WATER YEAR	IRRIGATED ACRES	ET_c (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2003	2,000	5,300	4,500	4,500
2004	2,000	5,100	4,300	4,300
2005	2,000	4,900	4,000	4,000
2006	2,000	4,700	4,000	4,000
2007	2,000	5,700	5,000	5,000
2008	2,000	4,900	4,300	4,300
2009	2,000	5,400	4,600	4,600
2010	2,000	5,500	4,700	4,700
2011	2,000	5,100	4,300	4,300
2012	2,000	5,400	4,700	4,700

Table 63 - County of Madera Historic Water Budget Data

14.2.2 Current Water Budget for the County of Madera

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	IRRIGATED ACRES	ET_C (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2013	2,000	6,300	5,300	5,300

Table 64 - County of Madera Current Water Budget Data

14.2.3 Projected Water Budget for the County of Madera

The County of Madera - 3 GSA area that can be used for production is currently fully planted. Any increase in demand is directly tied to Climate Change. The same process outlined in Section 2.2.3.3 was used to determine climate change factors. Below is a table of the projected water budget. The projected consumptive use of applied water is anticipated to increase by 500 AF/year on average. The net groundwater extraction is equal to consumptive use and ranges from 4,100 to 6,200 AF/year. Section 14.3 will discuss SMC in order for the County of Madera - 3 GSA to be sustainable. Section 14.4 will discuss projects and management actions to offset the groundwater extractions in excess of the sustainable yield.

WATER YEAR	HISTORICAL REFERENCE USED FOR HYDROLOGY	HISTORICAL REFERENCE FOR WATER DELIVERY/DEMAND	SHASTA WATER YEAR DESIGNATION	WATER YEAR TYPE (SJ VALLEY)
2014	-	2014	Critical	Critically Dry
2015	-	2015	Critical	Critically Dry
2016	-	2016	Non-Critical	Dry
2017	-	2011	Non-Critical	Wet
2018	1979	2010	Non-Critical	Above Normal
2019	1980	2011	Non-Critical	Wet
2020	1981	2012	Non-Critical	Dry
2021	1982	2011	Non-Critical	Wet
2022	1983	2011	Non-Critical	Wet
2023	1984	2010	Non-Critical	Above Normal
2024	1985	2012	Non-Critical	Dry
2025	1986	2011	Non-Critical	Wet
2026	1987	2013	Non-Critical	Critically Dry
2027	1988	2013	Non-Critical	Critically Dry
2028	1989	2013	Non-Critical	Critically Dry
2029	1990	2013	Non-Critical	Critically Dry
2030	1991	2014	Critical	Critically Dry
2031	1992	2015	Critical	Critically Dry
2032	1993	2011	Non-Critical	Wet
2033	1994	2013	Non-Critical	Critically Dry
2034	1995	2011	Non-Critical	Wet
2035	1996	2011	Non-Critical	Wet
2036	1997	2011	Non-Critical	Wet
2037	1998	2011	Non-Critical	Wet
2038	1999	2010	Non-Critical	Above Normal
2039	2000	2010	Non-Critical	Above Normal
2040	2001	2012	Non-Critical	Dry
2041	2002	2012	Non-Critical	Dry
2042	2003	2003	Non-Critical	Below Normal
2043	2004	2004	Non-Critical	Dry
2044	2005	2005	Non-Critical	Wet
2045	2006	2006	Non-Critical	Wet
2046	2007	2007	Non-Critical	Critically Dry
2047	2008	2008	Non-Critical	Critically Dry
2048	2009	2009	Non-Critical	Below Normal
2049	2010	2010	Non-Critical	Above Normal
2050	2011	2011	Non-Critical	Wet
2051	2001	2012	Non-Critical	Dry
2052	1992	2013	Non-Critical	Critically Dry
2053	1976	2014	Critical	Critically Dry
2054	1977	2015	Critical	Critically Dry
2055	2002	2016	Non-Critical	Dry
2056	2011	2011	Non-Critical	Wet
2057	1965	2011	Non-Critical	Wet
2058	1966	2009	Non-Critical	Below Normal
2059	1967	2011	Non-Critical	Wet
2060	1968	2012	Non-Critical	Dry
2061	1969	2011	Non-Critical	Wet
2062	1970	2010	Non-Critical	Above Normal
2063	1971	2009	Non-Critical	Below Normal
2064	1972	2012	Non-Critical	Dry
2065	1973	2010	Non-Critical	Above Normal
2066	1974	2011	Non-Critical	Wet
2067	1975	2011	Non-Critical	Wet
2068	1976	2014	Critical	Critically Dry
2069	1977	2015	Critical	Critically Dry
2070	1978	2011	Non-Critical	Wet

Table 65 – County of Madera Projected Water Budget Water Year Data

WATER YEAR	IRRIGATED ACRES	CLIMATE CHANGE FACTOR	TOTAL ET_c WITH CLIMATE CHANGE	TOTAL ET_{IW} WITH CLIMATE CHANGE	EFFECTIVE PUMPING (AF)
2014	2,000	-	5,300	4,600	4,600
2015	2,000	-	5,500	4,700	4,700
2016	2,000	-	6,700	5,800	5,800
2017	2,000	-	5,100	4,300	4,300
2018	2,000	1.033	5,700	4,900	4,900
2019	2,000	1.034	5,300	4,400	4,400
2020	2,000	1.033	5,600	4,900	4,900
2021	2,000	1.028	5,200	4,400	4,400
2022	2,000	1.035	5,300	4,500	4,500
2023	2,000	1.027	5,600	4,800	4,800
2024	2,000	1.03	5,600	4,800	4,800
2025	2,000	1.037	5,300	4,500	4,500
2026	2,000	1.028	6,500	5,400	5,400
2027	2,000	1.027	6,500	5,400	5,400
2028	2,000	1.031	6,500	5,500	5,500
2029	2,000	1.024	6,500	5,400	5,400
2030	2,000	1.029	5,500	4,700	4,700
2031	2,000	1.03	5,700	4,800	4,800
2032	2,000	1.028	5,200	4,400	4,400
2033	2,000	1.03	6,500	5,500	5,500
2034	2,000	1.033	5,300	4,400	4,400
2035	2,000	1.028	5,200	4,400	4,400
2036	2,000	1.028	5,200	4,400	4,400
2037	2,000	1.032	5,300	4,400	4,400
2038	2,000	1.03	5,700	4,800	4,800
2039	2,000	1.033	5,700	4,900	4,900
2040	2,000	1.023	5,500	4,800	4,800
2041	2,000	1.028	5,600	4,800	4,800
2042	2,000	1.03	5,500	4,600	4,600
2043	2,000	1.028	5,200	4,400	4,400
2044	2,000	1.028	5,000	4,100	4,100
2045	2,000	1.033	4,900	4,100	4,100
2046	2,000	1.075	6,100	5,400	5,400
2047	2,000	1.078	5,300	4,600	4,600
2048	2,000	1.084	5,900	5,000	5,000
2049	2,000	1.082	6,000	5,100	5,100
2050	2,000	1.089	5,600	4,700	4,700
2051	2,000	1.07	5,800	5,000	5,000
2052	2,000	1.093	6,900	5,800	5,800
2053	2,000	1.081	5,700	5,000	5,000
2054	2,000	1.08	5,900	5,100	5,100
2055	2,000	1.07	7,200	6,200	6,200
2056	2,000	1.089	5,600	4,700	4,700
2057	2,000	1.083	5,500	4,700	4,700
2058	2,000	1.088	5,900	5,000	5,000
2059	2,000	1.085	5,500	4,700	4,700
2060	2,000	1.079	5,800	5,100	5,100
2061	2,000	1.086	5,500	4,700	4,700
2062	2,000	1.082	6,000	5,100	5,100
2063	2,000	1.088	5,900	5,000	5,000
2064	2,000	1.09	5,900	5,100	5,100
2065	2,000	1.083	6,000	5,100	5,100
2066	2,000	1.086	5,500	4,700	4,700
2067	2,000	1.093	5,600	4,700	4,700
2068	2,000	1.081	5,700	5,000	5,000
2069	2,000	1.08	5,900	5,100	5,100
2070	2,000	1.068	5,400	4,600	4,600

Table 66 - County of Madera Projected Water Budget

14.3 Sustainable Management Criteria for the County of Madera

The County of Madera - 3 GSA has historically relied completely on groundwater extraction to meet demand. Groundwater overdraft in this area has primarily been offset by recharge from the SJREC service area and seepage from the San Joaquin River. The SJREC are invested in helping the County to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the County of Madera on Projects and Management actions to offset groundwater extractions by the County white area that is above their sustainable yield.

The historical consumptive use for the County of Madera was about 4,400 AF/year which equates to an average use of about 2.2 AF/acre for irrigated acres and about 1.4 AF/acre for the total area covered by the GSA. The sustainable yield for the County is 1,200 AF/year which leave a 3,200 AF/year consumptive use deficit that needs to me bet through projects and management actions. While the County of Madera - 3 GSA lies in the SJREC Monitoring Zone J, different SMC is developed in order for the County to achieve independent groundwater sustainability.

14.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the County of Madera - 3 GSA are positively impacted through recharge from the SJREC and seepage from the San Joaquin River. Water levels in the Monitoring Zone J will be used to sustainably manage groundwater levels around the County area. Sustainable groundwater management for the County is best achieved by offsetting overdraft through the implementation of projects and management actions.

14.3.2 Reduction in Groundwater Storage

Groundwater storage under the County of Madera - 3 GSA is positively impacted through recharge from the SJREC and seepage from the San Joaquin River. Managing groundwater storage for the County will be accomplished through updated water budgets for the County white areas. Sustainable groundwater management for the County is best achieved by offsetting overdraft through the implementation of projects and management actions.

14.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

14.3.4 Degraded Water Quality

Madera County is managing groundwater quality similar to the SJREC GSA. Salinity is the major water quality concern in the area. Madera County will monitor electrical conductivity and impose management actions as necessary. Currently no management actions are recommended to supplement the SJREC GSA management efforts. For more details refer to the following Sections in this GSP: 3.2.4, 3.3.4, and 3.4.4.

14.3.5 Land Subsidence

It is anticipated that the County of Madera - 3 GSA does not operate any wells perforated below the Corcoran Clay. As a result, inelastic land subsidence is unlikely to occur as a result of pumping from the wells within the GSA area. Therefore, no SMC have been established for this sustainability indicator.

The SJREC will continue to work with the County of Madera to monitor subsidence and work with regional partners on solutions if subsidence is observed and may cause damage to critical infrastructure.

14.3.6 Depletions of Interconnected Surface Water

The County of Madera plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. For more details refer to the following Sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

14.4 Projects and Management Actions for the County of Madera

In order to maintain sustainability for each GSA in the SJREC GSP group, the County is committed to offsetting estimated groundwater overdraft. Each project will be analyzed jointly with the County and the SJREC to maximize the regional benefits. The County is pursuing the following projects as a way to offset demand; 1) purchasing groundwater credits and 2) participation in recharge projects.

The SJREC will continue to work with the County to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources.

14.5 Plan Implementation for the County of Madera

The cost to develop and implement the GSP specific to the County of Madera has been cost shared at 50% between the SJREC GSA and the County of Madera - 3 GSA. Additionally, the SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the County of Madera - 3 GSA. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Mendota area was the implementation of monitoring and management program for well water transfers near the Mendota Pool. The SJREC worked with the regional water leaders to develop and implement a plan that would maximize water resources without sacrificing the needs of the local communities. As a result, water levels have remained fairly stable and none of the wells pumping as part of the program are contributing to land subsidence. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the County, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

15.0 PORTION OF MERCED COUNTY DELTA-MENDOTA GSA AREA

15.1 Background for County of Merced

There are 17,483 acres of lands not in a public water district, white area, in the portion of the County of Merced – Delta-Mendota GSA that has been included in the SJREC GSP; refer to Figure 2 for a graphical depiction of the area. The SJREC worked with County leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the County white areas. The County agreed to file as the GSA over the County white areas and worked with the SJREC and the GWD GSA to include the Merced County Delta-Mendota GSA lands in both the GGSA's GSP and the SJREC GSP. It was mutually determined that the logical approach would be to include most of the farming and industry lands in the SJREC GSP and include the managed duck clubs in the GGSA's GSP. The SJREC and the County of Merced agreed to include those lands in a discrete Section in the SJREC GSP.

The Merced County – Delta-Mendota GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 of this GSP describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix I for a discussion on the basin setting for the SJREC GSA and surrounding areas including the Portion of the County of Merced – Delta-Mendota GSA area in the SJREC GSP. The Water Budget, Sustainable Management Criteria and Projects & Management Actions are included below.

15.2 Water Budgets for the County of Merced

Presented herein is the compilation of the historic, current and projected water budgets specific to the portion of the County of Merced – Delta-Mendota GSA within the SJREC GSP.

Most of the data was collected using LandSAT, aerial imagery and local knowledge of the lands. While the portion of the County of Merced – Delta-Mendota GSA is fairly large, most of the lands aren't irrigated agriculture and predominantly rely on precipitation or are not actively using groundwater.

15.2.1 Historic Water Budget for the County of Merced

The portion of the County of Merced – Delta-Mendota GSA in the SJREC GSP encompasses 17,483 acres of land. Of that, about 5,000 acres are actively farmed, 2,500 acres encompass the footprint of three tomato processing plants (Industry) and about 10,000 acres are not actively farmed and do not pump groundwater. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. There are three tomato processing plants that pump groundwater for plant operations. The process water is used to irrigate crops and the plants also treat the process water and use for habitat. The consumptive use for the Industry includes pond evaporation. LandSAT data, aerial imagery and site visits were used to determine an approximated total irrigated acreage for this GSA. The crop coefficient method described in Section 2.2.3.1, similar to the SJREC GSA, was used to determine the crop consumptive use for irrigated agriculture. Consumptive use during this timeframe ranged from 6,100 to 8,000 AF/year with an average of approximately 7,000 AF/year. The approximate sustainable yield for the County of Merced – Delta-Mendota GSA is 0.40 acre-feet/acre or about 7,000 acre-feet/year. The estimated effective pumping of 7,000 AF/year is considered within the range of uncertainty of the estimate of sustainable yield for the portion of the Merced County – Delta-

Mendota GSA in the SJREC GSP. As such, no immediate actions are anticipated to reduce pumping or augment recharge in the GSA, and steps to achieve independent sustainability of the GSA are anticipated during Plan implementation.

WATER YEAR	MERCED COUNTY - GSA ACRES	IRRIGATED INDUSTRY ACRES	IRRIGATED AG ACRES	ET_C (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2003	17,500	1,800	5,000	8,600	6,700	6,700
2004	17,500	1,800	5,000	10,100	8,000	8,000
2005	17,500	1,800	5,000	9,000	6,200	6,200
2006	17,500	1,800	5,000	9,000	6,100	6,100
2007	17,500	1,800	5,000	9,200	7,800	7,800
2008	17,500	1,800	5,000	10,000	8,000	8,000
2009	17,500	1,800	5,000	10,100	7,700	7,700
2010	17,500	1,800	5,000	9,700	7,400	7,400
2011	17,500	1,800	5,000	9,400	7,200	7,200
2012	17,500	1,800	5,000	10,000	7,600	7,600

Table 67 - County of Merced Historic Water Budget Data

15.2.2 Current Water Budget for the County of Merced

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	MERCED COUNTY - GSA ACRES	IRRIGATED INDUSTRY ACRES	IRRIGATED AG ACRES	ETC (AF)	ETiw (AF)	EFFECTIVE PUMPING (AF)
2013	17,500	1,800	5,000	9,900	7,500	7,500

Table 68 - County of Merced Current Water Budget Data

15.2.3 Projected Water Budget for the County of Merced

The portion of the Merced County – Delta-Mendota GSA in the SJREC GSP, is not anticipated to increase the acreage of irrigated agriculture. Any increase in demand is more likely to be directly tied to Climate Change. The same process outlined in Section 2.2.3.3 was used to estimate climate change factors. Below is a table of the projected water budget. The projected consumptive use of applied water is anticipated to increase slightly during the projected water budget. The consumptive use of applied water ranges from 6,300 to 8,600 AF/year with an average of 7,700 AF/year. Section 15.3 will discuss SMC in order for the portion of Merced County - Delta-Mendota GSA in the SJREC GSP, to be sustainable. Section 15.4 will discuss projects and management actions to offset groundwater extractions in excess of the sustainable yield.

