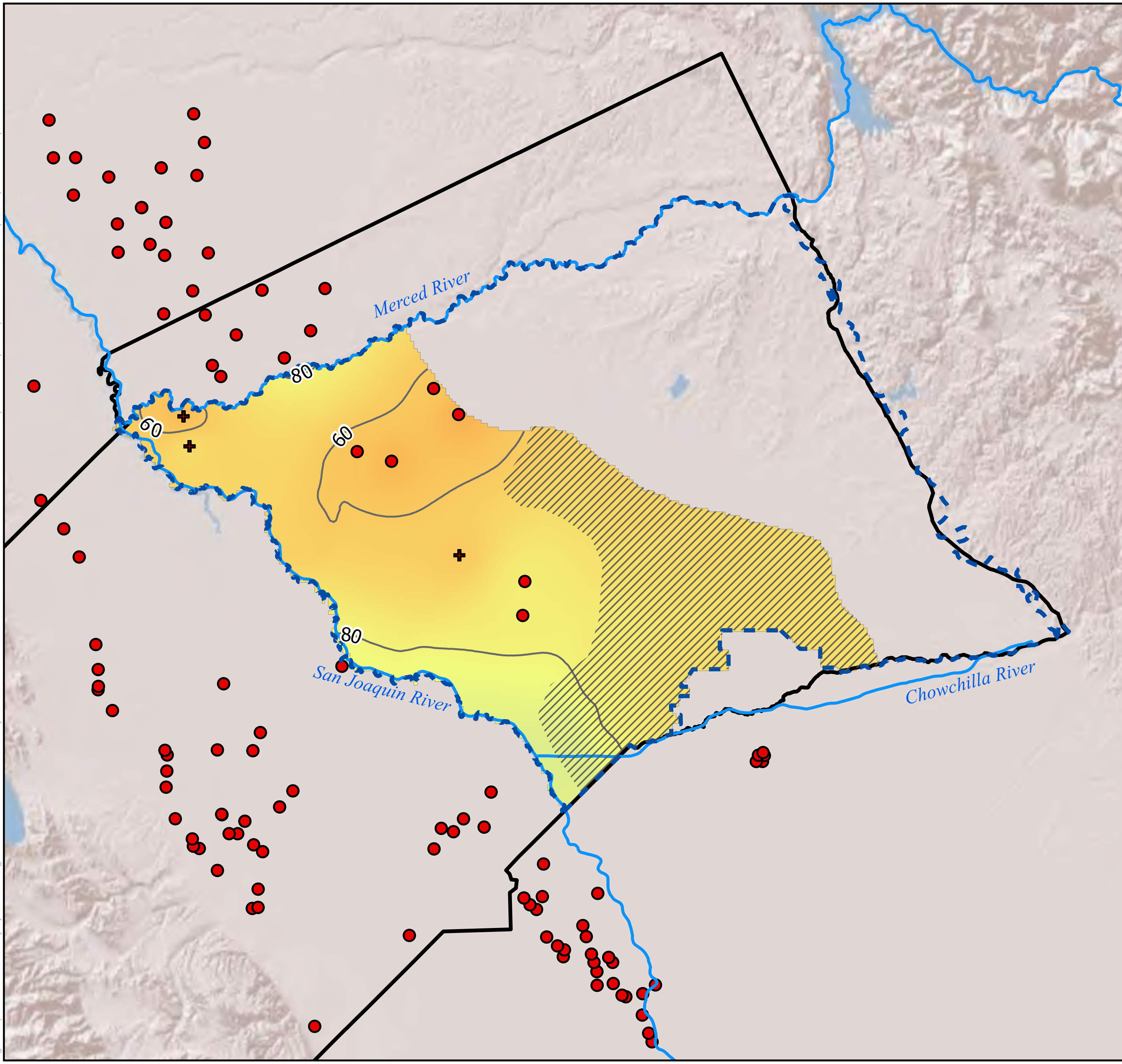
MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells

Merced Subbasin GSP

Spring 2016



Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

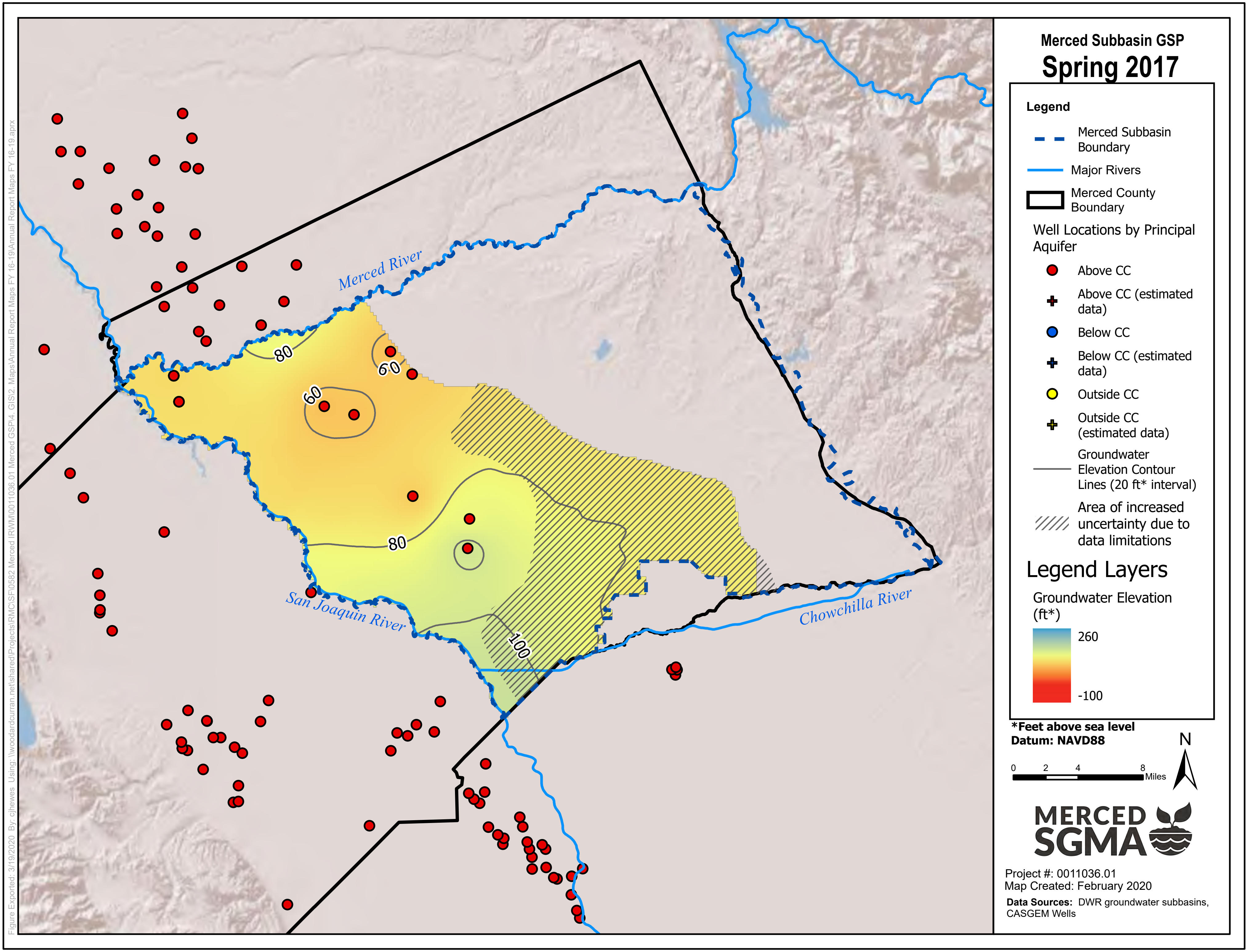
0 2 4 8 Miles

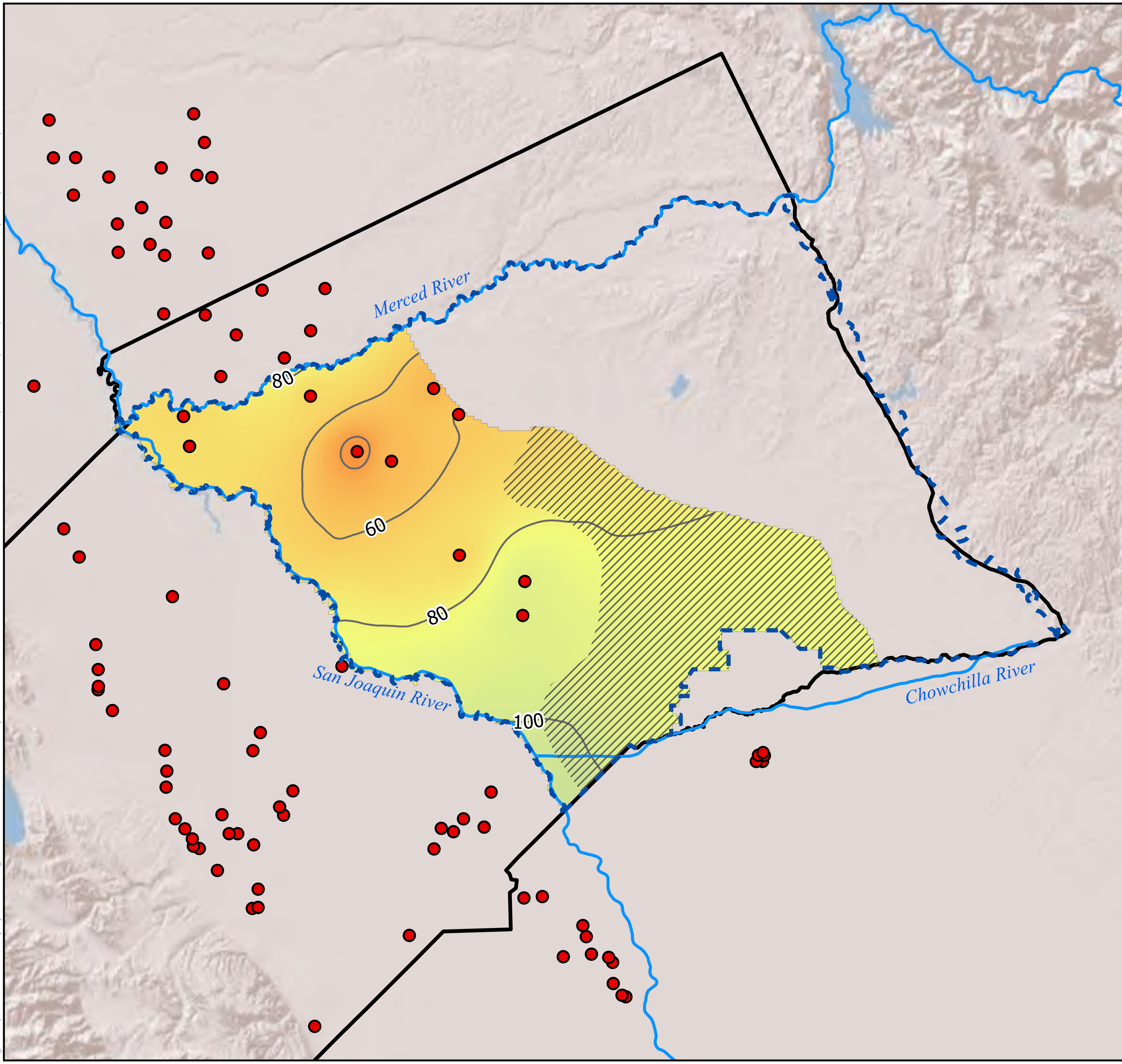
N

MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells


Merced Subbasin GSP
Spring 2017
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Legend Layers
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0
2
4
8
Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
80
60
60
80
100
Figure Exported: 3/19/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4_GIS\2_Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx



Merced Subbasin GSP

Spring 2018

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

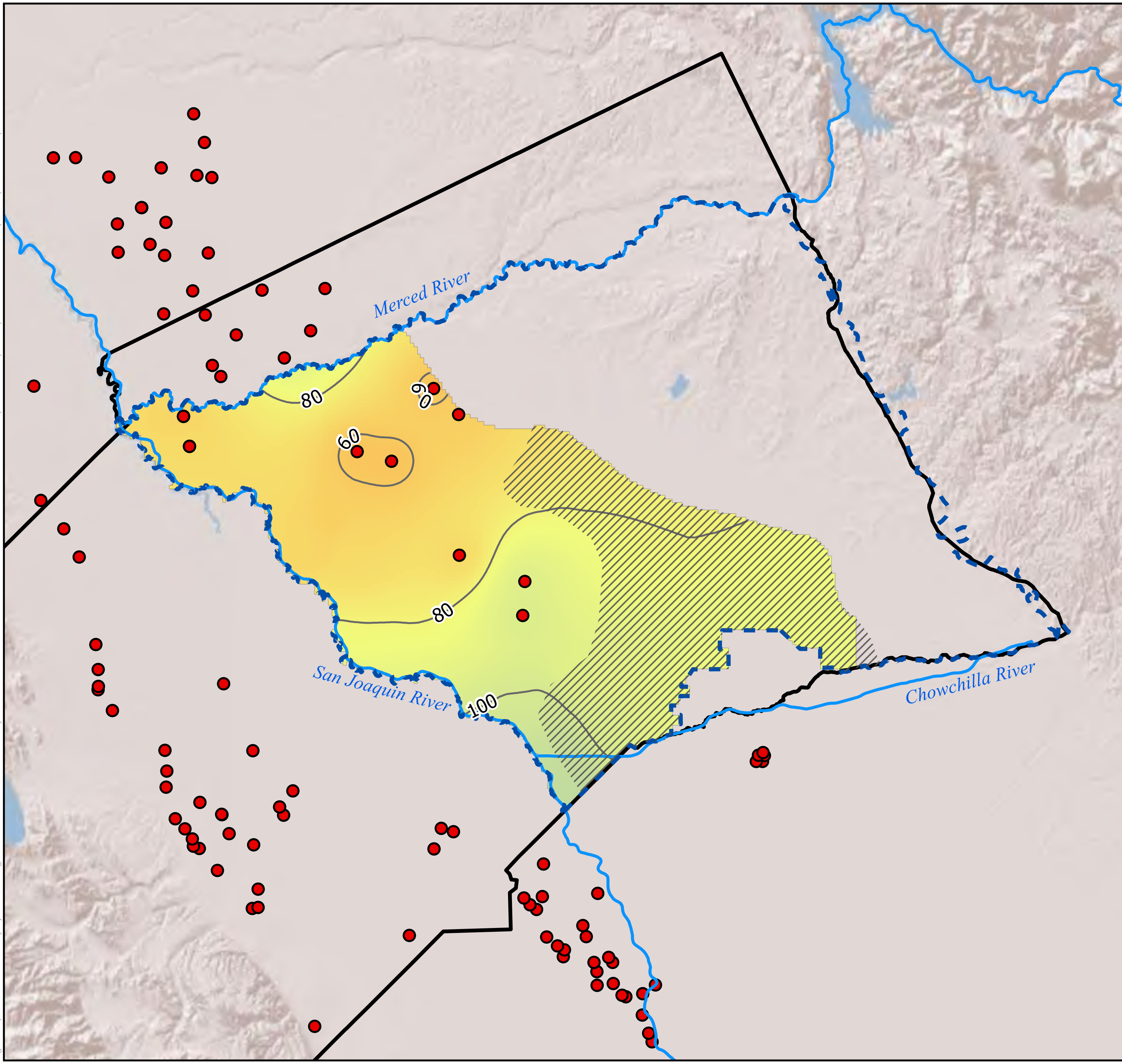
N

0 2 4 8 Miles

MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells



Merced Subbasin GSP

Spring 2019

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

0 2 4 8 Miles

N

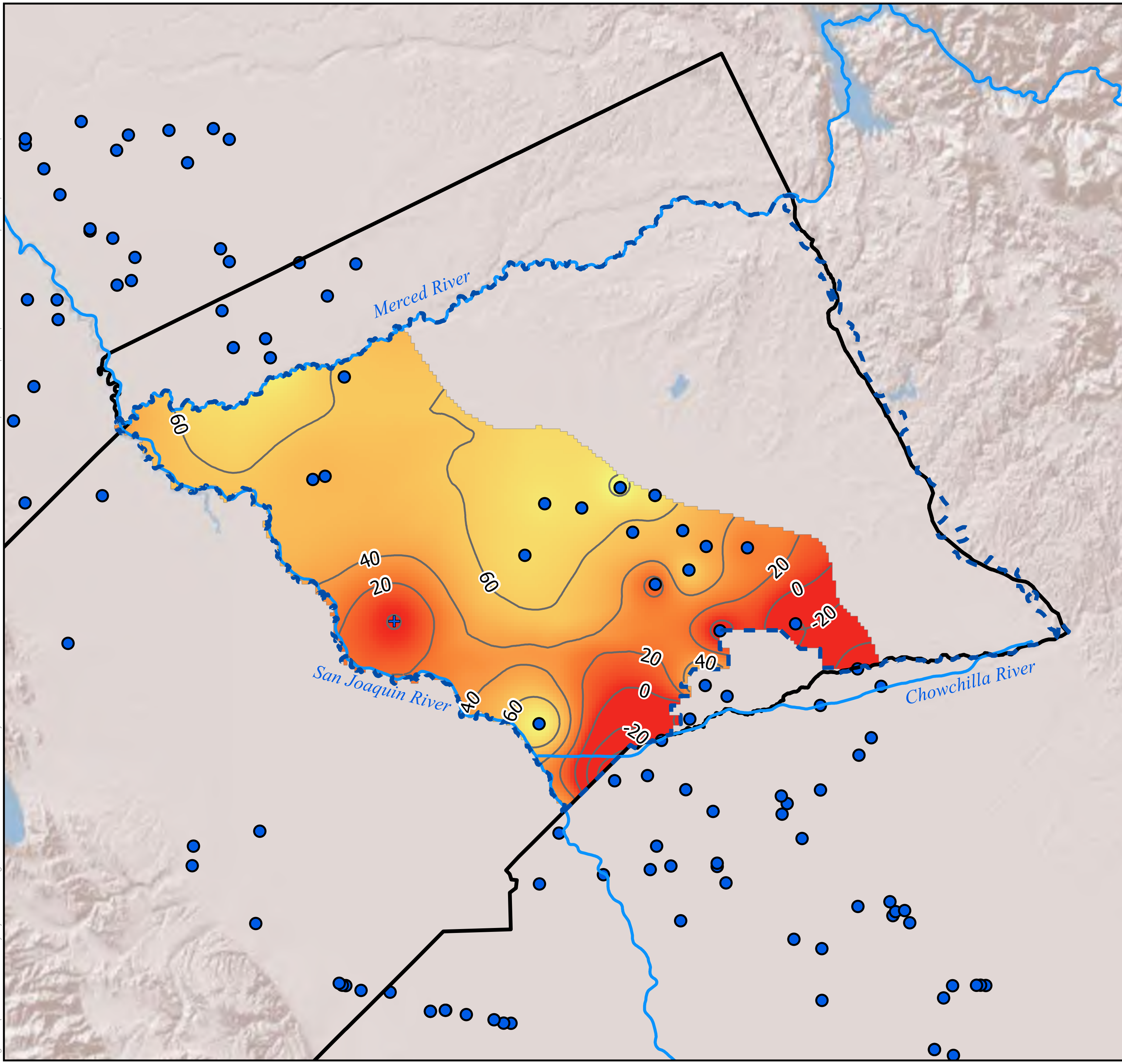
MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells

Merced Subbasin GSP

Fall 2016



Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

0 2 4 8 Miles

N

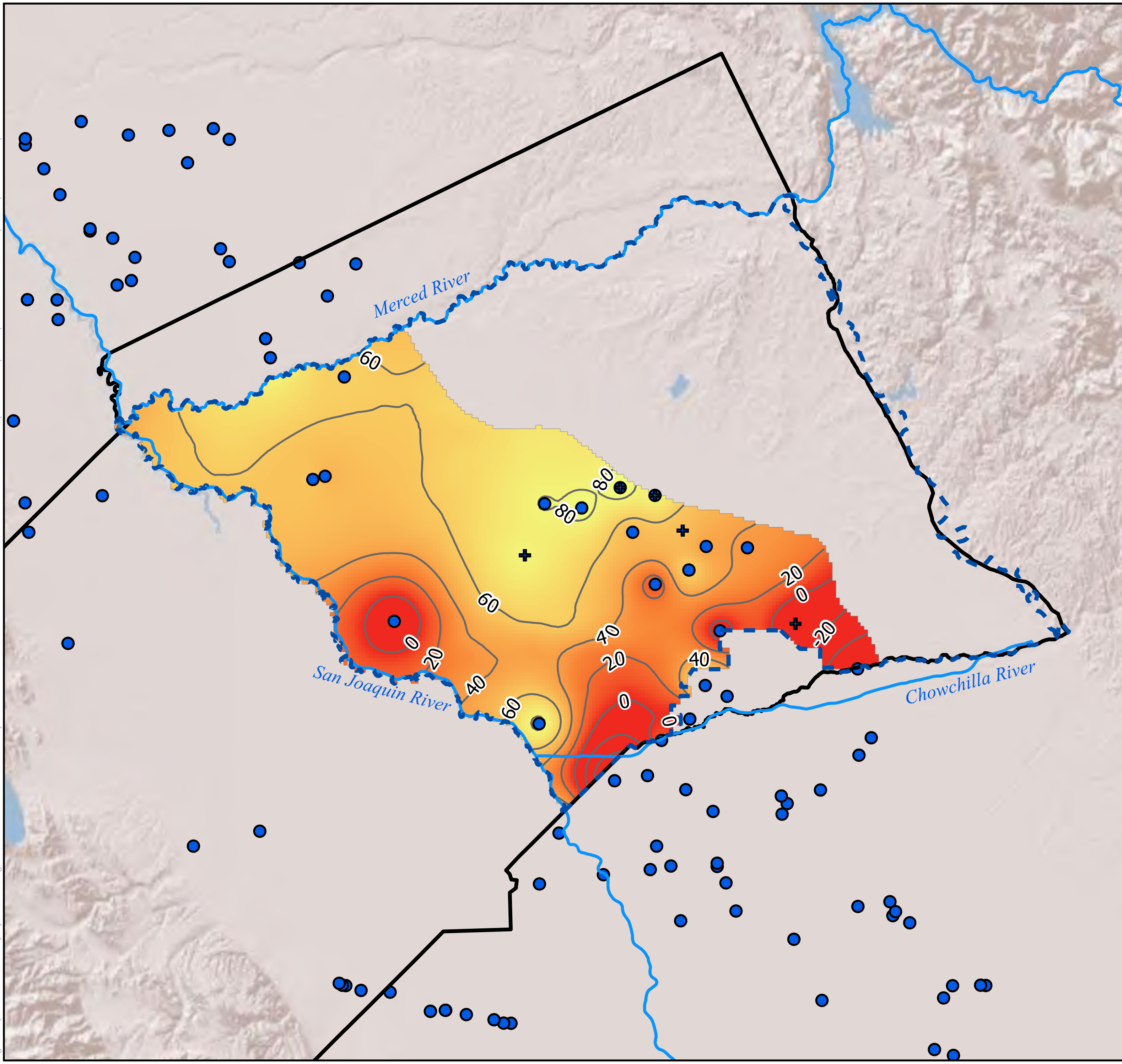
MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells

Merced Subbasin GSP

Fall 2016



Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

0 2 4 8 Miles

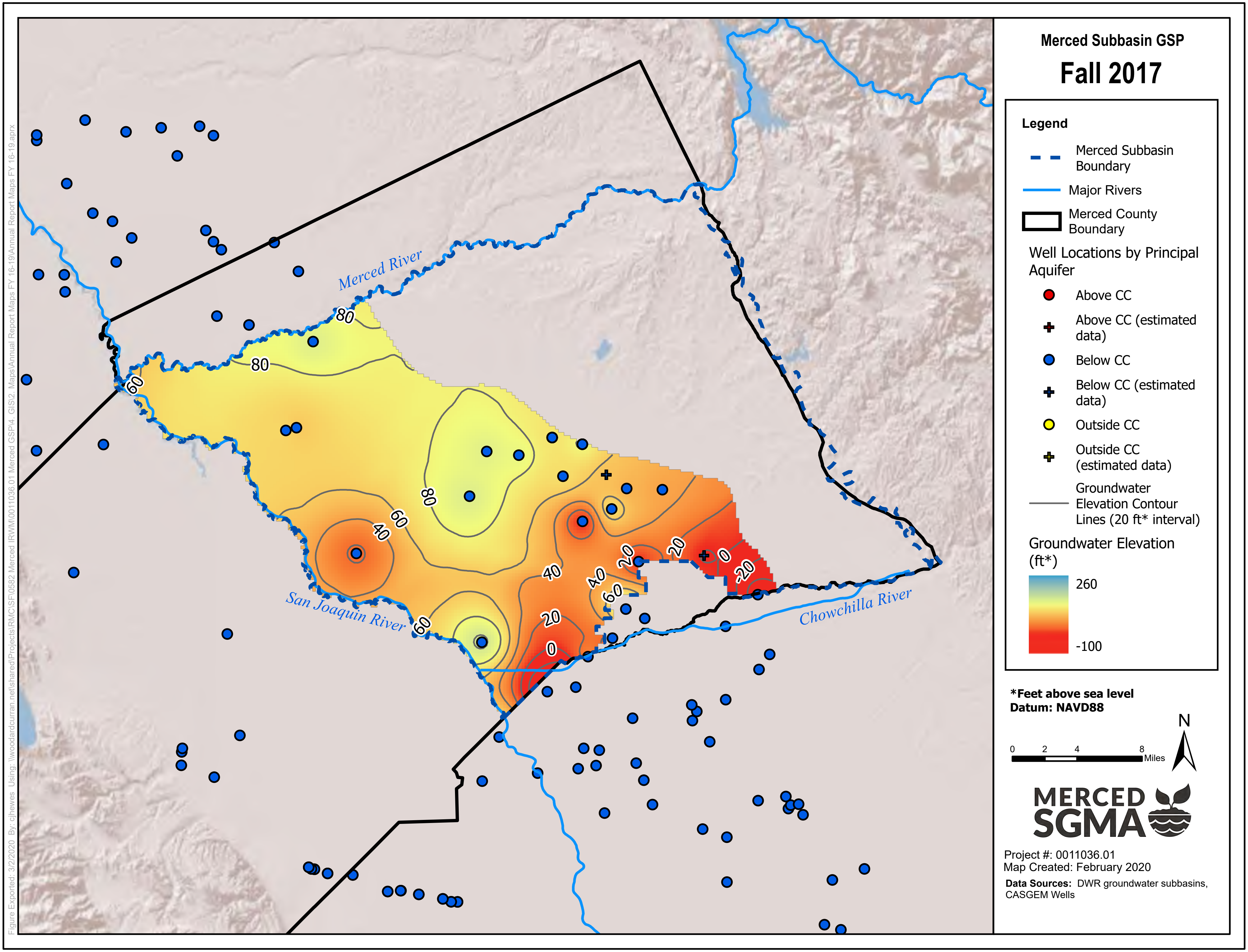
N

MERCED SGMA

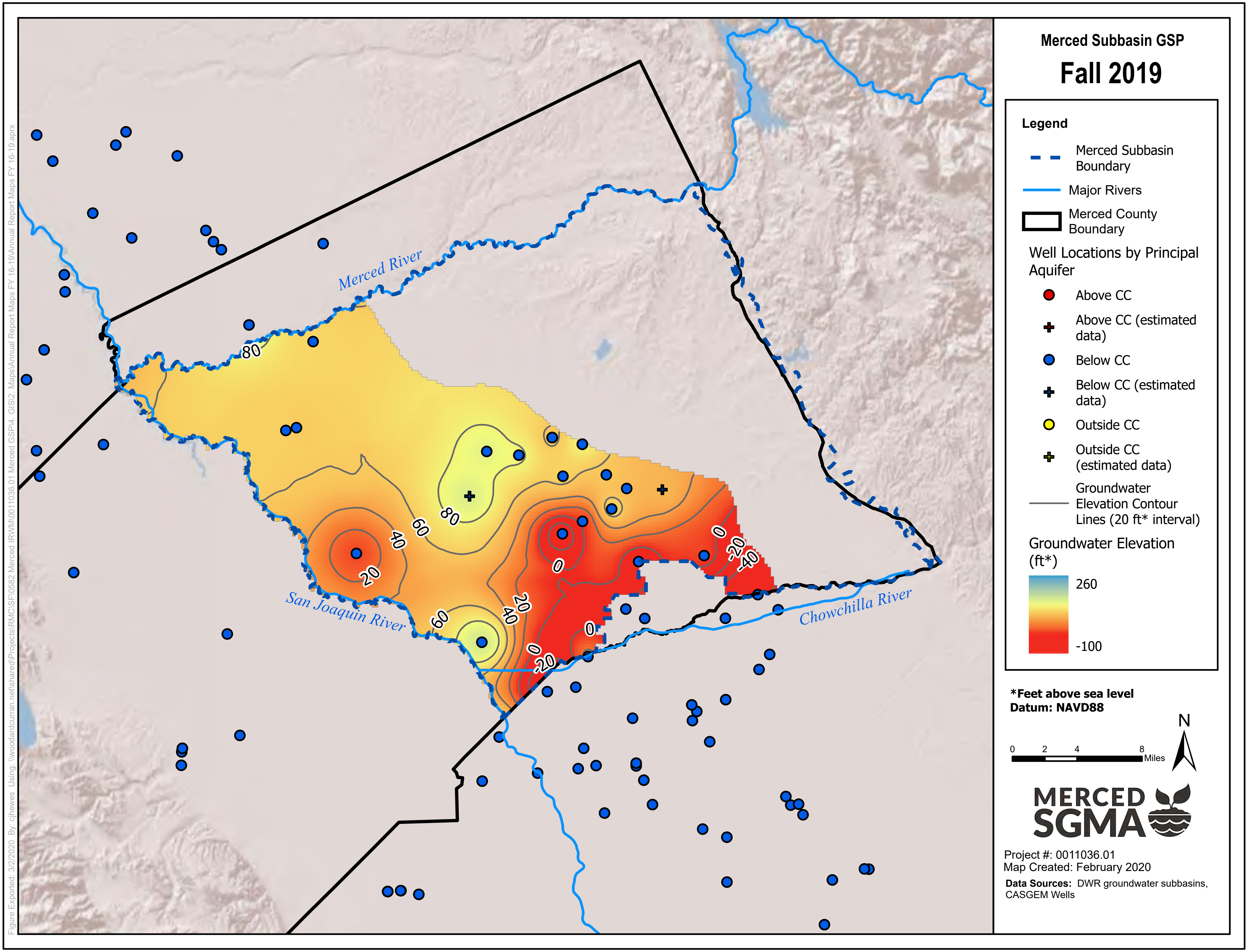
Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells

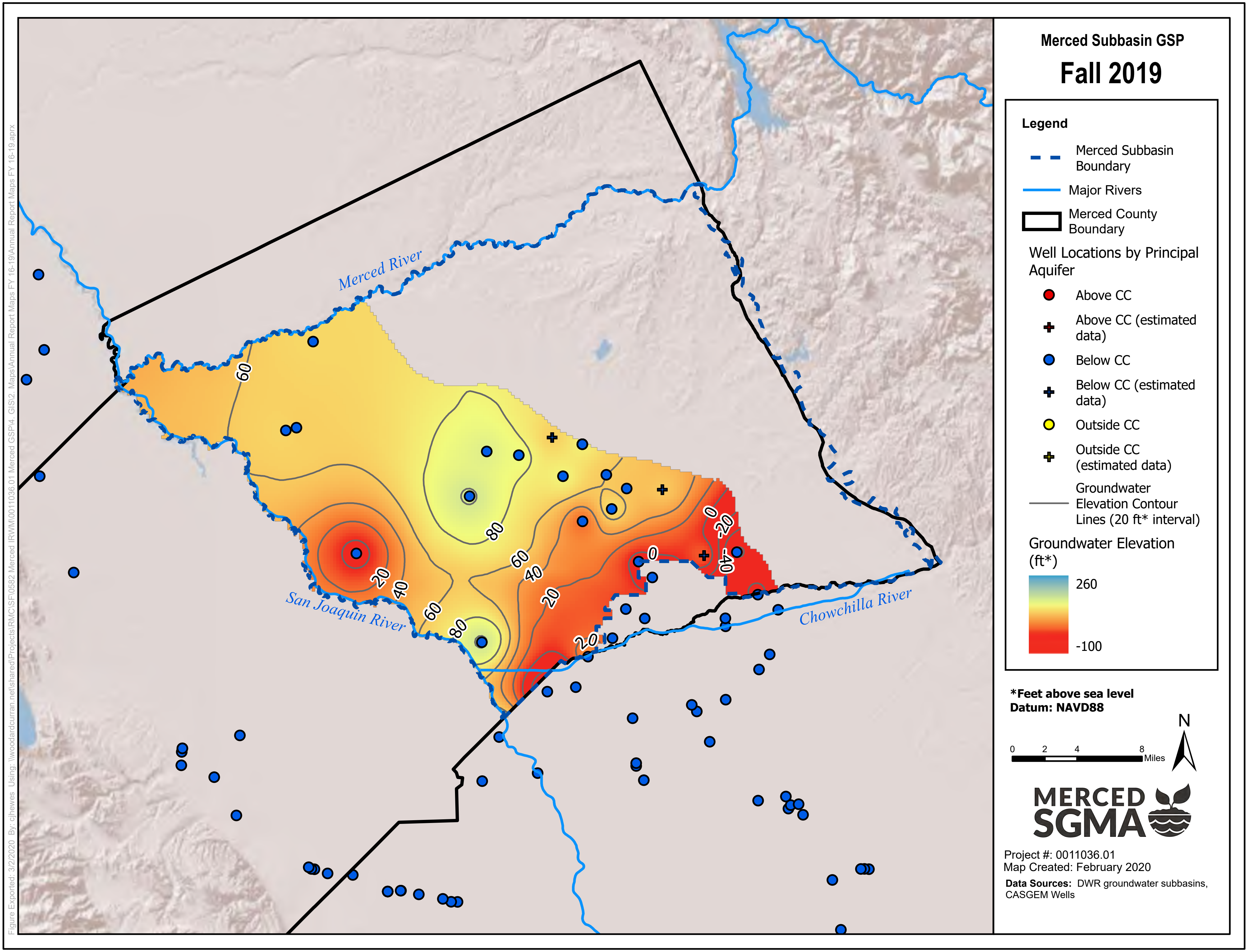
Figure Exported: 3/2/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx

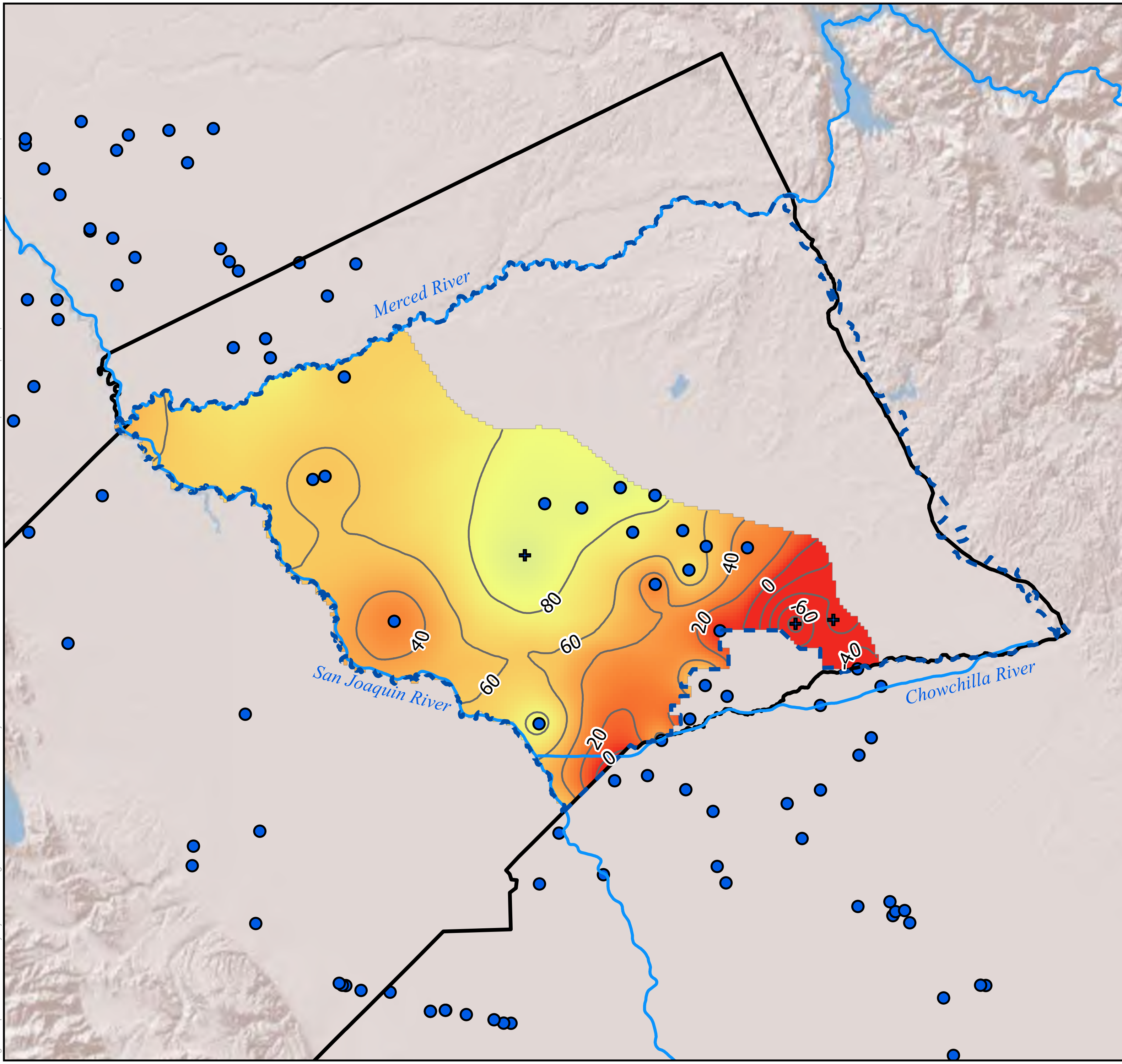


Merced Subbasin GSP
Fall 2017
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
80
80
60
80
60
40
40
20
0
-20
20
40
60
20
0
60



Merced Subbasin GSP
Fall 2019
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
80
60
40
20
0
-20
-40
Figure Exported: 3/2/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx


Merced Subbasin GSP
Fall 2019
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
60
80
60
40
20
0
-20
-40
20
40
60
80
20
0