WATER YEAR	HISTORICAL REFERENCE USED FOR HYDROLOGY	HISTORICAL REFERENCE FOR WATER DELIVERY/DEMAND	SHASTA WATER YEAR DESIGNATION	WATER YEAR TYPE (SJ VALLEY)
2014	-	2014	Critical	Critically Dry
2015	-	2015	Critical	Critically Dry
2016	-	2016	Non-Critical	Dry
2017	-	2011	Non-Critical	Wet
2018	1979	2010	Non-Critical	Above Normal
2019	1980	2011	Non-Critical	Wet
2020	1981	2012	Non-Critical	Dry
2021	1982	2011	Non-Critical	Wet
2022	1983	2011	Non-Critical	Wet
2023	1984	2010	Non-Critical	Above Normal
2024	1985	2012	Non-Critical	Dry
2025	1986	2011	Non-Critical	Wet
2026	1987	2013	Non-Critical	Critically Dry
2027	1988	2013	Non-Critical	Critically Dry
2028	1989	2013	Non-Critical	Critically Dry
2029	1990	2013	Non-Critical	Critically Dry
2030	1991	2014	Critical	Critically Dry
2031	1992	2015	Critical	Critically Dry
2032	1993	2011	Non-Critical	Wet
2033	1994	2013	Non-Critical	Critically Dry
2034	1995	2011	Non-Critical	Wet
2035	1996	2011	Non-Critical	Wet
2036	1997	2011	Non-Critical	Wet
2037	1998	2011	Non-Critical	Wet
2038	1999	2010	Non-Critical	Above Normal
2039	2000	2010	Non-Critical	Above Normal
2040	2001	2012	Non-Critical	Dry
2041	2002	2012	Non-Critical	Dry
2042	2003	2003	Non-Critical	Below Normal
2043	2004	2004	Non-Critical	Dry
2044	2005	2005	Non-Critical	Wet
2045	2006	2006	Non-Critical	Wet
2046	2007	2007	Non-Critical	Critically Dry
2047	2008	2008	Non-Critical	Critically Dry
2048	2009	2009	Non-Critical	Below Normal
2049	2010	2010	Non-Critical	Above Normal
2050	2011	2011	Non-Critical	Wet
2051	2001	2012	Non-Critical	Dry
2052	1992	2013	Non-Critical	Critically Dry
2053	1976	2014	Critical	Critically Dry
2054	1977	2015	Critical	Critically Dry
2055	2002	2016	Non-Critical	Dry
2056	2011	2011	Non-Critical	Wet
2057	1965	2011	Non-Critical	Wet
2058	1966	2009	Non-Critical	Below Normal
2059	1967	2011	Non-Critical	Wet
2060	1968	2012	Non-Critical	Dry
2061	1969	2011	Non-Critical	Wet
2062	1970	2010	Non-Critical	Above Normal
2063	1971	2009	Non-Critical	Below Normal
2064	1972	2012	Non-Critical	Dry
2065	1973	2010	Non-Critical	Above Normal
2066	1974	2011	Non-Critical	Wet
2067	1975	2011	Non-Critical	Wet
2068	1976	2014	Critical	Critically Dry
2069	1977	2015	Critical	Critically Dry
2070	1978	2011	Non-Critical	Wet

Table 69 – County of Merced Projected Water Budget Water Year Data

WATER YEAR	MERCED COUNTY - GSA ACRES	IRRIGATED INDUSTRY ACRES	IRRIGATED AG ACRES	CLIMATE CHANGE FACTOR	ET_c (AF)	ET_{iw} (AF)	TOTAL ET_c WITH CLIMATE CHANGE	TOTAL ET_{IW} WITH CLIMATE CHANGE	EFFECTIVE PUMPING (AF)
2014	17,500	1,800	5,000	1	10,200	7,800	10,200	7,800	7,800
2015	17,500	1,800	5,000	1	8,800	6,700	8,800	6,700	6,700
2016	17,500	1,800	5,000	1	9,600	7,300	9,600	7,300	7,300
2017	17,500	1,800	5,000	1	9,400	7,200	9,400	7,200	7,200
2018	17,500	1,800	5,000	1.035	9,700	7,400	10,000	7,700	7,700
2019	17,500	1,800	5,000	1.034	9,400	7,200	9,700	7,400	7,400
2020	17,500	1,800	5,000	1.036	10,000	7,600	10,400	7,900	7,900
2021	17,500	1,800	5,000	1.034	9,400	7,200	9,700	7,400	7,400
2022	17,500	1,800	5,000	1.035	9,400	7,200	9,700	7,500	7,500
2023	17,500	1,800	5,000	1.026	9,700	7,400	10,000	7,600	7,600
2024	17,500	1,800	5,000	1.036	10,000	7,600	10,400	7,900	7,900
2025	17,500	1,800	5,000	1.041	9,400	7,200	9,800	7,500	7,500
2026	17,500	1,800	5,000	1.034	9,900	7,500	10,200	7,800	7,800
2027	17,500	1,800	5,000	1.032	9,900	7,500	10,200	7,700	7,700
2028	17,500	1,800	5,000	1.033	9,900	7,500	10,200	7,700	7,700
2029	17,500	1,800	5,000	1.027	9,900	7,500	10,200	7,700	7,700
2030	17,500	1,800	5,000	1.029	10,200	7,800	10,500	8,000	8,000
2031	17,500	1,800	5,000	1.034	8,800	6,700	9,100	6,900	6,900
2032	17,500	1,800	5,000	1.035	9,400	7,200	9,700	7,500	7,500
2033	17,500	1,800	5,000	1.031	9,900	7,500	10,200	7,700	7,700
2034	17,500	1,800	5,000	1.037	9,400	7,200	9,700	7,500	7,500
2035	17,500	1,800	5,000	1.029	9,400	7,200	9,700	7,400	7,400
2036	17,500	1,800	5,000	1.03	9,400	7,200	9,700	7,400	7,400
2037	17,500	1,800	5,000	1.033	9,400	7,200	9,700	7,400	7,400
2038	17,500	1,800	5,000	1.035	9,700	7,400	10,000	7,700	7,700
2039	17,500	1,800	5,000	1.034	9,700	7,400	10,000	7,700	7,700
2040	17,500	1,800	5,000	1.03	10,000	7,600	10,300	7,800	7,800
2041	17,500	1,800	5,000	1.032	10,000	7,600	10,300	7,800	7,800
2042	17,500	1,800	5,000	1.032	8,600	6,700	8,900	6,900	6,900
2043	17,500	1,800	5,000	1.027	10,100	8,000	10,400	8,200	8,200
2044	17,500	1,800	5,000	1.036	9,000	6,200	9,300	6,400	6,400
2045	17,500	1,800	5,000	1.034	9,000	6,100	9,300	6,300	6,300
2046	17,500	1,800	5,000	1.079	9,200	7,800	9,900	8,400	8,400
2047	17,500	1,800	5,000	1.077	10,000	8,000	10,800	8,600	8,600
2048	17,500	1,800	5,000	1.079	10,100	7,700	10,900	8,300	8,300
2049	17,500	1,800	5,000	1.083	9,700	7,400	10,500	8,000	8,000
2050	17,500	1,800	5,000	1.083	9,400	7,200	10,200	7,800	7,800
2051	17,500	1,800	5,000	1.074	10,000	7,600	10,700	8,200	8,200
2052	17,500	1,800	5,000	1.086	9,900	7,500	10,800	8,100	8,100
2053	17,500	1,800	5,000	1.086	10,200	7,800	11,100	8,500	8,500
2054	17,500	1,800	5,000	1.078	8,800	6,700	9,500	7,200	7,200
2055	17,500	1,800	5,000	1.081	9,600	7,300	10,400	7,900	7,900
2056	17,500	1,800	5,000	1.083	9,400	7,200	10,200	7,800	7,800
2057	17,500	1,800	5,000	1.083	9,400	7,200	10,200	7,800	7,800
2058	17,500	1,800	5,000	1.086	10,100	7,700	11,000	8,400	8,400
2059	17,500	1,800	5,000	1.083	9,400	7,200	10,200	7,800	7,800
2060	17,500	1,800	5,000	1.085	10,000	7,600	10,900	8,200	8,200
2061	17,500	1,800	5,000	1.086	9,400	7,200	10,200	7,800	7,800
2062	17,500	1,800	5,000	1.076	9,700	7,400	10,400	8,000	8,000
2063	17,500	1,800	5,000	1.087	10,100	7,700	11,000	8,400	8,400
2064	17,500	1,800	5,000	1.085	10,000	7,600	10,900	8,200	8,200
2065	17,500	1,800	5,000	1.081	9,700	7,400	10,500	8,000	8,000
2066	17,500	1,800	5,000	1.087	9,400	7,200	10,200	7,800	7,800
2067	17,500	1,800	5,000	1.084	9,400	7,200	10,200	7,800	7,800
2068	17,500	1,800	5,000	1.086	10,200	7,800	11,100	8,500	8,500
2069	17,500	1,800	5,000	1.078	8,800	6,700	9,500	7,200	7,200
2070	17,500	1,800	5,000	1.072	9,400	7,200	10,100	7,700	7,700

Table 70 - County of Merced Projected Water Budget

15.3 Sustainable Management Criteria for the County of Merced

The portion of the Merced County – Delta-Mendota GSA in the SJREC GSP, has historically relied on groundwater extraction to meet demand due to lack of other supply options. Groundwater use in this area has primarily been offset by recharge from the SJREC service area, deep percolation from applied water and precipitation, and subsurface flows. The SJREC are invested in helping the Merced County – Delta-Mendota GSA to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the Merced County – Delta-Mendota GSA on Projects and Management actions to offset groundwater extractions by the County white area that are estimated to be above their sustainable yield.

Currently, the portion of the Merced County – Delta-Mendota GSA is sustainable from a water budget standpoint. The historical consumptive use for the County of Merced was about 7,000 AF/year which equates to an average use of about 1.0 AF/acre for irrigated acres and about 0.4 AF/acre for the total area covered by the GSA. The sustainable yield for the County is 7,000 AF/year. While a majority of the County of Merced GSA is mostly adjacent to the SJREC Monitoring Zones B and C, different SMC is developed in order for the County to achieve independent groundwater sustainability.

15.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the portion of the County of Merced – Delta-Mendota GSA in the SJREC GSP are positively impacted through recharge from the SJREC service area. Water levels in the SJREC Monitoring Zones will be used to sustainably manage groundwater levels around the County area. Sustainable groundwater management for the County is best achieved by offsetting use through the implementation of projects and management actions to avoid overdraft.

15.3.2 Reduction in Groundwater Storage

Groundwater storage under the portion of the Merced County – Delta-Mendota GSA in the SJREC GSP is positively impacted through recharge from the SJREC service area. Managing groundwater storage for the County will be accomplished through updated water budgets for the County white areas. Sustainable groundwater management for the County is best achieved by offsetting use through the implementation of projects and management actions to avoid overdraft.

15.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

15.3.4 Degraded Water Quality

Merced County is managing groundwater quality similar to the SJREC GSA. Salinity is the major water quality concern in the area. Electrical conductivity will be monitored and management actions will be developed as necessary. Currently no management actions are recommended to supplement the SJREC GSA management efforts. For more details refer to the following Sections in this GSP: 3.2.4, 3.3.4, and 3.4.4.

15.3.5 Land Subsidence

It is assumed that the portion of the Merced County – Delta-Mendota GSA in the SJREC GSP may have wells perforated below the Corcoran Clay. Even so, significant land surface subsidence has not been observed in this area. The SJREC GSA and the Merced County – Delta-Mendota GSA will work with the landowners to better understand well construction throughout the irrigated areas. The SJREC will continue to work with the County of Merced to monitor subsidence and work with regional partners on solutions if subsidence is observed and may cause damage to critical infrastructure.

15.3.6 Depletions of Interconnected Surface Water

The County of Merced plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. The portion of the Merced County – Delta-Mendota GSA in the SJREC GSP Group does not include lands adjacent to interconnected surface water. For more details refer to the following Sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

15.4 Projects and Management Actions for the County of Merced

In order to maintain sustainability for each GSA in the SJREC GSP group, the Merced County – Delta-Mendota GSA is committed to offsetting groundwater extractions above their sustainable yield. Each project will be analyzed jointly with the County and the SJREC to maximize the regional benefits. Options to offset demand include; 1) purchasing groundwater credits, 2) participation in recharge projects, and 3) reducing pumping elsewhere in the GSA.

The SJREC will continue to work with the County to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources.

15.5 Plan Implementation for the County of Merced

The cost to develop and implement the GSP specific to the portion of the Merced County – Delta-Mendota GSA has been fully funded by the County of Merced. The SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the portion of the Merced County – Delta-Mendota GSA in the SJREC GSP.

The SJREC GSP Group has been, and will continue to, sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Los Banos Creek area was the implementation of a representative well with a trigger level to limit groundwater transfers from the area. As a result of the annual groundwater investigations prepared by the SJREC, the problem presented itself along with a solution to mitigate the concern; resulting in the aquifer fully recovering after water levels dropped below established triggers and no long-term lowering of the aquifer was experienced. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the County, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

16.0 PORTION OF FRESNO COUNTY MANAGEMENT AREA B GSA AREA

16.1 Background for County of Fresno

There is about 1,800 acres of lands not in a public water district, white area, in the Portion of the Fresno County Management Area B that has been included in the SJREC GSP; refer to Figure 2 for a graphical depiction of the area. The SJREC worked with County leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the County White Areas. It was mutually agreed that the SJREC will work with the County to develop the requirements in the GSP and to include this in a discrete section of this plan.

The SJREC are committed to assist the County to maintain sustainability through the planning and implementation horizon. The Fresno County Management Area B GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 of this GSP describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix I for a discussion on the basin setting for the SJREC GSA and surrounding areas including the portion of the County of Fresno Management Area B GSA area in the SJREC GSP. The Water Budget, Sustainable Management Criteria and Projects & Management Actions are included below.

16.2 Water Budgets for the County of Fresno

Presented herein is the compilation of the historic, current and projected water budgets specific to the Portion of the County of Fresno – Management Area B GSA within the SJREC GSP.

16.2.1 Historic Water Budget for the County of Fresno

The portion of the County of Fresno Management Area B GSA in the SJREC GSP encompasses about 1,800 acres of land. Of that, about 550 acres are actively farmed and the remaining acres are not actively farmed and do not pump groundwater. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. It is assumed that all of the ET_{iw} needed to grow the crops in the area was met by pumping groundwater. Groundwater pumping during this timeframe ranged from 100 to 1,200 AF/year with an average pumping of 500 AF/year. The approximate sustainable yield for the Portion of the County of Fresno – Management Area B GSA is 0.40 acre-feet/acre or about 700 acre-feet/year.

WATER YEAR	IRRIGATED ACRES	ET_c (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2003	550	700	600	600
2004	550	800	700	700
2005	550	300	200	200
2006	550	300	200	200
2007	550	1,400	1,200	1,200
2008	550	1,100	900	900
2009	550	700	600	600
2010	550	200	100	100
2011	550	300	200	200
2012	550	900	700	700

Table 71 - County of Fresno Historic Water Budget Data

16.2.2 Current Water Budget for the County of Fresno

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	IRRIGATED ACRES	ET_C (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2013	550	900	700	700

Table 72 - County of Fresno Current Water Budget Data

16.2.3 Projected Water Budget for the County of Fresno

The Portion of the County of Fresno Management Area B GSA in the SJREC GSP, area that can be used for production is currently fully planted. Any increase in demand is directly tied to Climate Change. The same process outlined in Section 2.2.3.3 was used to determine climate change factors. Below is a table of the projected water budget. The projected consumptive use of applied water is anticipated to remain about the same during the projected water budget. The net groundwater extraction ranges from 100 to 1,300 AF/year. Section 16.3 will discuss SMC in order for the Portion of the County of Fresno Management Area B GSA in the SJREC GSP, to be sustainable. Section 16.4 will discuss projects and management actions to offset the groundwater extractions in excess of the sustainable yield.

WATER YEAR	HISTORICAL REFERENCE USED FOR HYDROLOGY	HISTORICAL REFERENCE FOR WATER DELIVERY/DEMAND	SHASTA WATER YEAR DESIGNATION	WATER YEAR TYPE (SJ VALLEY)
2014	-	2014	Critical	Critically Dry
2015	-	2015	Critical	Critically Dry
2016	-	2016	Non-Critical	Dry
2017	-	2011	Non-Critical	Wet
2018	1979	2010	Non-Critical	Above Normal
2019	1980	2011	Non-Critical	Wet
2020	1981	2012	Non-Critical	Dry
2021	1982	2011	Non-Critical	Wet
2022	1983	2011	Non-Critical	Wet
2023	1984	2010	Non-Critical	Above Normal
2024	1985	2012	Non-Critical	Dry
2025	1986	2011	Non-Critical	Wet
2026	1987	2013	Non-Critical	Critically Dry
2027	1988	2013	Non-Critical	Critically Dry
2028	1989	2013	Non-Critical	Critically Dry
2029	1990	2013	Non-Critical	Critically Dry
2030	1991	2014	Critical	Critically Dry
2031	1992	2015	Critical	Critically Dry
2032	1993	2011	Non-Critical	Wet
2033	1994	2013	Non-Critical	Critically Dry
2034	1995	2011	Non-Critical	Wet
2035	1996	2011	Non-Critical	Wet
2036	1997	2011	Non-Critical	Wet
2037	1998	2011	Non-Critical	Wet
2038	1999	2010	Non-Critical	Above Normal
2039	2000	2010	Non-Critical	Above Normal
2040	2001	2012	Non-Critical	Dry
2041	2002	2012	Non-Critical	Dry
2042	2003	2003	Non-Critical	Below Normal
2043	2004	2004	Non-Critical	Dry
2044	2005	2005	Non-Critical	Wet
2045	2006	2006	Non-Critical	Wet
2046	2007	2007	Non-Critical	Critically Dry
2047	2008	2008	Non-Critical	Critically Dry
2048	2009	2009	Non-Critical	Below Normal
2049	2010	2010	Non-Critical	Above Normal
2050	2011	2011	Non-Critical	Wet
2051	2001	2012	Non-Critical	Dry
2052	1992	2013	Non-Critical	Critically Dry
2053	1976	2014	Critical	Critically Dry
2054	1977	2015	Critical	Critically Dry
2055	2002	2016	Non-Critical	Dry
2056	2011	2011	Non-Critical	Wet
2057	1965	2011	Non-Critical	Wet
2058	1966	2009	Non-Critical	Below Normal
2059	1967	2011	Non-Critical	Wet
2060	1968	2012	Non-Critical	Dry
2061	1969	2011	Non-Critical	Wet
2062	1970	2010	Non-Critical	Above Normal
2063	1971	2009	Non-Critical	Below Normal
2064	1972	2012	Non-Critical	Dry
2065	1973	2010	Non-Critical	Above Normal
2066	1974	2011	Non-Critical	Wet
2067	1975	2011	Non-Critical	Wet
2068	1976	2014	Critical	Critically Dry
2069	1977	2015	Critical	Critically Dry
2070	1978	2011	Non-Critical	Wet

Table 73 – County of Fresno Projected Water Budget Water Year Data

WATER YEAR	IRRIGATED ACRES	CLIMATE CHANGE FACTOR	TOTAL ET_c WITH CLIMATE CHANGE	TOTAL ET_{IW} WITH CLIMATE CHANGE	EFFECTIVE PUMPING (AF)
2014	550	-	500	400	400
2015	550	-	300	300	300
2016	550	-	500	400	400
2017	550	-	300	200	200
2018	550	1.038	200	100	100
2019	550	1.034	300	200	200
2020	550	1.031	900	700	700
2021	550	1.034	300	200	200
2022	550	1.038	300	200	200
2023	550	1.035	200	100	100
2024	550	1.034	900	700	700
2025	550	1.038	300	200	200
2026	550	1.033	900	700	700
2027	550	1.027	900	700	700
2028	550	1.032	900	700	700
2029	550	1.03	900	700	700
2030	550	1.029	500	400	400
2031	550	1.032	300	300	300
2032	550	1.032	300	200	200
2033	550	1.031	900	700	700
2034	550	1.033	300	200	200
2035	550	1.026	300	200	200
2036	550	1.03	300	200	200
2037	550	1.034	300	200	200
2038	550	1.031	200	100	100
2039	550	1.033	200	100	100
2040	550	1.028	900	700	700
2041	550	1.028	900	700	700
2042	550	1.032	700	600	600
2043	550	1.032	800	700	700
2044	550	1.034	300	200	200
2045	550	1.03	300	200	200
2046	550	1.081	1,500	1,300	1,300
2047	550	1.081	1,200	1,000	1,000
2048	550	1.087	800	700	700
2049	550	1.088	200	100	100
2050	550	1.093	300	200	200
2051	550	1.08	1,000	800	800
2052	550	1.093	1,000	800	800
2053	550	1.084	500	400	400
2054	550	1.079	300	300	300
2055	550	1.075	500	400	400
2056	550	1.093	300	200	200
2057	550	1.093	300	200	200
2058	550	1.091	800	700	700
2059	550	1.087	300	200	200
2060	550	1.081	1,000	800	800
2061	550	1.089	300	200	200
2062	550	1.083	200	100	100
2063	550	1.093	800	700	700
2064	550	1.091	1,000	800	800
2065	550	1.084	200	100	100
2066	550	1.087	300	200	200
2067	550	1.098	300	200	200
2068	550	1.084	500	400	400
2069	550	1.079	300	300	300
2070	550	1.071	300	200	200

Table 74 - County of Fresno Projected Water Budget

16.3 Sustainable Management Criteria for the County of Fresno

The portion of the County of Fresno Management Area B GSA in the SJREC GSP, has historically relied on groundwater extraction to meet demand. Groundwater overdraft in this area has primarily been offset by recharge from the SJREC service area and seepage from the San Joaquin River. The SJREC are invested in helping the County to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the County of Fresno on Projects and Management actions to offset groundwater extractions by the County white area that is above their sustainable yield.

The historical consumptive use for the County of Fresno was about 500 AF/year which equates to an average use of about 1.0 AF/acre for irrigated acres and about 0.3 AF/acre for the total area covered by the GSA. The sustainable yield for the County is 700 AF/year. While the County of Fresno GSA is mostly adjacent to the SJREC Monitoring Zone J, different SMC is developed in order for the County to achieve independent groundwater sustainability.

16.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the portion of the County of Fresno Management Area B GSA in the SJREC GSP are positively impacted through recharge from the SJREC service area and seepage from the San Joaquin River. Water levels in the SJREC Monitoring Zone J will be used to sustainably manage groundwater levels around the County area. Sustainable groundwater management for the County is best achieved by offsetting overdraft through the implementation of projects and management actions.

16.3.2 Reduction in Groundwater Storage

Groundwater storage under the portion of the County of Fresno Management Area B GSA in the SJREC GSP is positively impacted through recharge from the SJREC and seepage from the San Joaquin River. Managing groundwater storage for the County will be accomplished through updated water budgets for the County white areas. Sustainable groundwater management for the County is best achieved by offsetting overdraft through the implementation of projects and management actions.

16.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

16.3.4 Degraded Water Quality

Fresno County is managing groundwater quality similar to the SJREC GSA. Salinity is the major water quality concern in the area. Fresno County will monitor electrical conductivity and impose management actions as necessary. Currently no management actions are recommended to supplement the SJREC GSA management efforts. For more details refer to the following Sections in this GSP: 3.2.4, 3.3.4, and 3.4.4.

16.3.5 Land Subsidence

It is anticipated that the portion of the County of Fresno Management Area B GSA in the SJREC GSP does not operate any wells perforated below the Corcoran Clay. As a result, inelastic land subsidence is unlikely to occur as a result of pumping from the wells within the GSA area. Therefore, no SMC have been established for this sustainability indicator. The SJREC will continue to work with the County of

Fresno to monitor subsidence and work with regional partners on solutions if subsidence is observed and may cause damage to critical infrastructure.

16.3.6 Depletions of Interconnected Surface Water

The County of Fresno plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. For more details refer to the following Sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

16.4 Projects and Management Actions for the County of Fresno

In order to maintain sustainability for each GSA in the SJREC GSP group, the County is committed to offsetting groundwater extractions above their sustainable yield. Each project will be analyzed jointly with the County and the SJREC to maximize the regional benefits. The County is pursuing the following projects as a way to offset demand; 1) purchasing groundwater credits and 2) participation in recharge projects.

The SJREC will continue to work with the County to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources.

16.5 Plan Implementation for the County of Fresno

The cost to develop and implement the GSP specific to the portion of the County of Fresno has been cost shared at 50% between the SJREC GSA and the County of portion of the County of Fresno Management Area B GSA in the SJREC GSP. Additionally, the SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the portion of the County of Fresno Management Area B GSA in the SJREC GSP. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Mendota area was the implementation of monitoring and management program for well water transfers near the Mendota Pool. The SJREC worked with the regional water leaders to develop and implement a plan that would maximize water resources without sacrificing the needs of the local communities. As a result, water levels have remained fairly stable and none of the wells pumping as part of the program are contributing to land subsidence. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the County, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

APPENDICES

Appendix A. Senate Bill 372
Appendix B. Delta-Mendota Subbasin Common Chapter (including Coordination Agreement)
Appendix C. Cost Sharing Agreement – Delta-Mendota Subbasin Coordination
Appendix D. Notice of Intent to Develop a GSP
Appendix E. List of Public Meetings
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Appendix Q. Update on Groundwater Conditions in the Newman Sub-Area of the SJREC GSP
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Appendix T. Groundwater Conditions in the Dos Palos Sub-Area of the SJREC GSP
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Appendix W. Groundwater Conditions in the Turner Island Water District – 2 GSA

Appendix A. Senate Bill 372

Senate Bill No. 372

CHAPTER 357

An act to amend Section 10723 of the Water Code, and to create the San Joaquin River Exchange Contractors Groundwater Sustainability Agency, and prescribing its boundaries, organization, operation, management, financing, and other powers and duties, relating to water districts, and declaring the urgency thereof, to take effect immediately.

[Approved by Governor September 28, 2017. Filed with
Secretary of State September 28, 2017.]

LEGISLATIVE COUNSEL'S DIGEST

SB 372, Cannella. San Joaquin River Exchange Contractors Groundwater Sustainability Agency.

Existing law, the Sustainable Groundwater Management Act, requires all groundwater basins designated as high- or medium-priority basins by the Department of Water Resources that are designated as basins subject to critical conditions of overdraft to be managed under a groundwater sustainability plan or coordinated groundwater sustainability plans by January 31, 2020, and requires all other groundwater basins designated as high- or medium-priority basins to be managed under a groundwater sustainability plan or coordinated groundwater sustainability plans by January 31, 2022, except as specified. The act authorizes any local agency or combination of local agencies overlying a groundwater basin to decide to become a groundwater sustainability agency for that basin. The act deems certain agencies created by statute to manage groundwater the exclusive local agencies within their respective statutory boundaries with powers to comply with the act and authorizes these agencies to opt out of being the exclusive groundwater management agency.

This bill would create the San Joaquin River Exchange Contractors Groundwater Sustainability Agency as the exclusive groundwater sustainability agency and successor in interest to the agency that submitted a notice of intent to become a groundwater sustainability agency to the department on December 22, 2015. The bill would establish the boundaries of the agency and would authorize the agency's boundaries to be changed. The bill would require the agency to develop and implement a groundwater sustainability plan to achieve sustainable groundwater management within the territory of the agency. The bill would generally specify the powers and purposes of the agency. The bill would prescribe the composition of the 4-member board of directors of the agency and would require members and alternates to be chosen by member agencies, as specified. By imposing duties on the agency and the member agencies, the bill would impose a state-mandated local program.

The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.

This bill would declare that it is to take effect immediately as an urgency statute.

The people of the State of California do enact as follows:

SECTION 1. Section 10723 of the Water Code is amended to read:

10723. (a) Except as provided in subdivision (c), any local agency or combination of local agencies overlying a groundwater basin may decide to become a groundwater sustainability agency for that basin.

(b) Before deciding to become a groundwater sustainability agency, and after publication of notice pursuant to Section 6066 of the Government Code, the local agency or agencies shall hold a public hearing in the county or counties overlying the basin.

(c) (1) Except as provided in paragraph (2), the following agencies created by statute to manage groundwater shall be deemed the exclusive local agencies within their respective statutory boundaries with powers to comply with this part:

(A) Alameda County Flood Control and Water Conservation District, Zone 7.

(B) Alameda County Water District.

(C) Desert Water Agency.

(D) Fox Canyon Groundwater Management Agency.

(E) Honey Lake Valley Groundwater Management District.

(F) Kings River East Groundwater Sustainability Agency.

(G) Long Valley Groundwater Management District.

(H) Mendocino City Community Services District.

(I) Mono County Tri-Valley Groundwater Management District.

(J) Monterey Peninsula Water Management District.

(K) North Fork Kings Groundwater Sustainability Agency.

(L) Ojai Groundwater Management Agency.

(M) Orange County Water District.

(N) Pajaro Valley Water Management Agency.

(O) San Joaquin River Exchange Contractors Groundwater Sustainability Agency.

(P) Santa Clara Valley Water District.

(Q) Sierra Valley Groundwater Management District.

(R) Willow Creek Groundwater Management Agency.

(2) An agency identified in this subdivision may opt out of being the exclusive groundwater management agency within its statutory boundaries by sending a notice to the department, which shall be posted on the department's Internet Web site within 15 days of receipt. If an agency

identified in paragraph (1) opts out of being the exclusive groundwater management agency, any other local agency or combination of local agencies operating within the statutory boundaries of the agency that has opted out may notify the department pursuant to Section 10723.8 of its decision to be the groundwater sustainability agency.

(3) A local agency listed in paragraph (1) may comply with this part by meeting the requirements of Section 10733.6 or opting to become a groundwater sustainability agency pursuant to this section. A local agency with authority to implement a basin-specific management plan pursuant to its principal act shall not exercise any authorities granted in this part in a manner inconsistent with any prohibitions or limitations in its principal act unless the governing board of the local agency makes a finding that the agency is unable to sustainably manage the basin without the prohibited authority.

(d) The decision of a local agency or combination of agencies to become a groundwater sustainability agency shall take effect as provided in Section 10723.8.

SEC. 2. This section shall be known and may be cited as the San Joaquin River Exchange Contractors Groundwater Sustainability Agency Act.

San Joaquin River Exchange Contractors Groundwater Sustainability Agency Act

Article 1. Findings and Declarations

101. The Legislature hereby finds and declares that the preservation of the groundwater resources within the boundaries of the agency is in the public interest and that the creation of the agency pursuant to this act is for the common benefit.

102. The Legislature further finds and declares that the groundwater management activities of the agency benefit all operators of groundwater extraction facilities within the boundaries of the agency.