Merced Subbasin GSP

Spring 2016

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

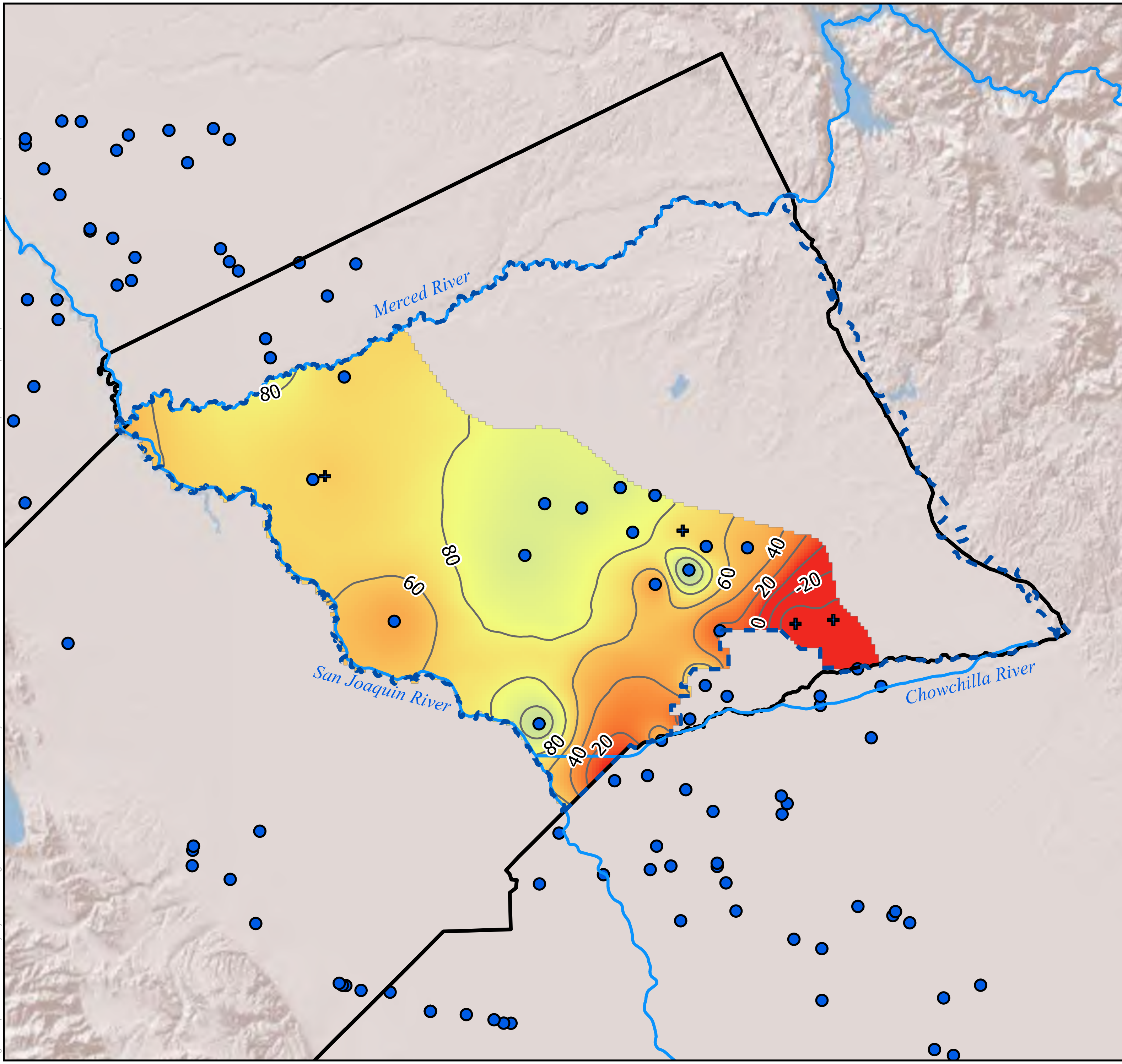
N

0 2 4 8 Miles

MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells



Merced Subbasin GSP

Spring 2017

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

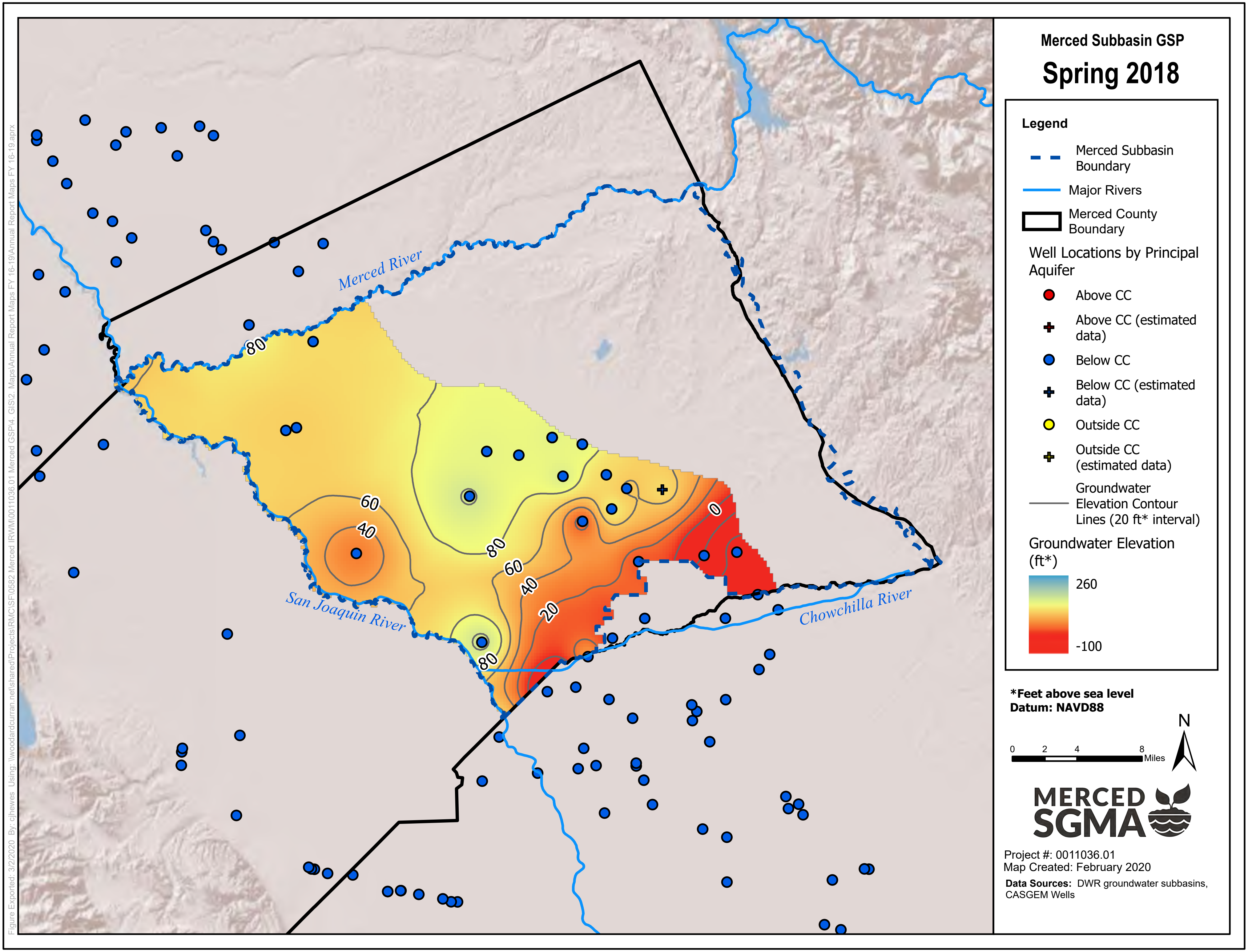
N

0 2 4 8 Miles

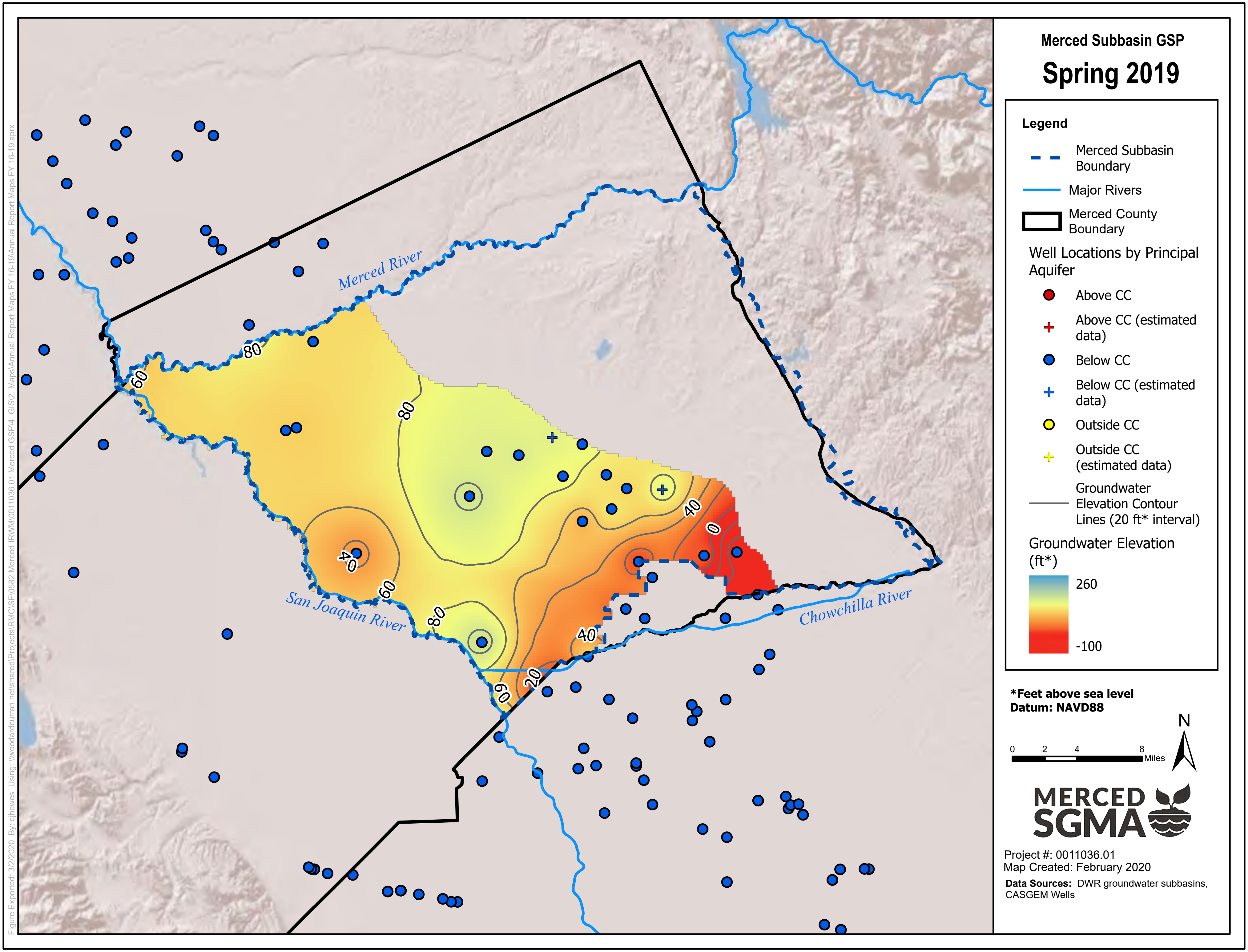
MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

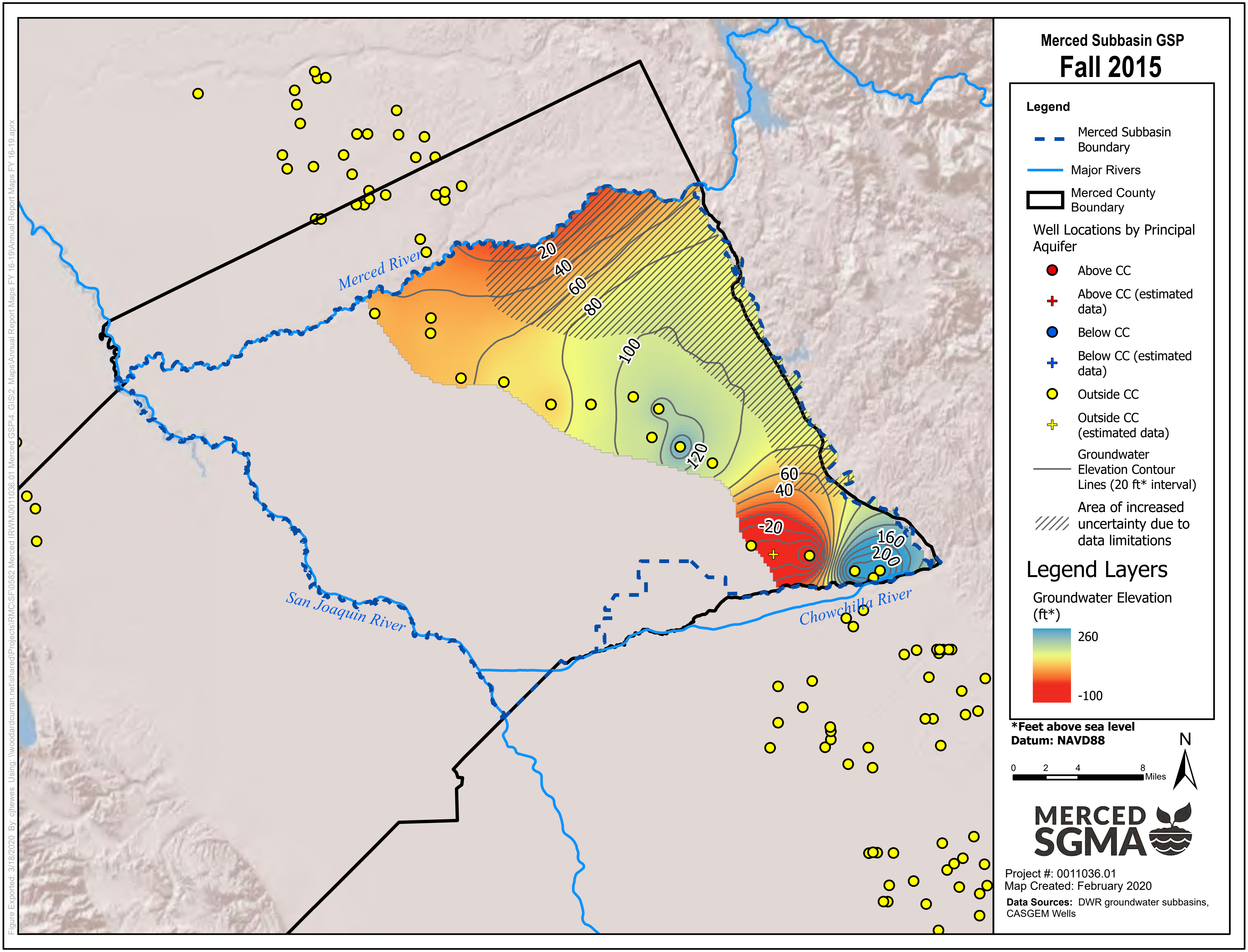
Data Sources: DWR groundwater subbasins, CASGEM Wells