103. The Legislature further finds and declares that circumstances within the boundaries of the agency formed by this act, including longstanding joint action among the entities within the boundaries, justify the formation of the agency and the grant of powers contained in this act.

Article 2. Creation and Purposes

201. (a) A groundwater management agency is hereby created in the Counties of Fresno, Madera, Merced, and Stanislaus to be known as the San Joaquin River Exchange Contractors Groundwater Sustainability Agency.

(b) The agency shall be the successor in interest to the San Joaquin River Exchange Contractors Water Groundwater Sustainability Agency that submitted its notice of intent to become a groundwater sustainability agency to the Department of Water Resources on December 22, 2015.

(c) The agency shall only exercise the powers granted by this act and the Sustainable Groundwater Management Act (Part 2.74 (commencing with Section 10720) of Division 6 of the Water Code) for purposes of groundwater management activities within the boundaries of the agency, together with any other powers as are reasonably implied, necessary, and proper to carry out the objectives and purposes of the agency to implement the Sustainable Groundwater Management Act. The agency shall abide by the rules and regulations promulgated by the Department of Water Resources and the State Water Resources Control Board to implement the Sustainable Groundwater Management Act.

Article 3. Boundaries

301. (a) For purposes of this act, the boundaries of the agency shall be as follows:

(1) All land located within the boundaries of Central California Irrigation District, including Class II lands.

(2) All land located within the boundaries of Firebaugh Canal Water District, including Class II lands.

(3) All land located within the boundaries of San Luis Canal Company.

(4) All land located within the boundaries of Columbia Canal Company.

(b) The lands included within the boundaries of the agency are depicted in the revised map submitted by the San Joaquin River Exchange Contractors Water Authority Groundwater Sustainability Agency to the Department of Water Resources on October 18, 2016.

(c) In the event of any ambiguity between the narrative boundary described in subdivision (a) and the map described in subdivision (b), the boundary depicted in the map shall control.

302. (a) The initial boundaries of the agency may be changed in accordance with either of the following procedures:

(1) Upon completion of a change of organization or a reorganization to the Central California Irrigation District or the Firebaugh Canal Water District pursuant to the Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000 (Division 3 (commencing with Section 56000) of Title 5 of the Government Code), the boundaries of the agency shall be automatically changed pursuant to Section 56120 of the Government Code.

(2) Upon a proposal for a change of organization or reorganization initiated by the adoption of a resolution of application by the board and approval of the proposal by the local agency formation commission pursuant to Part 3 (commencing with Section 56650) of Division 3 of Title 5 of the Government Code.

(b) The boundaries of the agency shall not be adjusted to include an area of the basin within the management area of another groundwater sustainability agency unless the agency has entered into a memorandum of agreement or other legal agreement with that groundwater sustainability agency that permits the area to be included.

Article 4. Definitions

401. Unless otherwise indicated by their context, the definitions set forth in this article govern the interpretation of this act.

402. "Agency" means the San Joaquin River Exchange Contractors Groundwater Sustainability Agency established by this act.

403. "Basin" has the same meaning as defined in Section 10721 of the Water Code.

404. "Board" means the board of directors of the agency, as more particularly described in Section 501.

405. "Delta-Mendota Subbasin" has the same meaning as described in the report entitled "California's Groundwater - Bulletin 118" updated in 2003, as it may be subsequently updated or revised by the Department of Water Resources in accordance with Section 12924 of the Water Code.

406. "Extraction" means the act of obtaining groundwater by pumping or other controlled means.

407. "Groundwater" has the same meaning as defined in Section 10721 of the Water Code.

408. "Groundwater management activities" means programs, measures, or actions taken to preserve, protect, and enhance groundwater resources within the boundaries of the agency.

409. "Member agency" means the mutual water companies, irrigation district, and water district entitled to representation on the agency's board of directors as specified in Section 501.

410. "Operator" has the same meaning as defined in Section 10721 of the Water Code.

411. "Person" has the same meaning as defined in Section 10735 of the Water Code.

412. "Plan" has the same meaning as defined in Section 10721 of the Water Code.

Article 5. General Provisions

501. (a) The agency shall be governed by a board of directors that shall consist of four members, as follows:

(1) One member shall be chosen by the Central California Irrigation District.

(2) One member shall be chosen by the Firebaugh Canal Water District.

(3) One member shall be chosen by the San Luis Canal Company.

(4) One member shall be chosen by the Columbia Canal Company.

(b) The governing board of each member agency shall choose a board member for the purpose of subdivision (a) from the member agency's board members.

(c) There shall be an alternate for each board member, chosen in the same manner and by the same entity as the board member. The alternate member shall act in place of the board member he or she is an alternate for in case of that board member's absence or inability to act.

(d) Initial members and their alternates shall be chosen on or before July 1, 2018.

502. It shall not be a conflict of interest for any board member to simultaneously serve on the agency board, the board of directors of the San Joaquin River Exchange Contractors Water Authority, and the board of directors of any member agency, or any combination of those offices.

503. Members of the board shall serve for a four-year term of office or until the member is no longer a board member of the member agency that appointed him or her. A member may serve for more than one term of office.

504. (a) The board may adopt an ordinance to provide compensation to members of the board in an amount not to exceed one hundred dollars ($100) per day for each day's attendance at meetings of the board or for each day's service rendered as a member of the board by request of the board. For purposes of this section, the determination of whether a board member's activities on any specific day are compensable shall be made pursuant to Article 2.3 (commencing with Section 53232) of Chapter 2 of Part 1 of Division 2 of Title 5 of the Government Code.

(b) Reimbursement for expenses of members of the board is subject to Sections 53232.2 and 53232.3 of the Government Code.

(c) The board, by ordinance adopted pursuant to Chapter 2 (commencing with Section 20200) of Division 10 of the Water Code, may increase the compensation received by members of the board above the amount of one hundred dollars ($100) per day. The increase shall not exceed an amount equal to 5 percent, for each calendar year following the operative date of the last adjustment, of the compensation that is received when the ordinance is adopted.

(d) A board member shall not be compensated for more than a total of 10 days in any calendar month.

505. (a) The board may adopt ordinances for the purpose of regulating, conserving, managing, and controlling the use and extraction of groundwater within the boundary of the agency.

(b) An ordinance adopted by the board shall become effective 30 days from the date of its passage.

(c) All ordinances shall be adopted at noticed, public hearings by a majority vote of the board. No ordinance shall be adopted by the board except at a public hearing. Notice of the hearing shall be published in a newspaper of general circulation pursuant to Section 6066 of the Government Code.

(d) The board shall provide notice of the adoption of all ordinances.

506. No provision of this act shall be construed as denying any member agency or the San Joaquin River Exchange Contractors Water Authority any rights or powers that they already have or that they may be granted.

507. The agency may hire contractors and consultants as it considers appropriate.

508. The agency shall enter into a coordination agreement with other local agencies for purposes of coordinating the agency's plan with other agencies or groundwater sustainability plans within the Delta-Mendota Subbasin as required by the Sustainable Groundwater Management Act (Part 2.74 (commencing with Section 10720) of Division 6 of the Water Code).

509. The agency may exclude from any of the requirements of this act, or the operation of any ordinance, any operator who annually extracts less than a minimum amount of groundwater as specified by an ordinance adopted by the board.

Article 6. Studies and Investigations

601. The agency may collect data and conduct technical and other investigations of all kinds in order to carry out the provisions of this act. All hydrological investigations and studies carried out by or on behalf of the agency shall be constructed by or under the supervision of licensed engineers, licensed hydrogeologists, or other persons qualified in groundwater geology or hydrology.

602. The agency may recommend and encourage water recycling and other water development projects, where those projects will enhance and contribute to the responsible management of groundwater resources, as part of its annual plan for implementation of groundwater management objectives.

Article 7. Sustainable Groundwater Management Powers

701. The agency shall develop and implement a groundwater sustainability plan pursuant to Chapter 6 (commencing with Section 10727) of Part 2.74 of Division 6 of the Water Code to achieve sustainable groundwater management within the territory of the agency.

702. The agency shall be the exclusive groundwater sustainability agency pursuant to Chapter 4 (commencing with Section 10723) of Part 2.74 of Division 6 of the Water Code for that portion of the Delta-Mendota Subbasin that lies within the boundaries of the agency.

703. The agency may exercise any of the powers described in Chapter 5 (commencing with Section 10725) of Part 2.74 of Division 6 of the Water Code and the enforcement powers described in Chapter 9 (commencing with Section 10732) of Part 2.74 of Division 6 of the Water Code.

Article 8. Fee Authority

801. Pursuant to Chapter 8 (commencing with Section 10730) of Part 2.74 of Division 6 of the Water Code, the agency may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other

regulated activity, to fund the costs of a groundwater sustainability program, that include, but are not limited to, the preparation, adoption, and amendment of a groundwater sustainability plan, investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve.

Article 9. Miscellaneous

901. The agency shall have the authority to sue and to be sued, including, but not limited to, as a party to an action pursuant to Chapter 7 (commencing with Section 830) of Title 10 of Part 2 of the Code of Civil Procedure.

902. In the event of any conflict between the San Joaquin River Exchange Contractors Groundwater Sustainability Agency Act and the provisions of the Sustainable Groundwater Management Act (Part 2.74 (commencing with Section 10720) of Division 6 of the Water Code), the provisions of the Sustainable Groundwater Management Act shall prevail.

SEC. 3. No reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution because a local agency or school district has the authority to levy service charges, fees, or assessments sufficient to pay for the program or level of service mandated by this act, within the meaning of Section 17556 of the Government Code.

SEC. 4. This act is an urgency statute necessary for the immediate preservation of the public peace, health, or safety within the meaning of Article IV of the California Constitution and shall go into immediate effect. The facts constituting the necessity are:

In order for the San Joaquin River Exchange Contractors Groundwater Sustainability Agency to establish itself as a groundwater sustainability agency and to begin managing the area within its boundaries without interrupting local control, it is necessary that this act take effect immediately.

O

Appendix B. Delta-Mendota Subbasin Common Chapter

DELTA-
MENDOTA
SGMA

July 20, 2022

Paul Gosselin
California Department of Water Resources
715 P Street
Sacramento, CA 95814

Re: Response to 'Incomplete' Determination Letter for the Delta-Mendota Subbasin

Dear Mr. Gosselin:

The Delta-Mendota Subbasin (Subbasin) received a Consultation Initiation Letter (CIL) on January 21, 2022 from the California Department of Water Resources (DWR). The CIL identified four potential deficiencies across the six Subbasin Groundwater Sustainability Plans (GSPs) which may preclude DWR's approval of the GSPs, as well as potential corrective actions to address each potential deficiency. The CIL initiated consultation between DWR, the Basin Manager, GSP Managers, and the Subbasin's 23 Groundwater Sustainability Agencies (GSAs) on February 18, 2022 regarding the amount of time needed to address the potential deficiencies and corrective actions. Subsequent meetings with DWR were held on March 7, March 30, April 19, and May 24, 2022 to discuss the Subbasin's proposed approach to addressing the identified deficiencies.

This letter has been prepared in response to the deficiencies identified in the CIL, based on direction provided by the Delta-Mendota Subbasin Coordination Committee (Coordination Committee), the Delta-Mendota Technical Working Group (Technical Working Group), the Subbasin GSAs, and DWR. It is intended to document how the deficiencies identified in the CIL were addressed in the revised GSPs and associated Common Chapter, and where those revisions are addressed in the Common Chapter.

The four deficiencies identified in DWR's CIL are summarized as follows:

Potential Deficiency 1: The GSPs do not use the same data and methodologies.

Potential Deficiency 2: The GSPs have not established common definitions of undesirable results in the Subbasin.

Potential Deficiency 3: The GSPs in the Subbasin have not set sustainable management criteria in accordance with GSP regulations.

Potential Deficiency 4: The management areas established in the Plan have not sufficiently addressed the requirements specified in 23 CCR §354.20.

Response to Potential Deficiency 1

DWR's Deficiency 1 focused on the water budget (and associated water budget components), change in groundwater storage and sustainable yield as presented in the Common Chapter. For this deficiency, DWR stated that "...the Plan lacks detail and confirmation that the six GSPs not only consider the other

GSPs within and adjacent to the Subbasin but have addressed the regulatory aspects of Sustainable Groundwater Management Act (SGMA) in a manner that substantially complies with the GSP Regulations." Additionally, DWR stated that "Department staff find that the Plan for the Subbasin does not utilize same data and methodologies to support the various water budget, change in storage, and sustainable yield approaches; therefore, it is unclear how the GSAs will reach, let alone track, sustainability throughout the Subbasin in a coordinated manner." To address this deficiency, DWR recommended that "The 23 GSAs developing the six GSPs should provide supporting information that is sufficiently detailed and provide explanations that are sufficiently thorough and reasonable to explain how the various components of each GSP will together achieve the Subbasin's common sustainability goal. The explanation should describe how the sustainable management criteria established for each GSP (including management areas if applicable) relate to each other and how they are collectively informed by the basin setting, including the water budget, change in groundwater storage, and sustainable yield, on the Subbasin-wide level."

To address Deficiency 1, the Technical Working Group and Coordination Committee met on multiple occasions during the period from February through June of 2022 to clarify and explain how the six GSPs utilized common data and methodologies to develop the Subbasin water budget, change in groundwater storage, and sustainable yield.

Use of Common Data and Methodologies

The CIL indicates that "a statement that the GSPs are coordinated without accompanying explanation is not sufficient coordination" and goes on to state that "Department staff find that the Plan for the Subbasin does not utilize same data and methodologies to support the various water budget, change in storage, and sustainable yield approaches; therefore, it is unclear how the GSAs will reach, let alone track, sustainability throughout the Subbasin in a coordinated manner."

The following subsections summarize how the 23 GSAs and their respective six GSPs coordinated and used the same data and methodologies to support the "sum-of-the-parts" approach to compiling water budgets at the Subbasin-level using the same data and methods, as required by the SGMA and GSP Emergency Regulations, and is intended to explain and document revisions to the Common Chapter regarding the water budgets, change in storage, and calculation of Subbasin sustainable yields.

Water Budget

Regarding coordination and use of the same data and methodologies for water budget development, the CIL states that "while the categories of inflows and outflows were agreed upon by the Coordination Committee for the land surface budget and groundwater budget, each of the GSP areas prepared separate water budgets using different modeling methods while often relying upon customized hydrogeological conceptual models which were then 'rolled-up' to the Subbasin level." DWR stated that "it is uncertain whether the outflow from a particular GSP within the Subbasin is comparable to the inflow from an adjacent GSP area, as there is no coordinated explanation provided in the Plan." Additionally, the CIL states that "some of the GSP groups used numerical models to calculate the inflows and outflows from the respective GSP areas while others used non-numerical and spreadsheet models – there was no explanation in the Common Chapter that indicated how these differing modeling approaches used the same data or methodology." The CIL also references Technical Memoranda #1 and #3, *Common Datasets and Assumptions used in the Delta-Mendota Subbasin GSPs* and *Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield*, respectively.

The purpose of the eight Technical Memoranda appended to the Common Chapter is to document the use of common data and methodologies across the six Subbasin GSPs pursuant to Water Code Section 10727.6 and Title 23, California Code of Regulations (CCR), Section 357.4 and as described in the Subbasin Coordination Agreement. In preparing the water budgets, each GSP group coordinated use of publicly available data sets along with the best available data for their GSP region. While the same data sources were used, the terminology used to describe those data sets were not consistent across the Subbasin. The Delta-Mendota Subbasin GSAs acknowledge additional detail is needed to demonstrate that all water budget components across the six Subbasin GSPs utilize the same data sources and methodologies. As such, subsequent to receipt of the CIL, the Technical Working Group met to identify the specific data used and to develop a consistent terminology for the various water budget components. Additionally, the Technical Working Group attempted to simplify the presentation of the Subbasin water budgets.

During development of the original GSPs, the Technical Working Group met monthly to ensure modeling methods and approaches were comparable and consistent between the six Subbasin GSP water budgets, including using comparable inflows and outflows between GSP regions. (Please note that all meetings were held according to the Brown Act and meeting notes available at deltamendota.org). Technical Memorandum #1 appended to the Common Chapter states that "boundary flows were evaluated by comparing inflows and outflows assessed by each GSP Group's water budget analyses and associated data, as well as groundwater flow trends from groundwater contours and hydrogeologist input. Each set of neighboring GSP Groups had independent meetings to coordinate and compare their respective contributions to inflows and outflows, and the results were provided and discussed by the Technical Working Group and Coordination Committee." Regarding the use of numerical, analytical, and spreadsheet models by the six Delta-Mendota GSP groups, Technical Memorandum #3 appended to the Common Chapter documents meetings held in September and November 2017 with DWR representatives to discuss the use of numerical and analytical models in the Subbasin, demonstrating that the hydrologic principles and equations used for both types of modeling in the Delta-Mendota Subbasin are the same.

Following receipt of the CIL, the six Delta-Mendota GSP groups agreed to a set of common simplified definitions for water budget components, and mapped their prior water budget components to the new common definitions. Table CC-8 in the revised Common Chapter documents the data sources utilized in each of the six Subbasin GSPs' historical (Water Year [WY] 2003 to 2012) and current (WY 2013) water budgets according to the common simplified water budget component definitions, and Table CC-9 includes the same information for the projected (WY 2014-2070) water budget. No water budget data were modified during this mapping process. And, as previously noted, efforts were made to use the same data sources throughout the Subbasin where available, due to variability in data availability throughout the Subbasin, the best available data were used and characterized appropriately.

The revised water budgets contained in the redline version of the Common Chapter utilize the simplified list of coordinated water budget components that use the same data sources and methods as contained in the original water budgets, but mapped to the agreed-upon set of consistent terminology. The revised land surface budget and groundwater budget tables that align with the revised data categories are presented respectively for the historical water budget in Tables CC-10 and CC-11, for the current water budget in Tables CC-12 and CC-13, and for the projected water budget with climate change factors and projects and management actions in Tables CC-14 and CC-15. Narrative describing the simplified set of water budget components can be found starting on page CC-131 of the revised Common Chapter.

Change in Storage

DWR's CIL states that "additional explanation of historical, current, and projected change in groundwater storage for the Subbasin is warranted, as well as a straightforward quantification of overdraft throughout the Subbasin. The compilation of water budgets and the estimation of change in groundwater storage for the Subbasin does not appear to use the same data and methodology, or the Plan lacks adequate explanation for how or why the various approaches in the GSPs can be considered as using the same data and methodologies."

Additionally, the CIL stated "The explanation related to coordinated change in storage calculations and water budgets is insufficient, especially since information presented in text, and data displayed in figures and tables, do not seem to correlate with each other and it is uncertain what the current loss of storage is throughout the Subbasin. Statements in Common Chapter Section 4.2.3, state that, 'For information on how change in storage was calculated, refer to Section 4.3.3 – *Water Budgets of this Common Chapter*.' However, Section 4.3.2 only states, 'Individual historical, current, and projected water budgets were developed by each GSP Group for their respective Plan Area. For more information on the development of those water budgets, as well as tabular and graphical representation of the results, refer to the respective sections of the individual GSPs.' This fragmented and multi-staged presentation of information is insufficient to demonstrate that the various GSPs are coordinated – Section 4.2.3 of the Common Chapter refers readers to Section 4.3.2, which then refers readers to six different GSP sections. For the Upper Aquifer, four methods [were] chosen by the respective GSP regions and summed to a subbasin total." The CIL also noted, for the Lower Aquifer, "... two methods [were] chosen by the respective GSP regions and summed to a Subbasin total."

The change in groundwater storage from the Upper Aquifer was calculated using the coordinated water budgets at the Subbasin level. Water level hydrographs and groundwater storage coefficients were used to cross-check the inputs to the water budget. All six GSPs used observed land subsidence to determine Lower Aquifer change in groundwater storage. Where data were available, water budgets for the Lower Aquifer were used as a cross-check. In response to both comments (Upper and Lower Aquifer changes in groundwater storage), please refer to Table CC-8 and Table CC-9 in the revised Common Chapter (with associated narrative found on pages CC-137 through CC-138) for information regarding the use of same data and methodologies used to calculate change in storage across the six Subbasin GSPs for the historical, current, and projected water budgets, respectively, with Subbasin-level change in storage presented in Table CC-11 for the historical water budget, Table CC-13 for the current water budget, and Table CC-15 for the projected water budget.

Finally, the CIL noted a discrepancy in compiled cumulative change in storage values presented in the Common Chapter. The text on page CC-98 of the Common Chapter has been edited to address a typographical error and provide the correct cumulative change in storage in each principal aquifer between WYs 2003 and 2013, which is -624,000 acre-feet in the Upper Aquifer and -375,000 acre-feet in the Lower Aquifer.

Sustainable Yield

The CIL states: "The Common Chapter (Section 4.3.4) and Technical Memoranda #3 address the methodology for calculating sustainable yield in the Subbasin. Of the six GSPs, three provide a sustainable yield specifically for the GSP area while the other three rely upon the estimate for the entire Subbasin." The CIL also notes that "as indicated throughout the Plan, a sustainable yield estimate is not established for each GSP area and those estimates are not correlated with undesirable results." The CIL also notes, under Deficiency 2, that common definitions for significant and unreasonable were not established at the Subbasin level and there were 17 management areas that created uncertainties as to how the SMCs were coordinated with the sustainable yield.

In response to these comments, the Subbasin has now established common definitions in response to Deficiency 2, and has removed the designation of management areas in response to Deficiency 4. Sustainable yield for each principal aquifer is discussed starting on page CC-150.

Additional Coordination Components

DWR's CIL also questions the use of same data and methodologies for groundwater elevation data, groundwater extraction data, surface water supply data, and total water use data (defined as evapotranspiration in the historical, current, and projected water budgets). All of these components are inputs into the coordinated water budget; see Tables CC-8 and CC-9 and the associated water budget narrative beginning on page CC-131 of this revised Common Chapter.

Response to Potential Deficiency 2

The CIL for potential deficiency 2 states, "The GSPs have not established common definitions of undesirable results in the Subbasin." To address this deficiency, DWR's recommended corrective action was that the GSAs "...should modify each of their respective GSPs, as well as any applicable coordination materials, to substantially comply with the GSP Regulations and define undesirable results in a manner that addresses groundwater conditions occurring throughout the Subbasin..."

The Technical Working Group and Coordination Committee met to develop, at a Subbasin level, coordinated definitions and methods for establishing sustainable management criteria (SMC) for each applicable sustainability indicator. These revised definitions, and the associated numeric SMC developed using the agreed-upon methodologies, are summarized in the revised Common Chapter (see Tables CC-16 through CC-23 and Figures CC-65 through CC-70) and in the respective Sustainable Management Criteria chapters of each Subbasin GSP. Additionally, see the Response to Potential Deficiency 3, below, for more information relative to the development of the coordinated SMC.

Response to Potential Deficiency 3

DWR's Deficiency 3 comments built on their Deficiency 2 comments, stating that the Subbasin did not comply with the Emergency GSP Regulations in establishing common definitions and methodologies for SMC. In response to these comments, the six individual GSPs have been revised to reflect the agreed-upon Subbasin-wide sustainability goal as stated on page CC-153 of the revised Common Chapter, and the Technical Working Group and Coordination Committee met to develop common definitions of significant and unreasonable impacts, common methodologies for establishing numeric MTs and MOs, and common interim milestones for each sustainability indicator. See Tables CC-16 through CC-23 for these revised SMC, and narrative describing the process starting on page CC-154 of the revised Common Chapter.

Response to Potential Deficiency 4

Deficiency 4, as detailed in DWR's CIL, pertains to the use of a total of 17 management areas in four of the six GSPs prepared for the Subbasin, stating "The Management Areas established in the Plan have not sufficiently addressed the requirements" ...defined in SGMA.

In response to the DWR comments, the Subbasin GSAs agreed to eliminate or rename the formerly identified management areas as monitoring zones throughout the six GSPs and Common Chapter, and to continue to monitor and manage groundwater use in these monitoring zones according to the metrics previously set forth. Therefore, in the six GSPs and Common Chapter, all management areas have been renamed monitoring zones.

Please feel free to contact me at (209) 826-1872 if there are any questions regarding our responses to the January 21, 2022 CIL, the work conducted by the Subbasin to prepare those responses, and revisions made to the six Subbasin GSPs and Common Chapter.

Sincerely,

John Brodie
Delta-Mendota Subbasin Plan Administrator

DELTA-
MENDOTA
SGMA

Common Chapter

For the Delta-Mendota Subbasin Groundwater Sustainability Plan

August 2019; revised June 2022

PROP 1 WATER BOND 2014

Department of Water Resources · State of California

San Joaquin River Exchange Contractors GSP Group

The County of Fresno

Grassland Water District

Northern & Central Delta-Mendota

Aliso Water District Groundwater Sustainability Agency

FARMERS WATER DISTRICT

Delta-Mendota
Groundwater Subbasin

Groundwater Sustainability Plan: Revised Common Chapter

Prepared by:

WOODARD
&CURRAN

August 2019; Revised June 2022

Difficulty Accessing Material

If you have difficulty accessing any material in this document, please contact us in writing or via telephone and we will work with you to make the information available. You can direct your request to:

ATTN: John Brodie
San Luis and Delta-Mendota Water Authority
842 6th Street
Los Banos, CA 93635
Telephone (209) 826-1872Email: john.brodie@sldmwa.org

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Tables

Figures

Appendices

Acronyms

AB 3030	1992 California Assembly Bill 3030
AWMP	Agricultural Water Management Plan
BMP	Best Management Practice
CASGEM	California Statewide Groundwater Elevation Monitoring
CCC	Columbia Canal Company
CCF	Climate Change Factors
CCID	Central California Irrigation District
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CVO	Central Valley Operations
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
DAC	Disadvantaged Community
DMC	Delta-Mendota Canal
DPWD	Del Puerto Water District
DWR	California Department of Water Resources
ET	Evapotranspiration
ET_c	Total Crop Evapotranspiration
ET_{iw}	Crop Evapotranspiration of Irrigation Water
ET_{misc}	Miscellaneous Evapotranspiration including; canal evaporation, consumptive use of phreatophytes, etc.
FCWD	Firebaugh Canal Water District
FNF	Full Natural Flow
GAMA	Groundwater Ambient Monitoring and Assessment
gpm	gallons per minute
GRCD	Grassland Resource Conservation District
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWD	Grassland Water District

Acronyms

HCM	Hydrogeologic Conceptual Model
HMRD	Henry Miller Reclamation District
IM	interim milestone
IRWM	Integrated Regional Water Management
JPA	Joint Powers Authority
KDSA	Kenneth D. Schmidt and Associates
MAF	million acre-feet
MO	measurable objective
MSL	Mean Sea Level
MT	minimum threshold
NASA JPL	National Aeronautics and Space Administration Jet Propulsions Laboratory
P&P	Provost and Pritchard Consulting Group
RCD	Resource Conservation District
RWQCB	Regional Water Quality Control Board
SB 372	2017 California Senate Bill 372
SGMA	Sustainable Groundwater Management Act
SGWP	Sustainable Groundwater Planning
SJREC	San Joaquin River Exchange Contractors
SJRECWA	San Joaquin River Exchange Contractors Water Authority
SJRIP	San Joaquin River Improvement Program
SJRRP	San Joaquin River Restoration Program
SLDMWA	San Luis & Delta-Mendota Water Authority
SMC	Sustainable Management Criteria
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TDS	Total Dissolved Solids
TIWD	Turner Island Water District
TNC	The Nature Conservancy
UNAVCO	University NAVSTAR Consortium

Acronyms

USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USF&WS	U.S. Fish & Wildlife Service
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WDL	Water Data Library
WMP	Water Management Plan
WSIP	Water Storage Investment Program
WWD	Westlands Water District
WY	Water Year

DISCLAIMER

The work products presented in this Common Chapter and associated Technical Memoranda (Appendix B) are a compilation of work completed by the six (6) individual Groundwater Sustainability Plan (GSP) regions under the direction of a Professional Geologist (PG) or Professional Engineer (PE) as indicated by the stamps on the respective GSP Executive Summaries. The signature here represents work completed in compiling the Common Chapter from these individual GSPs, and the signing Professional Engineer assumes no responsibility for any errors or misleading statements presented therein. Compilation of the Common Chapter, exclusive of work conducted for the individual GSPs, and revisions to this Common Chapter have been prepared under the oversight of Leslie Dumas, P.E. and the signature below is specifically for that compilation.

REGISTERED PROFESSIONAL ENGINEER
LESLIE S. DUMAS
C 43897
EXP 6/30/23
CIVIL
STATE OF CALIFORNIA

1. INTRODUCTION

1.1 Purpose of Common Chapter

The 23 Groundwater Sustainability Agencies (GSAs) overlying the Delta-Mendota Subbasin (Subbasin) have prepared six Groundwater Sustainability Plans (GSPs) that, together, encompass the entire Subbasin area (**Figure CC-1**). These GSPs have been prepared in a coordinated manner under the oversight of the Delta-Mendota Subbasin Coordination Committee (Coordination Committee) and in accordance with the Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement) for the Subbasin. This Common Chapter has been prepared as means of integrating key parts of the six GSPs to meet subbasin-level requirements per the Sustainable Groundwater Management Act (SGMA) and the Emergency GSP regulations (DWR, 2016).

On January 21, 2022, the Subbasin received a Consultation Initiation Letter (CIL) from the California Department of Water Resources (DWR). The CIL identified four potential deficiencies across the six Subbasin GSPs which may preclude DWR's approval, as well as potential corrective actions to address each potential deficiency. The CIL thus initiated consultation between DWR, the Subbasin Point of Contact, Plan Managers, and the Subbasin's GSAs. This Common Chapter has been revised to incorporate changes required to reflect the Subbasin's response to the deficiencies identified in the CIL, based on direction provided by the Coordination Committee, the Delta-Mendota Technical Working Group (Technical Working Group), the Subbasin GSAs and DWR. This revised Common Chapter, along with the attached cover letter, are intended to document how the deficiencies identified in the CIL were addressed in the revised Subbasin GSPs and this revised Common Chapter.

This revised Common Chapter, along with the six Subbasin GSPs, Coordination Agreement (**Appendix A**) and Common Technical Memoranda (**Appendix B**), meets regulatory requirements established by DWR as shown in the completed *Preparation Checklist for GSP Submittal* (**Appendix C**). The Common Technical Memoranda summarize the common data sets, assumptions and methodologies used during preparation of the six Subbasin GSPs. The reader is referred to the individual GSP (and their associated Executive Summaries) for information, data, and GSP requirements specific to each GSP Plan Area.

1.2 Delta-Mendota Subbasin

The Delta-Mendota Subbasin (DWR Basin 5-022.07) is located in the San Joaquin Valley Groundwater Basin and adjoins nine (9) subbasins of the San Joaquin Valley Groundwater Basin. The Delta-Mendota Subbasin boundaries generally correspond to DWR's California's Groundwater Bulletin 118 – Update 2003 (Bulletin 118) groundwater basin boundaries. Changes made to the Subbasin boundaries as part of the SGMA planning process include the following:

- A jurisdictional internal boundary modification made in 2016 to extend the boundary of the Delta-Mendota Subbasin eastward to include all of Aliso Water District.
- A jurisdictional internal boundary modification made in 2016 to bring areas that straddle the Delta-Mendota Subbasin and adjacent subbasins fully within the Delta-Mendota Subbasin. This modification adjusted areas from the southern boundary of the Delta-Mendota Subbasin and the Westside Subbasin in coordination with Westlands Water District, and moved the eastern boundary of the Delta-Mendota Subbasin from the Madera Subbasin into the Delta-Mendota

Subbasin in coordination with Aliso Water District. The modification also moved areas from the Tracy Subbasin into the Delta-Mendota Subbasin so that Del Puerto Water District and West Stanislaus Irrigation District were fully within the Delta-Mendota Subbasin, and cleaned up boundaries between the Delta-Mendota Subbasin and the Kings Subbasin to conform with the boundaries of Tranquillity Irrigation District and the Traction Ranch property (bounded on the east by Mid-Valley Water District).