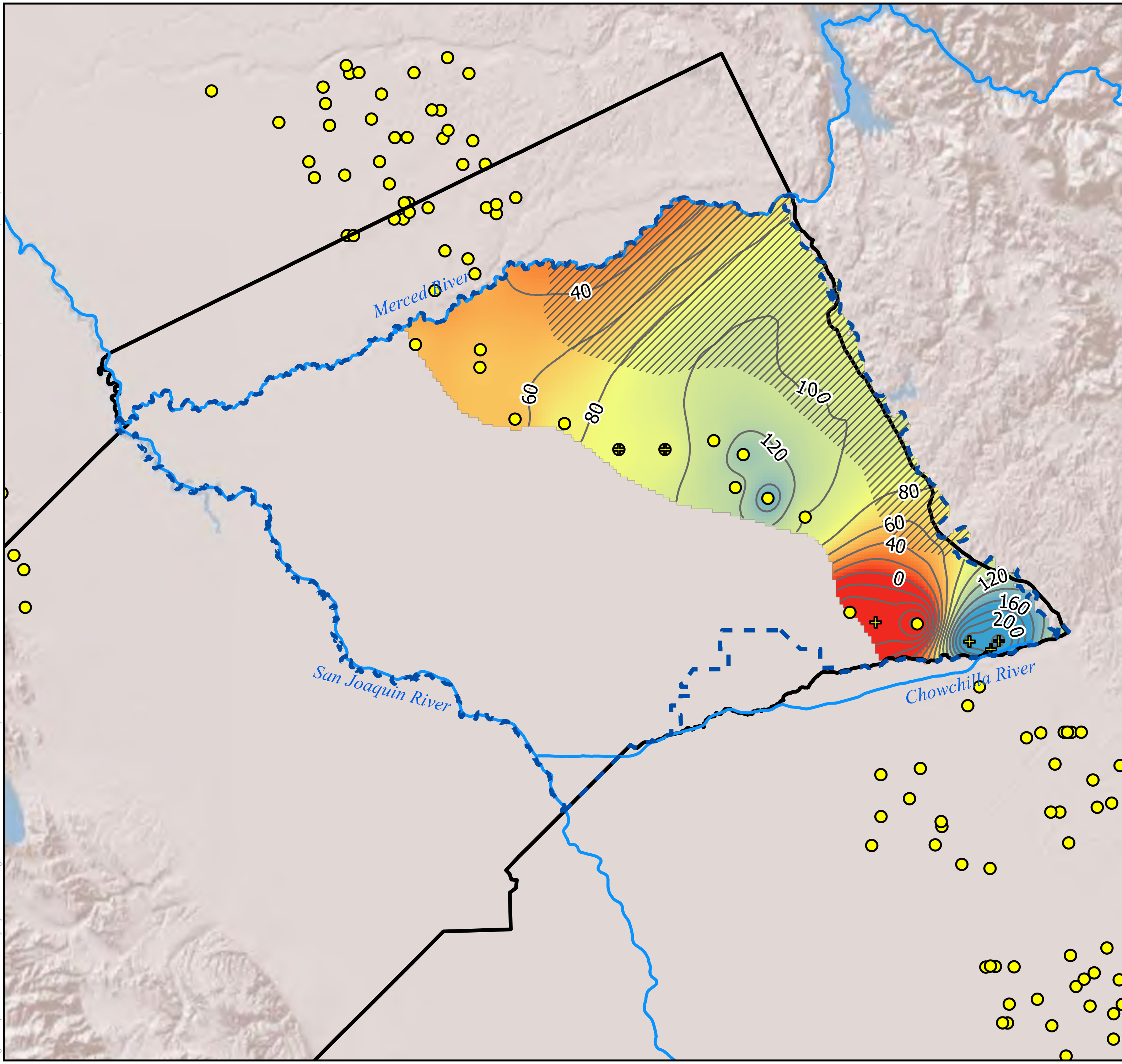
Merced Subbasin GSP
Spring 2018
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
80
60
40
20
0



Merced Subbasin GSP
Spring 2019
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
80
60
40
20
0



Merced Subbasin GSP
Fall 2015
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Legend Layers
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
20
40
60
80
100
120
60
40
-20
160
200
Figure Exported: 3/18/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx



Merced Subbasin GSP

Fall 2016

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer

- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

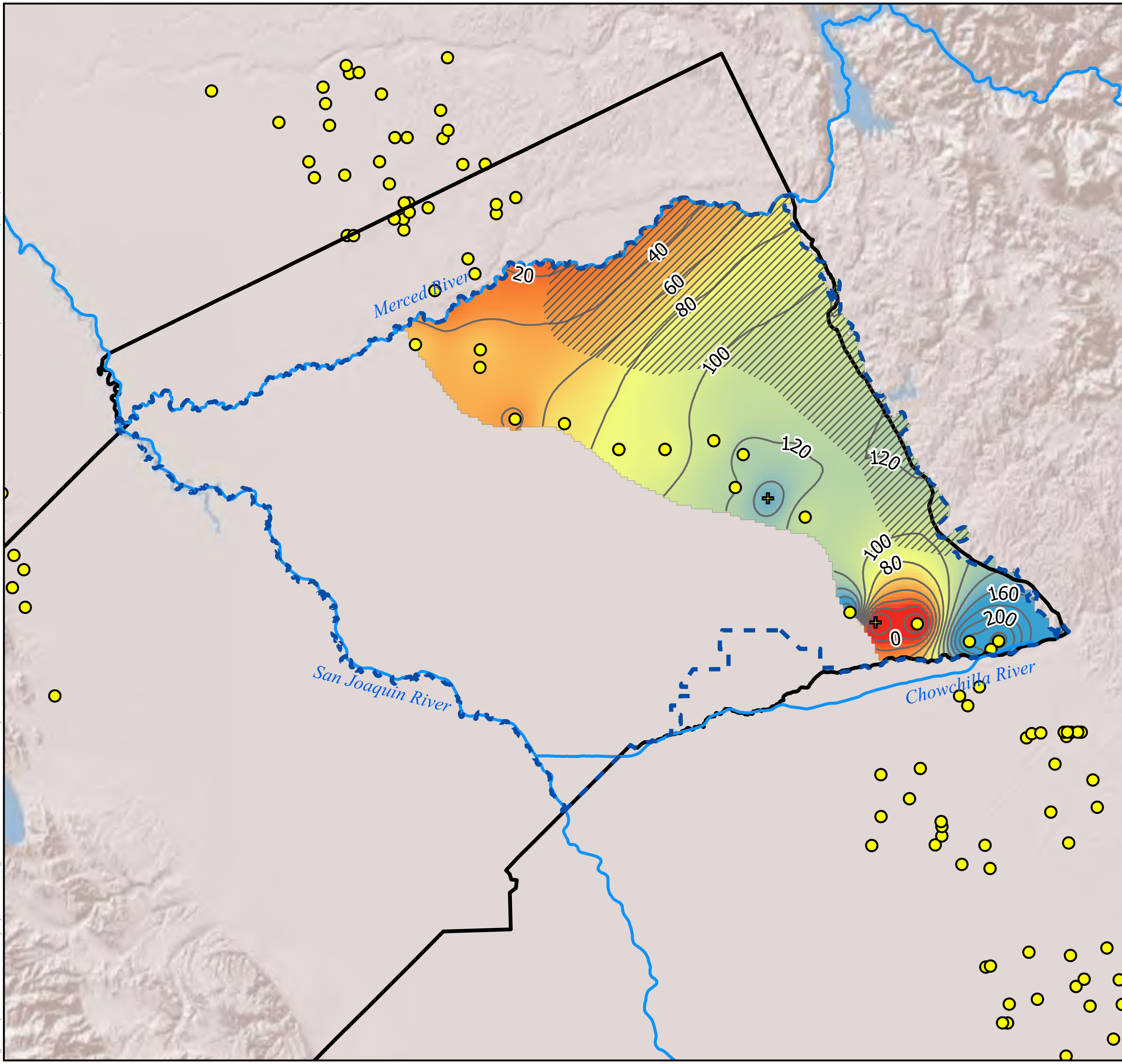
0 2 4 8 Miles

N

MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells



Merced Subbasin GSP
Fall 2017

Legend

Merced Subbasin Boundary

Major Rivers

Merced County Boundary

Well Locations by Principal Aquifer

Above CC

Above CC (estimated data)

Below CC

Below CC (estimated data)

Outside CC

Outside CC (estimated data)

Groundwater Elevation Contour Lines (20 ft* interval)

Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

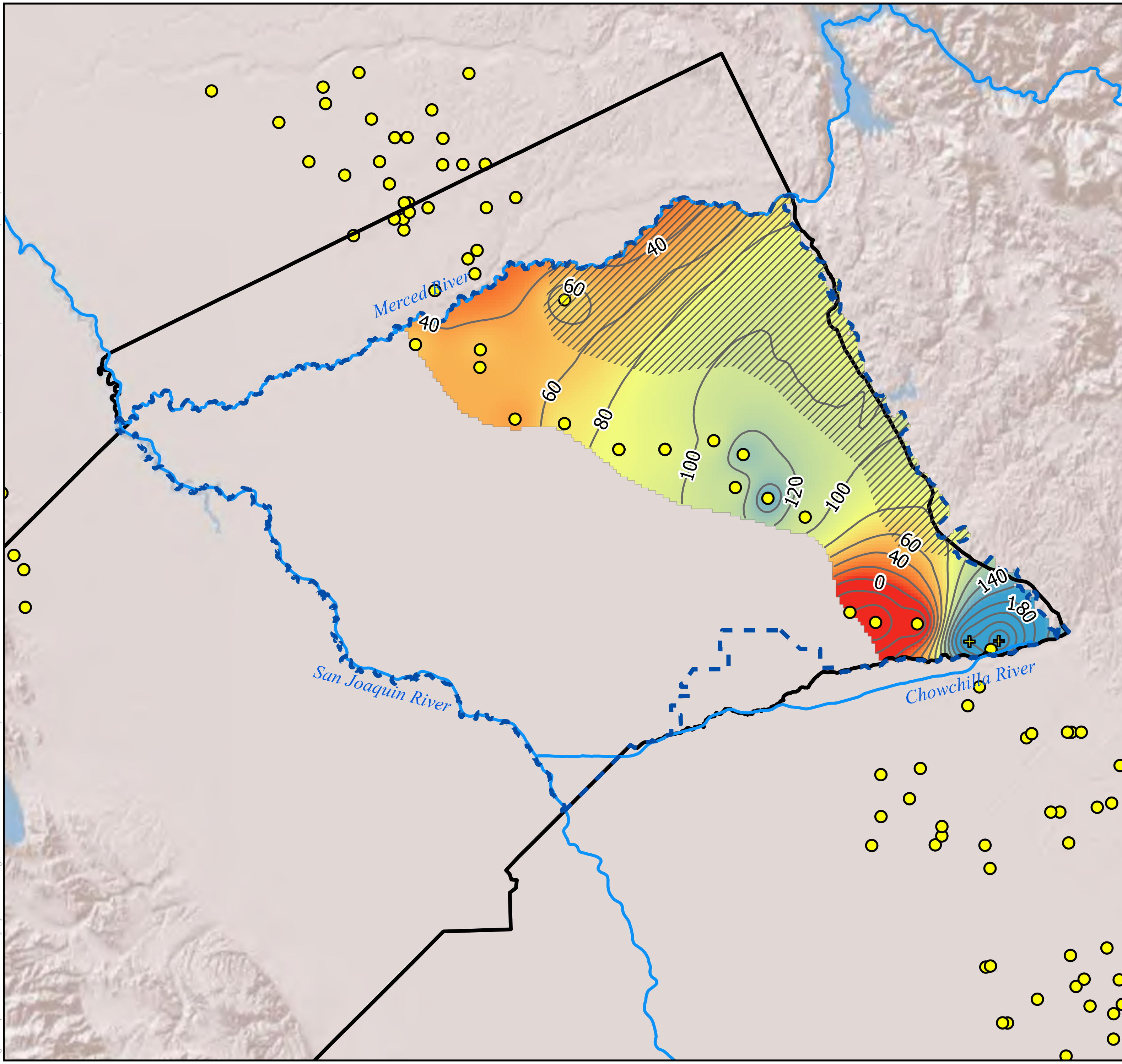
N

0 2 4 8 Miles

MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells



Merced Subbasin GSP

Fall 2018

Legend

Merced Subbasin Boundary

Major Rivers

Merced County Boundary

Well Locations by Principal Aquifer

Above CC

Above CC (estimated data)