- A jurisdictional internal boundary modification made in 2018 to modify the boundary between the Delta-Mendota and the Chowchilla Subbasins to follow the western boundary of Triangle T Water District and the southern boundary of Clayton Water District. This modification moved approximately 700 acres of land from the Chowchilla Subbasin into the Delta-Mendota Subbasin.

The western San Joaquin Valley is a highly agricultural region with an economy dependent on that industry. There are no large cities or industries in the Delta-Mendota Subbasin to provide an alternative economic base; hence the availability of Central Valley Project (CVP) imported supplies and surface water supplies (primarily from the San Joaquin and Kings River) are essential elements to the economic health of the region. Other uses of CVP and surface water in the Subbasin are for municipal and industrial (M&I) purposes and wildlife refuge water supply.

Groundwater is a key component of overall water supplies in the Delta-Mendota Subbasin. Agricultural and wildlife refuge needs may be supplemented by groundwater for areas with access to CVP water. Other landowners within the Subbasin may rely wholly on groundwater for irrigation and/or potable purposes. Municipal and industrial (M&I) water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities, and predominantly uses groundwater to meet those demands. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2015 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 21,498) and Los Banos (population 37,457) (U.S. Census Bureau, 2015).

As previously noted, most communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Patterson, Grayson, Tranquillity, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, Westley, Volta, and Vernalis.

1.3 Disadvantaged Communities within the Delta-Mendota Subbasin

A disadvantaged community (DAC) is defined as a community with a Median Household Income (MHI) less than 80% of the California statewide MHI. The California Department of Water Resources (DWR) compiled U.S. Census Bureau's American Community Survey (ACS) data from 2012 to 2016; these data were used in GIS to identify DACs within the Delta-Mendota Subbasin. California's average statewide MHI from 2012 to 2016 is $63,783; thus, a community with an MHI less than or equal to $51,026 is considered a DAC. Based on these criteria, 93% of the geographic area of the Subbasin is considered disadvantaged. Furthermore, a community with an MHI of less than 60% of the California statewide MHI, meaning an MHI of less than or equal to $38,270, is considered a severely disadvantaged community (SDAC). According to the U.S. Census ACS 2012-2016 data, there are a number of SDACs throughout the Subbasin. See **Figure CC-2** for a map of the DACs and SDACs throughout the Delta-Mendota Subbasin.

As noted above, a significant portion of the Subbasin contains DACs. Of the total population of 117,120 within the Subbasin, 80% of the population lives within a DAC, with 93% of the Subbasin's total geographic area consisting of DACs. **Table CC-1** includes the proportion of DACs in the Subbasin based on population and geographic area.

Table CC-1: DACs as a Percentage of the Delta-Mendota Subbasin

Area	Geographic Area (Square Miles)	% Based on Geographic Area	Population	% Based on Population
DAC (including SDAC)	1,109	93%	93,786	80%
Delta-Mendota Subbasin	1,194		117,120	

Table CC-2 includes Census Designated Places that are DACs in the Delta-Mendota Subbasin, with their associated MHIs and percentage of the California MHI from the ACS 5-Year 2012-2016 average. Several DACs in the Subbasin have considerably lower MHI than 80% of the California Statewide MHI and are further designated as Severely Disadvantaged Communities (SDACs). In **Table CC-2**, SDACs are indicated in bold text. Note that according to the U.S. Department of the Interior Indian Affairs, as of January 2017, there are no listed federally recognized tribes within the Region (Mosley, 2017).

Table CC-2: DAC and SDAC Census Designated Places in Delta-Mendota Subbasin

Census Designated Place (CDP)	Median Household Income (MHI)	% of CA MHI
City of Dos Palos	**$36,509**	**57%**
City of Firebaugh	**$36,181**	**57%**
City of Gustine	**$37,770**	**59%**
City of Los Banos	$45,751	72%
City of Mendota	**$26,094**	**41%**
City of Newman	$52,783	83%
Crows Landing	**$26,786**	**42%**
Dos Palos Y (CDP)	**$16,656**	**26%**
Grayson	**$29,787**	**47%**
Madera County	$45,490	74%
Merced County	$43,066	70%
Fresno County	$45,963	72%
Santa Nella	**$27,778**	**44%**
South Dos Palos	$41,992	66%
Tranquillity	**$30,441**	**48%**
Volta	$48,250	76%
Westley	**$23,375**	**37%**

Data Sources:
1. U.S. Census ACS data from 2012 to 2016 provided by DWR Mapping Tool.

Census Designated Place (CDP)	Median Household Income (MHI)	% of CA MHI

2. MHI data are from the 2016 Census, and percent of CA MHI is calculated based on the 2012-2016 Statewide MHI. Bold rows indicate severely disadvantaged communities (less than 60% of CA Statewide MHI).

1.4 Economically Disadvantaged Areas within the Delta-Mendota Subbasin

An economically distressed area (EDA) is defined by the State of California as a “municipality with a population of 20,000 persons or less, a rural county, or a reasonably isolated and divisible segment of a larger municipality where the segment of the population is 10,000 persons or less, with an annual median household income that is less than 85% of the statewide median household income, and with one or more of the following conditions as determined by the (sic) Department of Water Resources:

1. Financial hardship
2. Unemployment rate at least two percent higher than the statewide average
3. Low population density (CA Assembly, 2014).”

U.S. Census GIS data provided by DWR were used to identify EDAs in the Delta-Mendota Subbasin. **Figure CC-3** shows the location of EDAs within the Delta-Mendota Subbasin

A significant portion of the Subbasin contains EDAs. Of the total population of 117,120 within the Subbasin, 87% live in areas that meet EDA Criterion 2, 20% live in areas that meet EDA Criterion 3, and 87% live in areas that meet Criteria 2 or 3. In all, 93% of the geographic area within the Subbasin consists of areas considered to meet either EDA Criteria 2 or 3. **Table CC-3** includes the proportion of EDAs in Subbasin based on population and geographic area.

Table CC-3: EDAs as a Percentage of the Delta-Mendota Subbasin

Area	Geographic Area (Square Miles)	% Based on Geographic Area	Population	% Based on Population
EDA Criterion 2	1,112	93%	102,407	87%
EDA Criterion 3	1,004	84%	23,688	20%
EDA Criteria 2 or 3	1,112	93%	102,407	87%
Delta-Mendota Subbasin	1,194		117,120	

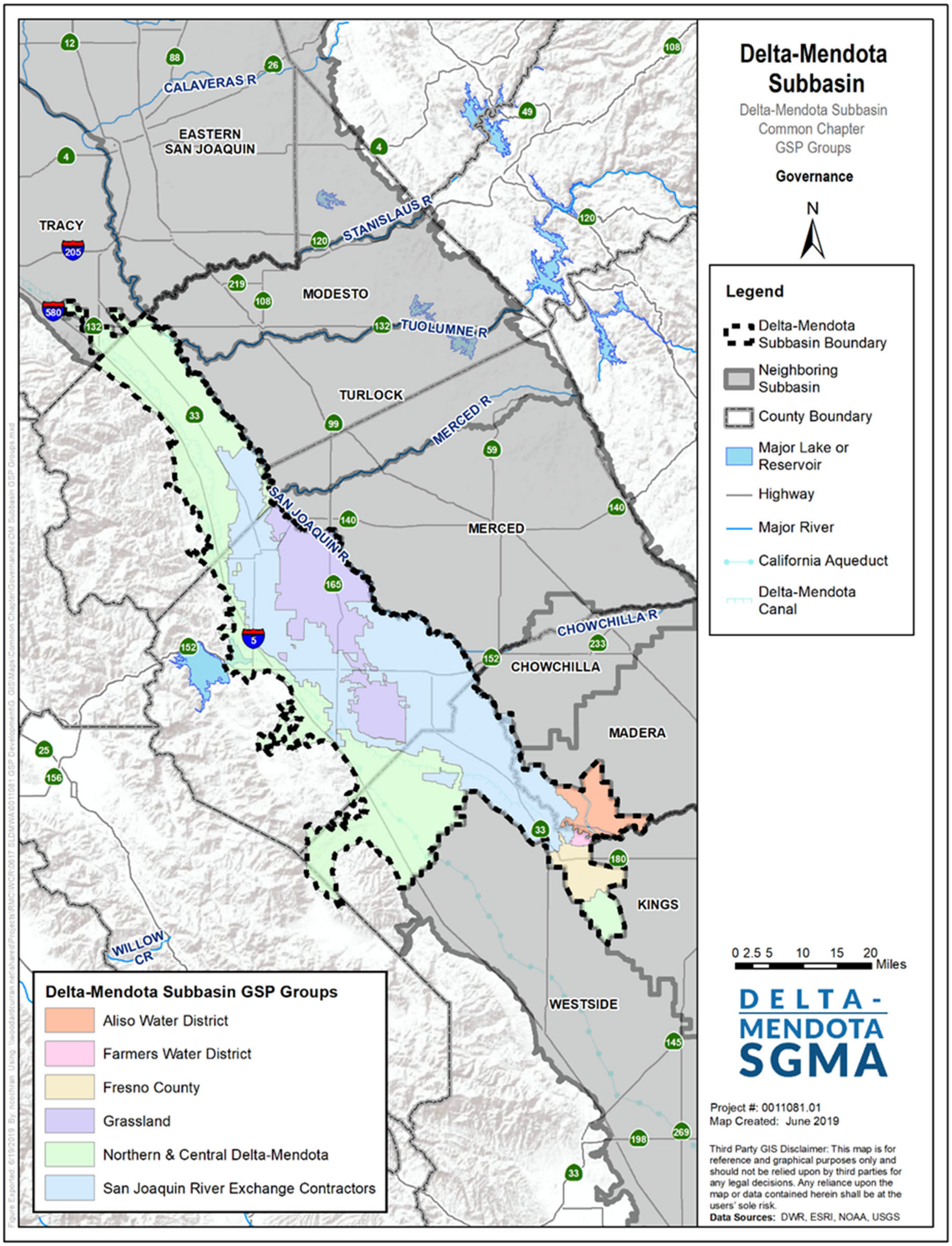


Figure CC-1: Delta-Mendota Subbasin and GSP Regions

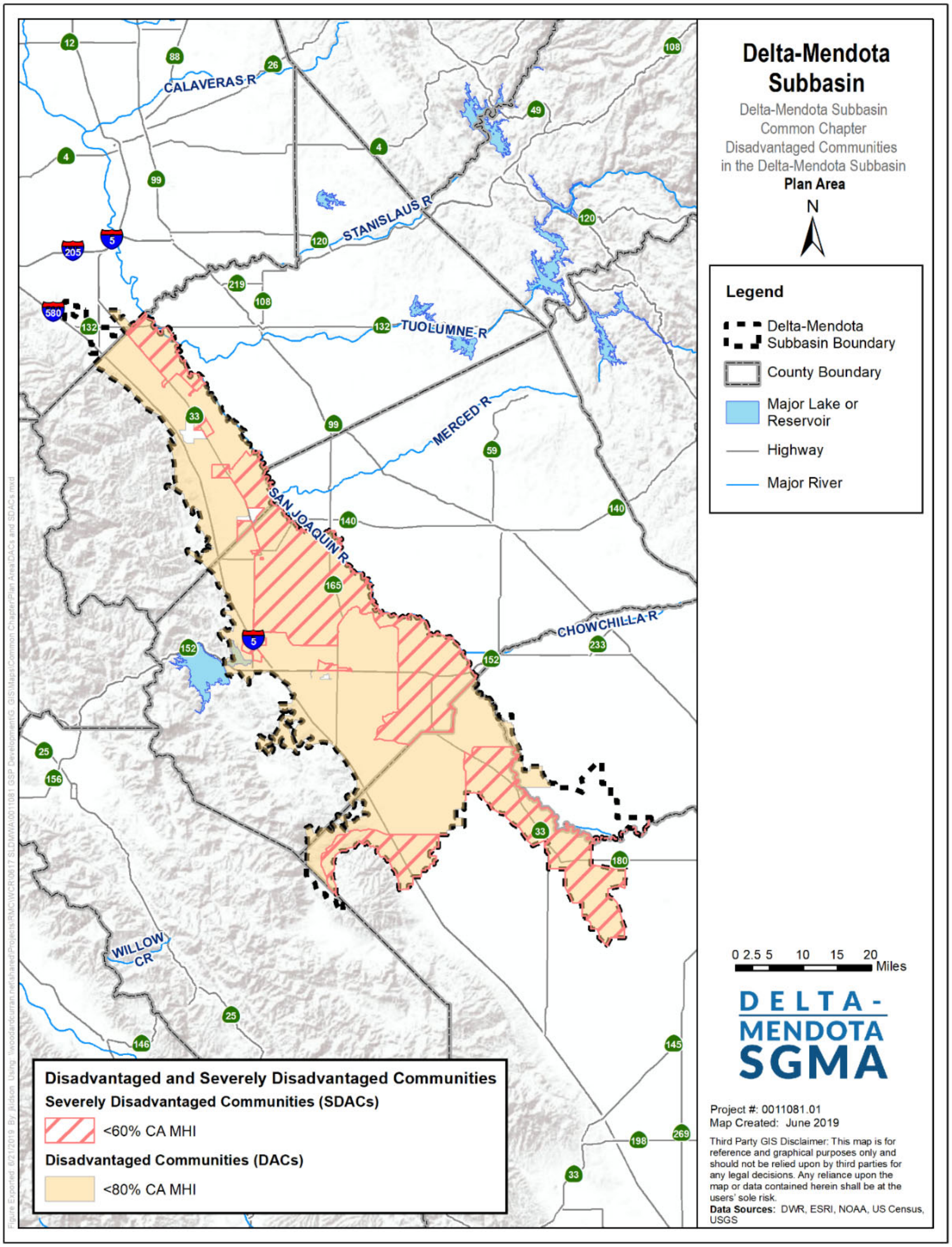


Figure CC-2: Disadvantaged and Severely Disadvantaged Communities in the Delta-Mendota Subbasin

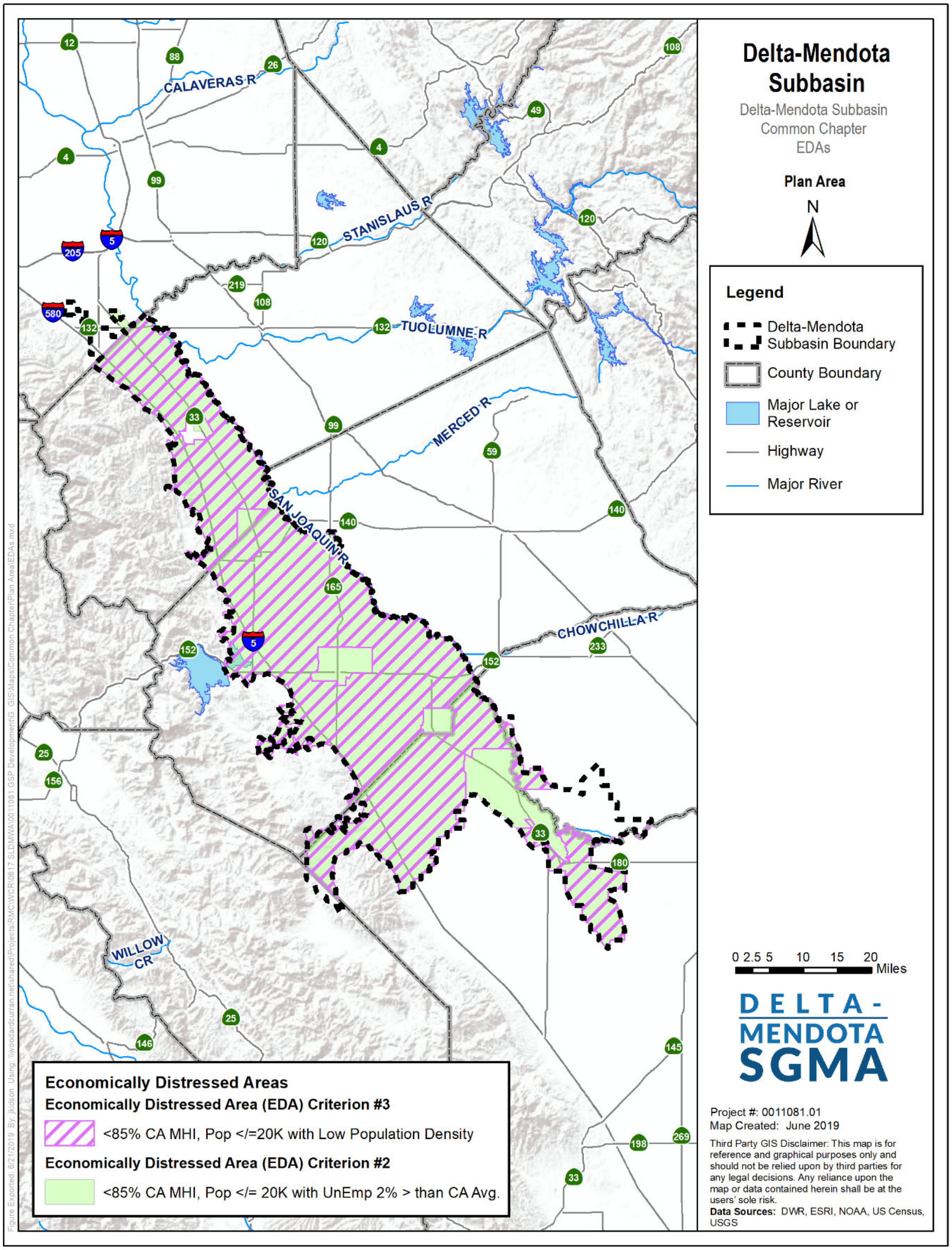


Figure CC-3: Economically Distressed Areas in the Delta-Mendota Subbasin

2. DELTA-MENDOTA SUBBASIN GOVERNANCE

This section includes information pursuant to Article 5. Plan Contents, Subarticle 1. Administrative Information, § 354.6 (Agency Information) as well as Subarticle 8. Interagency Agreements (§ 357.2 Interbasin Agreements and § 357.4 Coordination Agreements), as required by the Groundwater Sustainability Plan (GSP) Regulations. Agency Contact information for the Delta-Mendota Subbasin and the plan manager is included in this section. The organization and management structure, as well as the legal authority of each Groundwater Sustainability Agency (GSA) in the Delta-Mendota Subbasin, is detailed and accompanied by GSA boundary maps and a description of intra-basin and inter-basin coordination agreements in place for the development and implementation of the GSPs overlying the Delta-Mendota Subbasin.

Agency Contact Information

This Common Chapter to the six GSPs for the Delta-Mendota Subbasin has been prepared in a cooperative manner by the following GSAs in the Delta-Mendota Subbasin:

Northern & Central Delta-Mendota Region GSP

- Patterson Irrigation District GSA
- West Stanislaus Irrigation District GSA
- DM-II GSA
- City of Patterson GSA
- Northwestern Delta-Mendota GSA
- Central Delta-Mendota GSA
- Widren Water District GSA
- Oro Loma Water District GSA

San Joaquin River Exchange Contractors (SJREC) GSP

- San Joaquin River Exchange Contractors Water Authority GSA
- Turner Island Water District-2 GSA
- City of Mendota GSA
- City of Firebaugh GSA
- City of Los Banos GSA
- City of Dos Palos GSA
- City of Gustine GSA
- City of Newman GSA
- Madera County – 3 GSA
- Portion of Merced County – Delta-Mendota GSA
- Portion of Fresno County Management Area B GSA

Grassland GSP

- Grassland GSA
- Portion of Merced County – Delta-Mendota GSA

Aliso Water District GSP

- Aliso Water District GSA

Farmers Water District GSP

- Farmers Water District GSA

Fresno County GSP

- Fresno County Management Area A GSA
- Portion of Fresno County Management Area B GSA

The plan areas covered by each of the six Subbasin GSPs is show in **Figure CC-1**. **Figure CC-4** through **Figure CC-6** show the location of the GSAs comprising the six GSP regions. These GSAs are coordinating development and implementation of the six GSPs under the Coordination Agreement, as described below in Section 2.1.

The current Plan Manager for the coordinated Delta-Mendota Subbasin GSPs is John Brodie, Water Resources Program Manager for San Luis & Delta-Mendota Water Authority (SLDMWA). Mr. Brodie can be contacted as follows:

Mr. John Brodie, Plan Manager
Delta-Mendota Subbasin
842 6th Street
Los Banos, CA 93635
Phone: (209) 826-1872/ Fax (209) 833-1034
john.brodie@sldmwa.org

Contact information for each GSP plan administrator can be found in the respective GSPs. The DWR Point of Contact is shown below.

Department of Water Resources Point of Contact

The point of contact for the Delta-Mendota Subbasin is:

Christopher Olvera
Department of Water Resources
Christopher.Olvera@water.ca.gov
(559) 230-3373

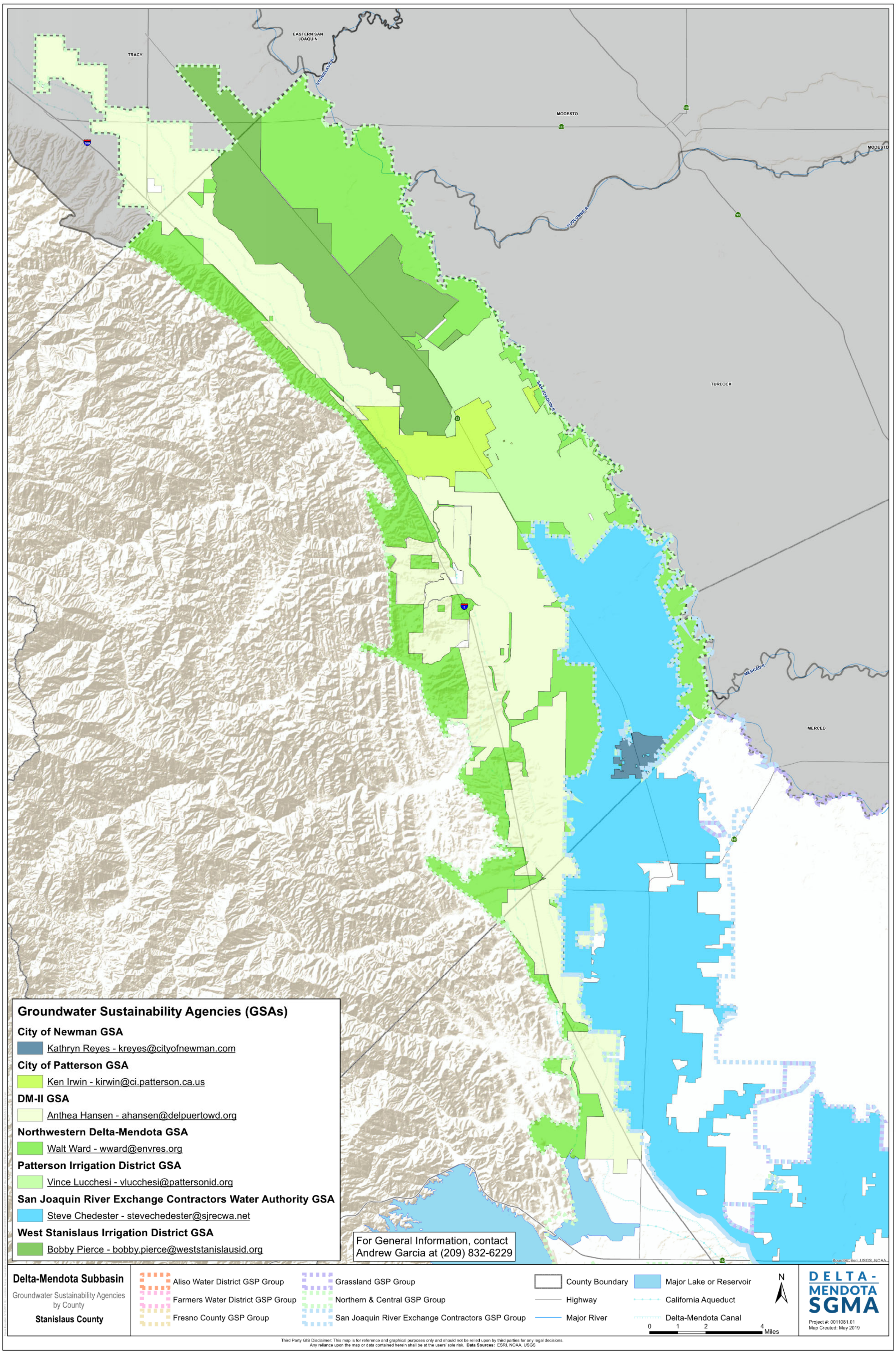


Figure CC-4: GSAs in the Delta-Mendota Subbasin – Stanislaus County

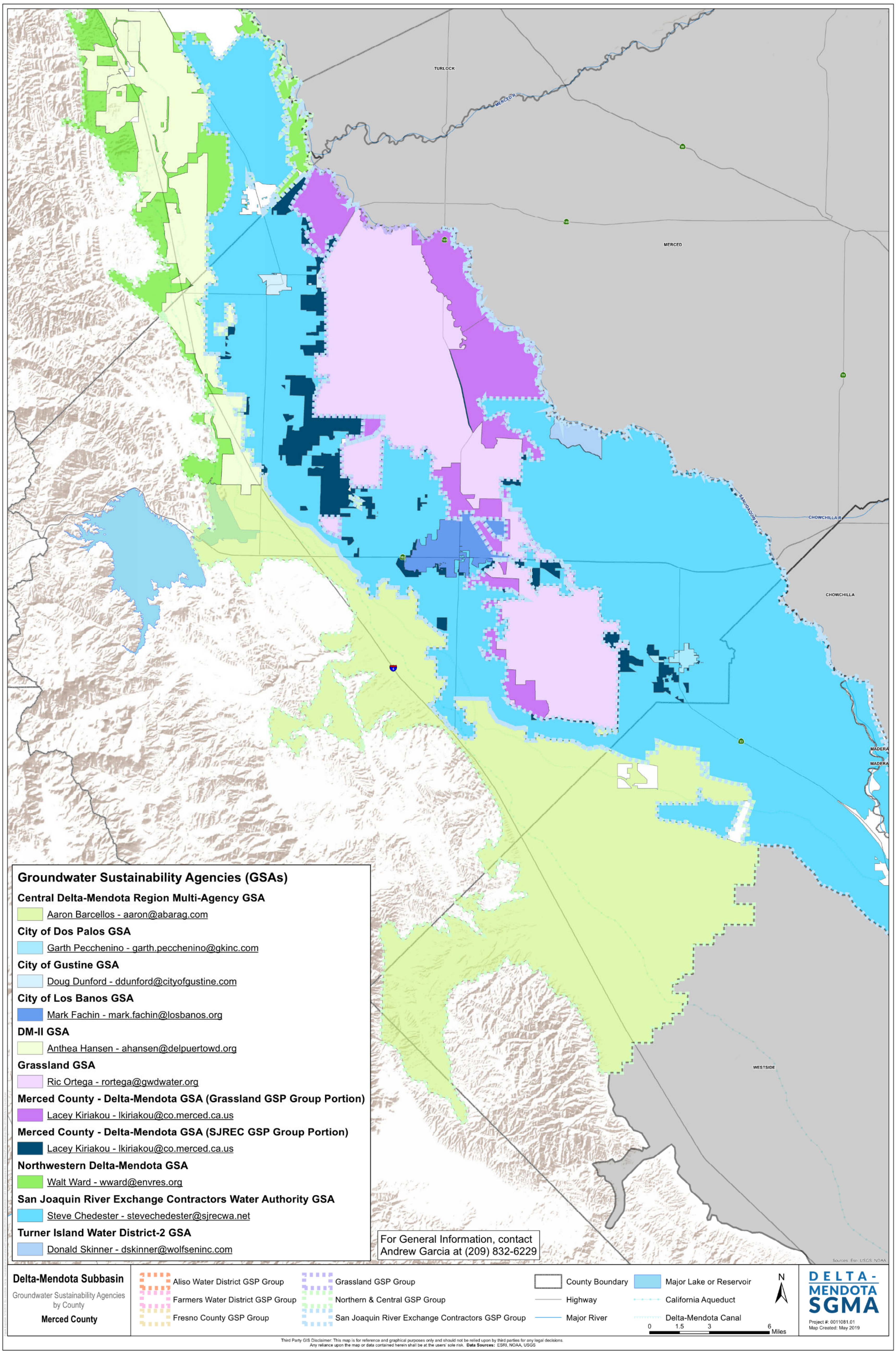


Figure CC-5: GSAs in the Delta-Mendota Subbasin – Merced County

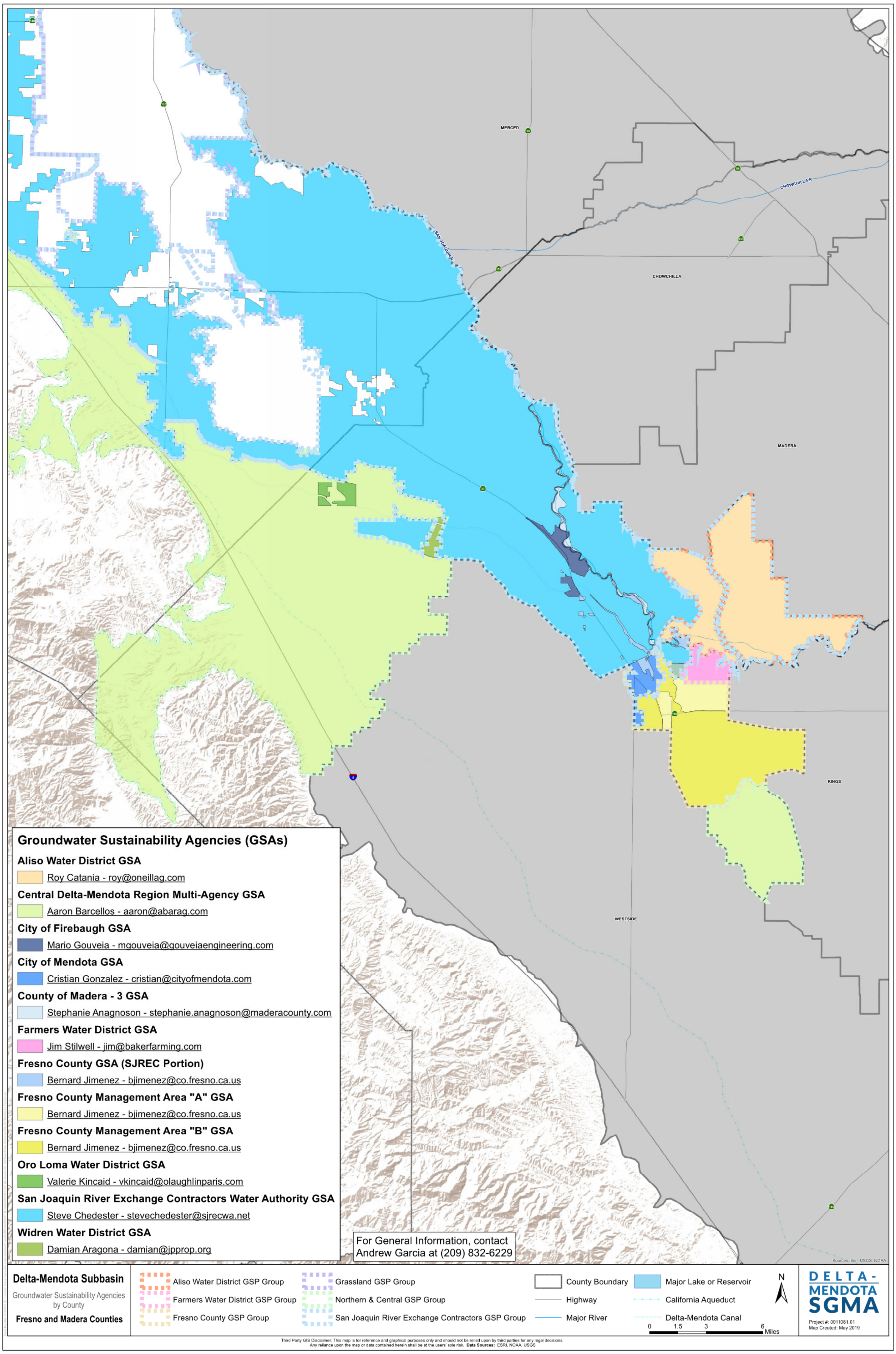


Figure CC-6: GSAs in the Delta-Mendota Subbasin – Fresno and Madera Counties

2.1 GSA and GSP Coordination and Governance

This section includes a description of intra-basin coordination agreements, which are required where there is more than one GSP prepared for a groundwater basin, and inter-basin coordination agreements, which are optional agreements between neighboring groundwater subbasins, pursuant to Article 8. Interagency Agreements, § 357.4. Coordination Agreements and § 357.2 Interbasin Agreements.