Below CC

Below CC (estimated data)

Outside CC

Outside CC (estimated data)

Groundwater Elevation Contour Lines (20 ft* interval)

Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

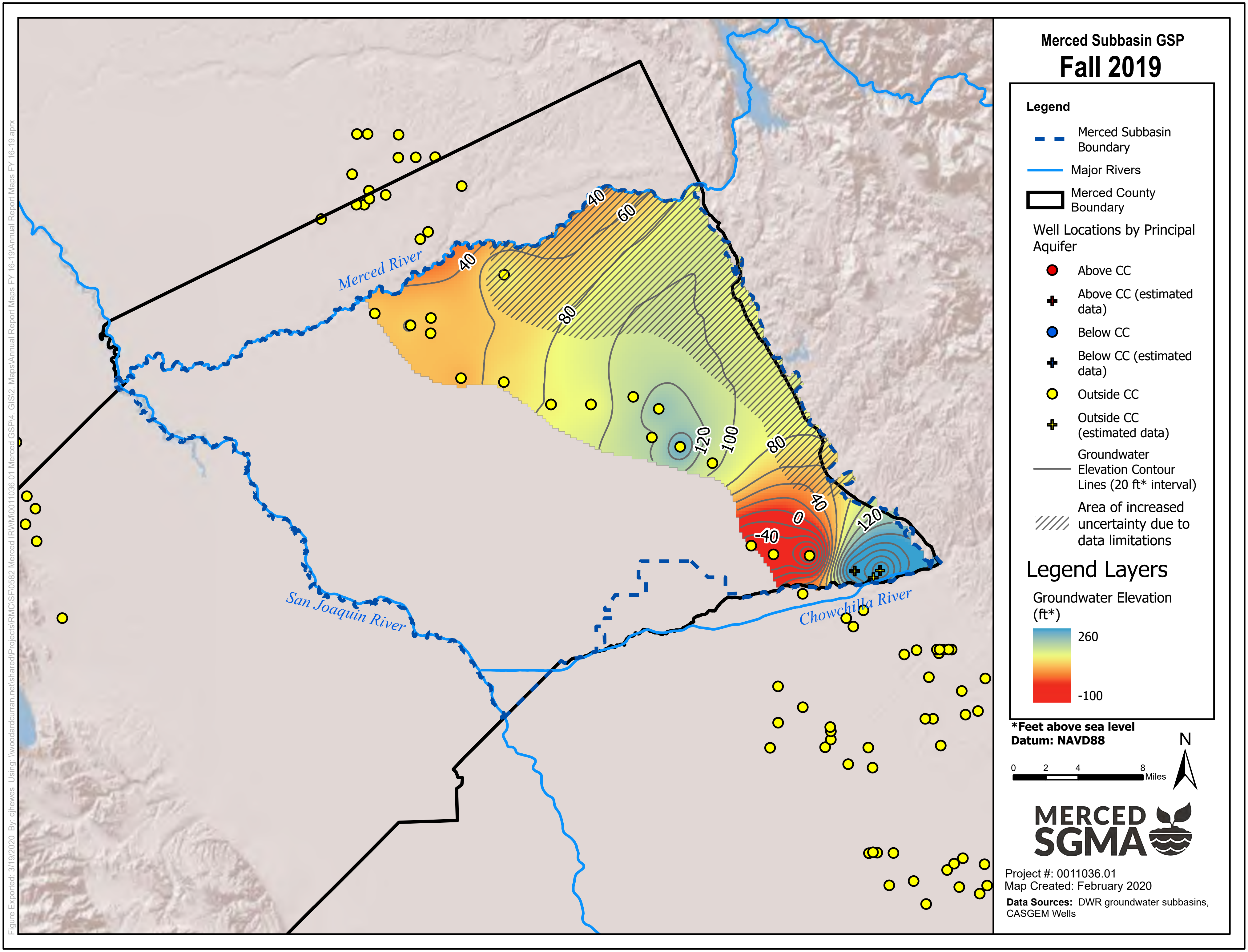
0 2 4 8 Miles

N

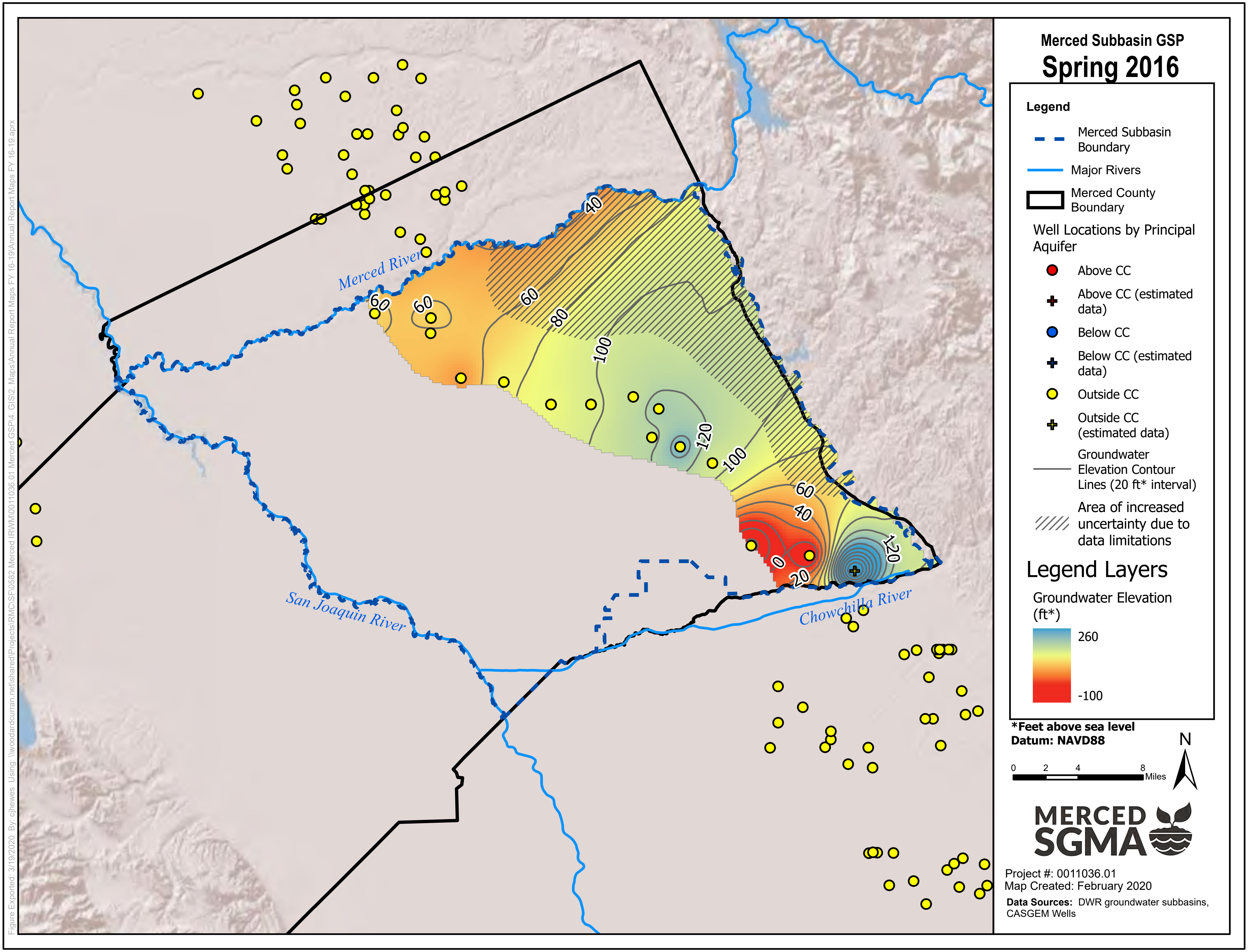
MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

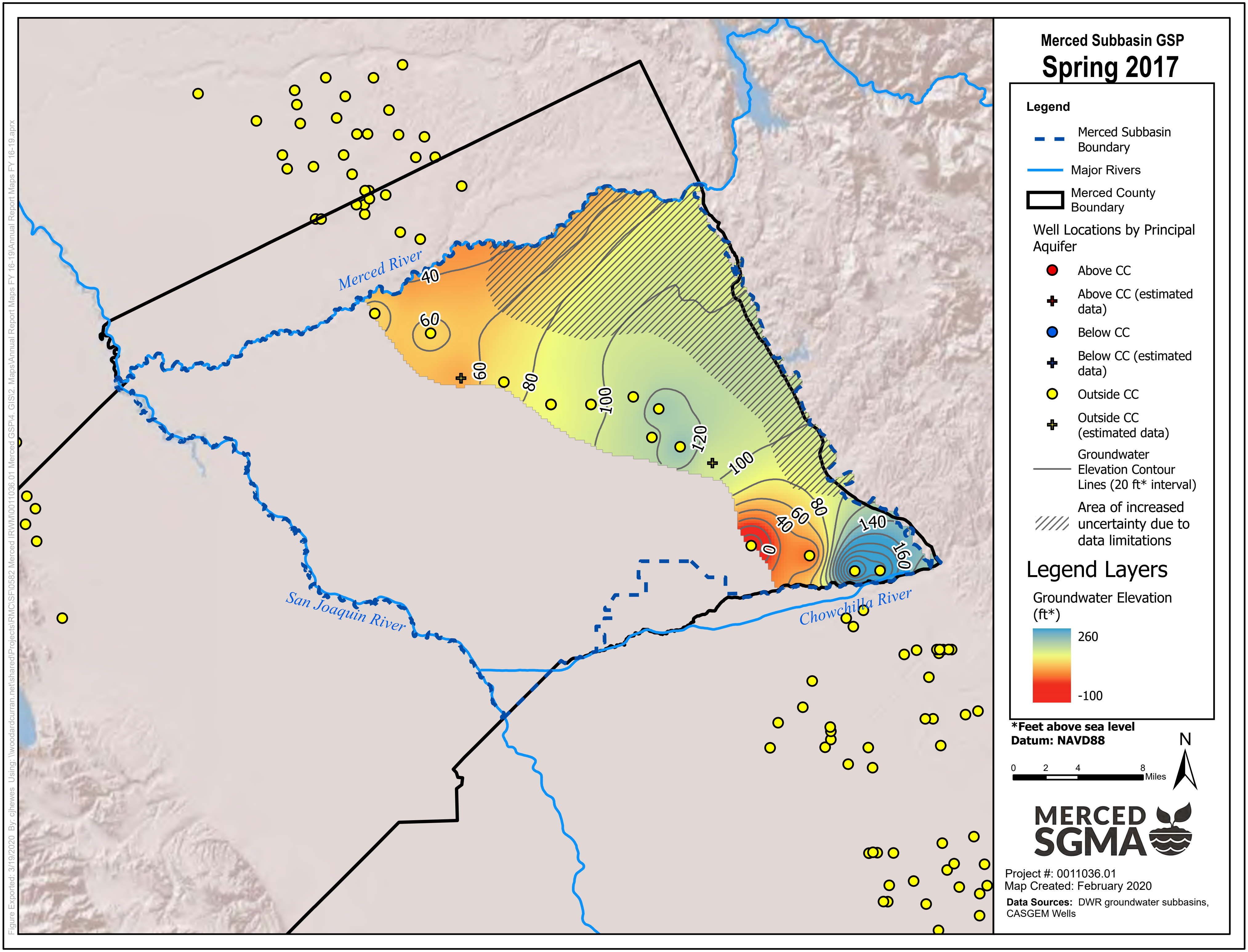
Data Sources: DWR groundwater subbasins, CASGEM Wells



Merced Subbasin GSP
Fall 2019
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Legend Layers
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
40
60
40
80
120
100
80
40
0
-40
120
Figure Exported: 3/19/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4_GIS\2_Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx

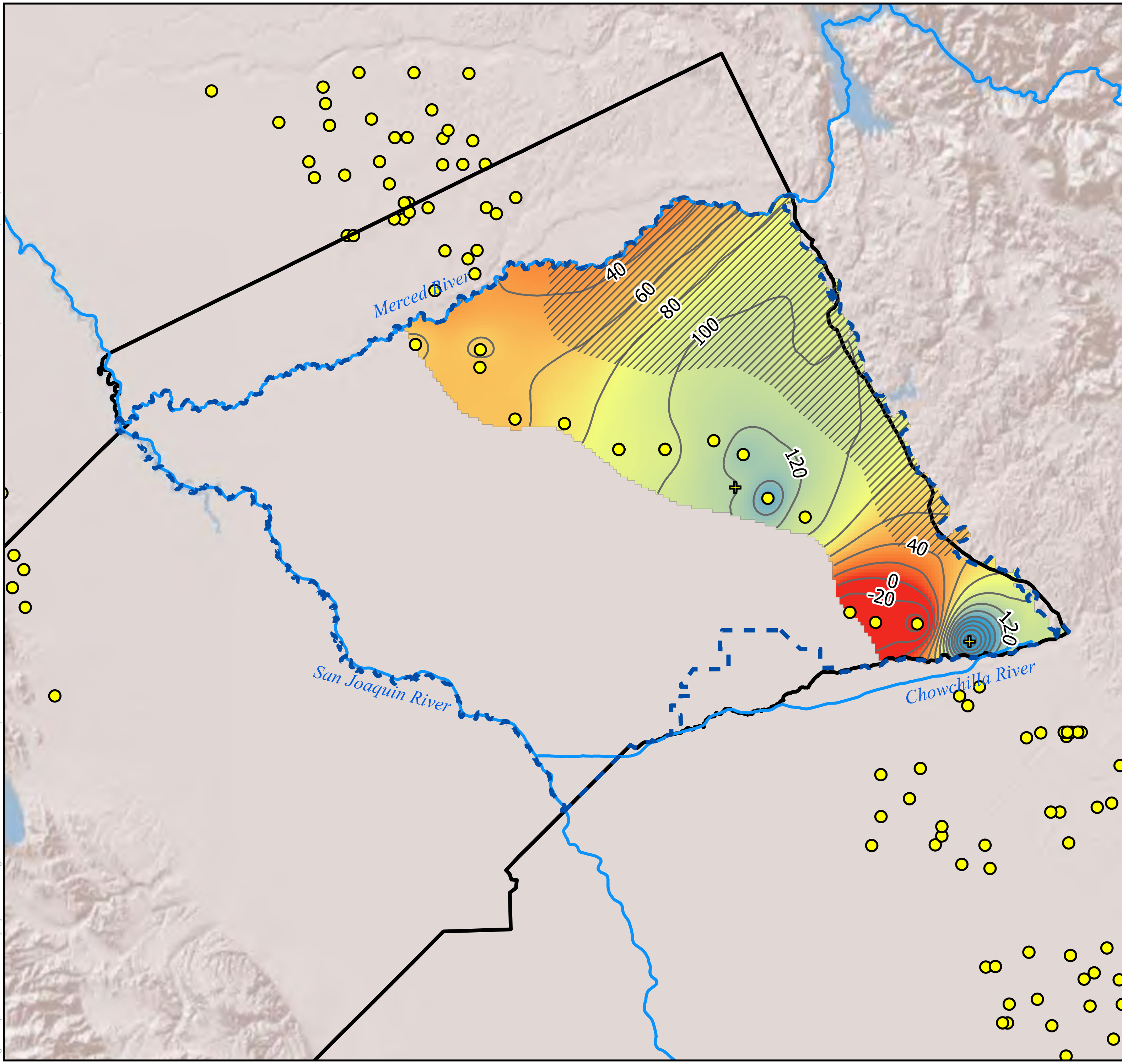


Merced Subbasin GSP
Spring 2016
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Legend Layers
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
40
60
60
60
80
100
120
100
60
40
0
20
120
Figure Exported: 3/19/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx



Merced Subbasin GSP
Spring 2017
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Legend Layers
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
40
60
60
80
100
120
100
80
60
40
0
140
160
Figure Exported: 3/19/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4_GIS\2_Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx

Merced Subbasin GSP
Spring 2018



Legend

Merced Subbasin Boundary

Major Rivers

Merced County Boundary

Well Locations by Principal Aquifer

Above CC

Above CC (estimated data)

Below CC

Below CC (estimated data)

Outside CC

Outside CC (estimated data)

Groundwater Elevation Contour Lines (20 ft* interval)

Area of increased uncertainty due to data limitations

Legend Layers

Groundwater Elevation (ft*)

260

-100

***Feet above sea level**
Datum: NAVD88

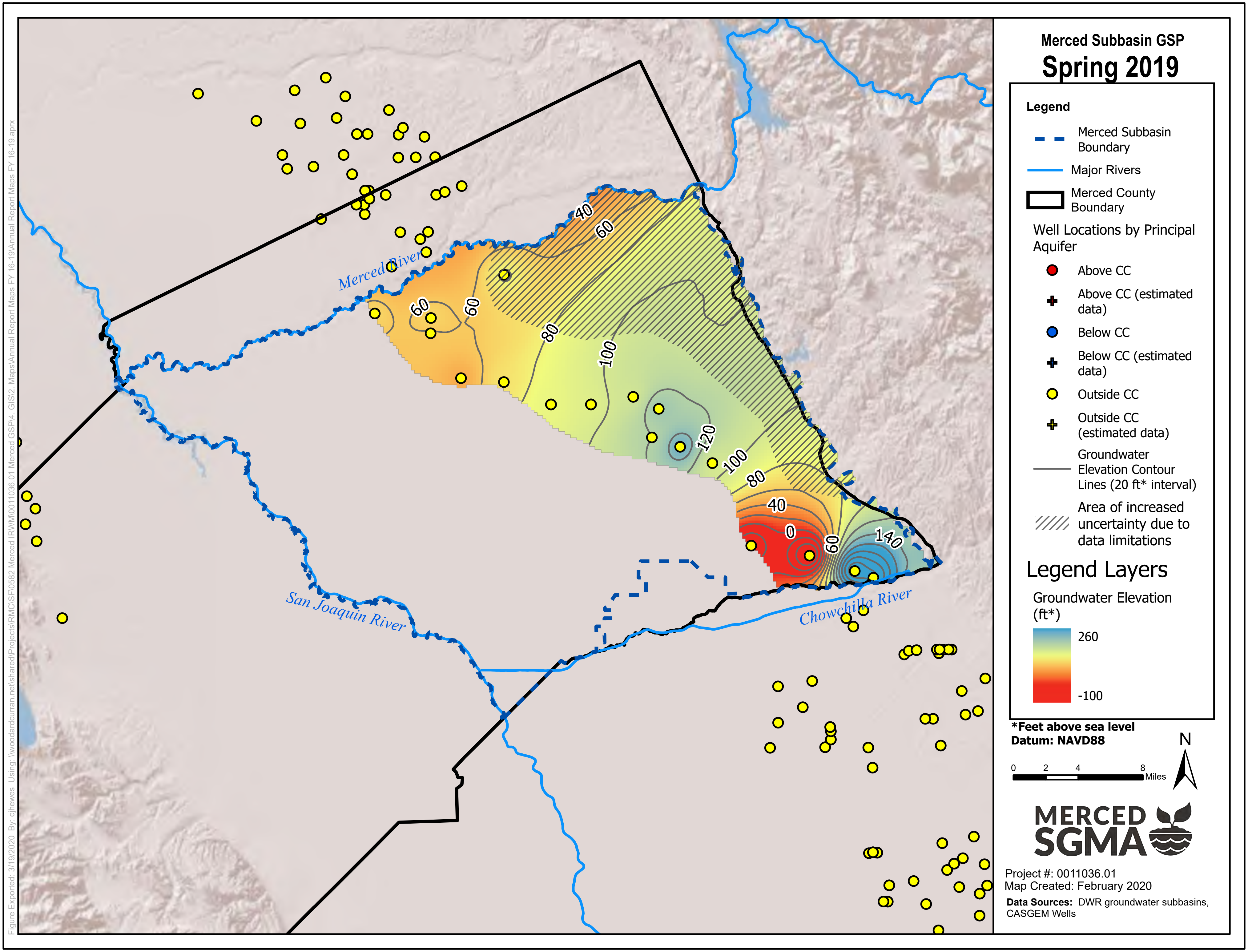
N

0 2 4 8 Miles

MERCED SGMA

Project #: 0011036.01
Map Created: February 2020

Data Sources: DWR groundwater subbasins, CASGEM Wells



Merced Subbasin GSP
Spring 2019
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer
Above CC
Above CC (estimated data)
Below CC
Below CC (estimated data)
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Legend Layers
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2020
Data Sources: DWR groundwater subbasins, CASGEM Wells
Merced River
San Joaquin River
Chowchilla River
40
60
80
100
120
140
0
Figure Exported: 3/19/2020 By: cjhewes Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\Annual Report Maps FY 16-19\Annual Report Maps FY 16-19.aprx

WOODARD
&CURRAN

woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS

Prepared by:

Woodard & Curran
801 T Street
Sacramento, CA 95811
916.999.8700

Image courtesy: Veronica Adrover/UC Merced