2.1.1 Delta-Mendota Subbasin SGMA Governance Structure

The GSAs within the Delta-Mendota Subbasin adopted and executed a Coordination Agreement on December 12, 2018 to comply with the SGMA requirement that multiple GSAs within a given subbasin must coordinate when developing and implementing their GSPs (see Intra-Agency Coordination subsection above for more information). Additionally, a Cost Sharing Agreement was signed and executed by the same parties on December 12, 2018. **Figure CC-5** shows the SGMA governance structure within the Delta-Mendota Subbasin. In addition to the two members appointed to represent each of the Northern & Central Delta-Mendota GSP Region and the San Joaquin River Exchange Contractors (SJREC) GSP Region on the Delta-Mendota Subbasin Coordination Committee as voting members, the Grassland GSP Region, Farmers Water District GSP Region, Fresno County Management Areas A & B GSP Region, and Aliso Water District GSP Region all have appointed one voting member each for a total of eight voting members.

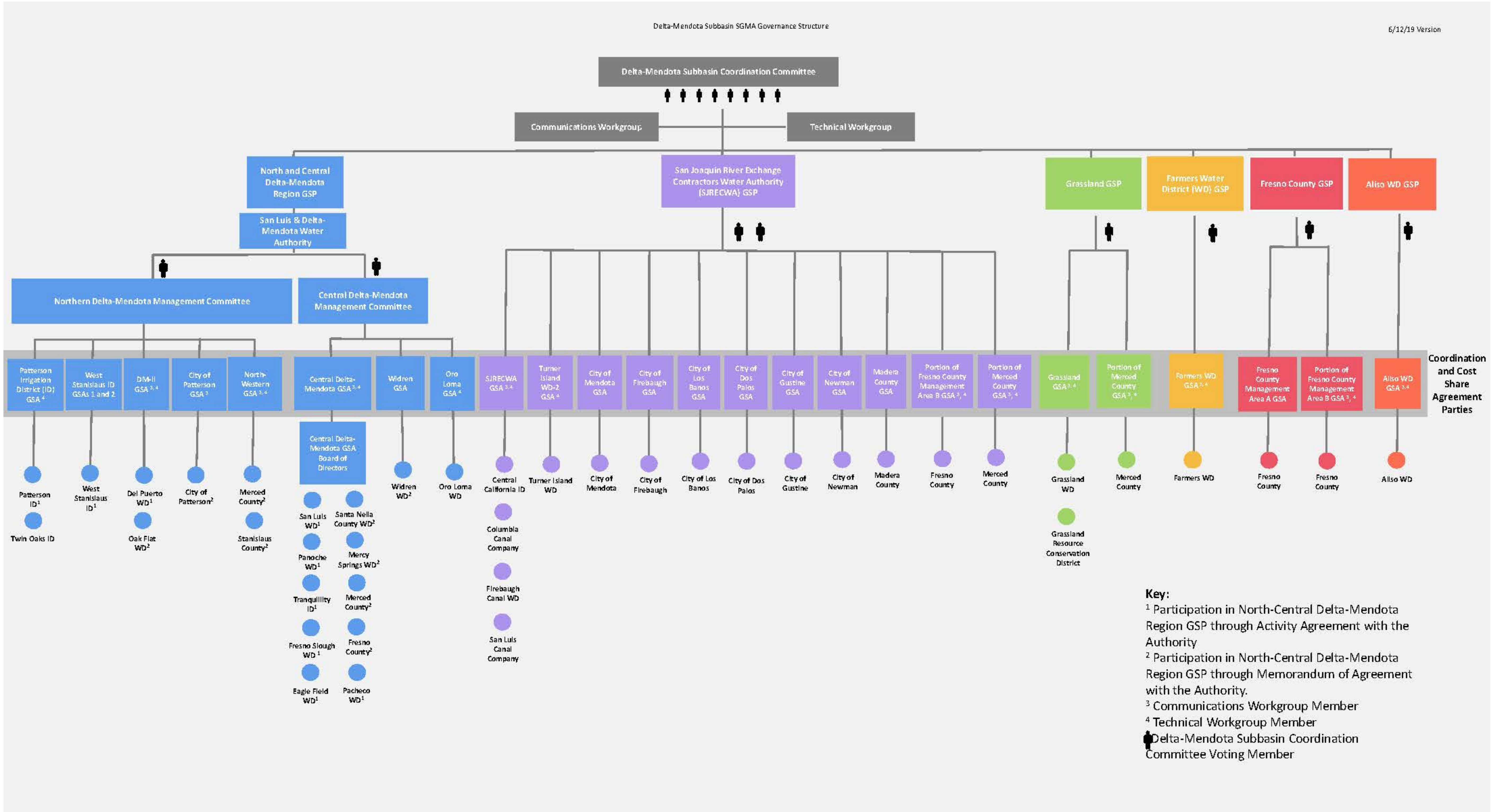
Three working groups were formed under the auspices of the Delta-Mendota Subbasin Coordination Committee: the Technical Working Group, the Communications Working Group and the DMS Working Group. Representatives of each GSP region participate in each working group.

Table CC-4: Delta-Mendota Subbasin Coordination Committee Members

GSP		GSA	Agency	Coordination Committee Members	
				Primary	Alternate
Northern & Central Delta-Mendota Region GSP	Northern Delta Mendota Region Management Committee	Patterson Irrigation District GSA	Patterson Irrigation District	Vince Lucchesi	Walt Ward
			Twin Oaks Irrigation District		
		West Stanislaus Irrigation District GSA	West Stanislaus Irrigation District		
		DM-II GSA	Del Puerto Water District		
			Oak Flat Water District		
		City of Patterson GSA	City of Patterson		
		Northwestern Delta-Mendota GSA	Merced County		
			Fresno County		
	Central Delta-Mendota Region Management Committee	Central Delta-Mendota GSA	San Luis Water District	Ben Fenters	Lacey Kiriakou
			Panoche Water District		
			Tranquillity Irrigation District		
			Fresno Slough Water District		
			Eagle Field Water District		
			Pacheco Water District		
			Santa Nella County Water District		
			Mercy Springs Water District		
			Merced County		
			Fresno County		
		Widren Water District GSA	Widren Water District		
		Oro Loma Water District GSA	Oro Loma Water District		

GSP	GSA	Agency	Coordination Committee Members	
			Primary	Alternate
San Joaquin River Exchange Contractors GSP	San Joaquin River Exchange Contractors Water Authority GSA	Central California Irrigation District	Jarrett Martin, Alejandro Paolini	Chris White, John Wiersma
		Columbia Canal Company		
		Firebaugh Canal Water District		
		San Luis Canal Company		
	Turner Island Water District-2 GSA	Turner Island Water District		
	City of Mendota GSA	City of Mendota		
	City of Firebaugh GSA	City of Firebaugh		
	City of Los Banos GSA	City of Los Banos		
	City of Dos Palos GSA	City of Dos Palos		
	City of Gustine GSA	City of Gustine		
	City of Newman GSA	City of Newman		
	County of Madera – 3 GSA	County of Madera		
	Portion of Merced County – Delta-Mendota GSA	County of Merced		
	Portion of Fresno County Management Area B GSA	County of Fresno		
Grassland GSP	Grassland GSA	Grassland Water District	Ric Ortega	Ken Swanson
		Grassland Resource Conservation District		
	Portion of Merced County Delta-Mendota GSA	County of Merced		
Farmers Water District GSP	Farmers Water District GSA	Farmers Water District	Jim Stilwell	Don Peracchi
Fresno County GSP	Fresno County – Management Area A	County of Fresno	Buddy Mendes	Glenn Allen or Augustine Ramirez

GSP	GSA	Agency	Coordination Committee Members	
			Primary	Alternate
	Fresno County – Management Area B	County of Fresno		
Aliso Water District GSP	Aliso Water District GSA	Aliso Water District	Joe Hopkins	Board Secretary (Ross Franson)



Key:
[1] Participation in North-Central Delta-Mendota Region GSP through Activity Agreement with the Authority
[2] Participation in North-Central Delta-Mendota Region GSP through Memorandum of Agreement with the Authority.
[3] Communications Workgroup Member
[4] Technical Workgroup Member
Delta-Mendota Subbasin Coordination Committee Voting Member

Figure CC-7: Governance Structure of the Delta-Mendota Subbasin

2.1.2 Intra-Basin Coordination

The Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement), effective as of December 12, 2018, has been signed by all participating agencies in the Delta-Mendota Subbasin; a copy of this agreement is included in **Appendix A**. The purpose of the Agreement, including technical reports to be developed after the initial execution of this Agreement, is to comply with SGMA requirements and to ensure that the multiple GSPs within the Subbasin are developed and implemented utilizing the same datasets, methodologies and assumptions, that the elements of the GSPs are appropriately coordinated to support sustainable subbasin management of groundwater resources, and to ultimately set forth the information necessary to show how the multiple GSPs in the Subbasin will achieve the sustainability goal as determined for the Subbasin in compliance with SGMA and its associated regulations.

A key goal of basin-wide coordination is to ensure that the Subbasin GSPs utilize the same data and methodologies during their plan development and that elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting, as required by SGMA and associated regulations. The Coordination Agreement defines how the coordinated efforts will be achieved and documented, and also sets out the process for identifying the Plan Manager. The Coordination Agreement is part of each individual GSP within the Delta-Mendota Subbasin.

The Coordination Agreement for the Delta-Mendota Subbasin covers the following topics:

1. Purpose of the Agreement, including:
    a. Compliance with SGMA and
    b. Description of Criteria and Function;
2. General Guidelines, including:
    a. Responsibilities of the Parties and
    b. Adjudicated or Alternative Plans in the Subbasin;
3. Role of San Luis & Delta-Mendota Water Authority (SLDMWA), including:
    a. Agreement to Serve,
    b. Reimbursement of SLDMWA, and
    c. Termination of SLDMWA’s Services;
4. Responsibilities for Key Functions, including:
    a. Coordination Committee,
    b. Coordination Committee Officers,
    c. Coordination Committee Authorized Action and Limitations,
    d. Subcommittees and Workgroups,
    e. Coordination Committee Meetings, and
    f. Voting by Coordination Committee;
5. Approval by Individual Parties;
6. Exchange of Data and Information, including:
    a. Exchange of Information and
    b. Procedure for Exchange of Information;
7. Methodologies and Assumptions, including:
    a. SGMA Coordination Agreements,
    b. Pre-GSP Coordination, and

    - c. Technical Memoranda Required;
8. Monitoring Network
9. Coordinated Water Budget
10. Coordinated Data Management System
11. Adoption and Use of the Coordination Agreement, including:
    - a. Coordination of GSPs and
    - b. GSP and Coordination Agreement Submission;
12. Modification and Termination of the Coordination Agreement, including:
    - a. Modification or Amendment of Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages),
    - b. Modification or Amendment of Coordination Agreement, and
    - c. Amendment for Compliance with Law;
13. Withdrawal, Term, and Termination;
14. Procedures for Resolving Conflicts;
15. General Provisions, including:
    - a. Authority of Signers,
    - b. Governing Law,
    - c. Severability,
    - d. Counterparts, and
    - e. Good Faith; and
16. Signatories of all Parties

Coordination During GSP Implementation

The Coordination Agreement ensures that the multiple GSAs are working cooperatively and collaboratively to ensure GSPs within the Subbasin are developed and implemented utilizing the same methodologies and assumptions and to ultimately establish the processes necessary to show how the multiple GSPs in the Subbasin will be sustainably managed to achieve the Delta-Mendota Subbasin's sustainability goal. The Coordination Committee intends to continue to meet and confer following the submittal of the Subbasin's GSPs and will develop guidelines for GSP implementation between the GSP Groups and update the Coordination Agreement as the Parties to the Agreement deem necessary.

The Coordination Committee will continue meeting regularly following submittal of the Subbasin GSPs in order to develop the guidelines for coordinated implementation of GSPs. The intent of the guidelines will be to outline processes that will ensure the GSAs are progressing toward the Subbasin sustainability goal, while meeting the Annual Reporting requirements or any other requirements agreed upon for purposes of coordination.

Agency Responsibilities

In meeting the terms of the Coordination Agreement, all Parties (meaning the Delta-Mendota Subbasin GSAs) agree to work collaboratively to meet the objectives of SGMA and the Coordination Agreement. Each Party to the Agreement is a GSA and acknowledges that it is bound by the terms of the Coordination Agreement as an individual party.

The Parties have established a Coordination Committee to provide a forum to accomplish the coordination obligations of SGMA. The Coordination Committee operates in full compliance with the Brown Act and is composed of a Chairperson and Vice Chairperson, Secretary, Plan Manager, and a GSP Group Representative and Alternate Representative for each of the six GSP groups. The Chairperson and Vice Chairperson are rotated annually among GSP Groups in alphabetical order. The Secretary assumes primary responsibility for Brown Act compliance. The GSP Group Representatives, who are identified in **Table CC-4**, are selected by each respective GSP Group at the discretion of the respective GSP Group, and such appointments are effective upon providing written notice to the Secretary and to each Group Contact. The Coordination Committee recognizes each GSP Group Representative and GSP Group Alternate Representative until the Group Contact provides written notice of removal and replacement to the Secretary and to every other Group Contact. Each GSP Group is required to promptly fill any vacancy created by the removal of its Representative or Alternate Representative so that each GSP Group has the number of validly designated representatives.

Each GSP Group Representative is entitled to one vote at the Coordination Committee, where the Alternate Representative is authorized to vote in the absence of the GSP Group Representative. The unanimous vote of the GSP Representatives from all GSP Groups is required on most items upon which the Coordination Committee is authorized to act, with the exception of certain ministerial and administrative items. Voting procedures to address a lack of unanimity take place upon a majority vote of a quorum of the Coordination Committee and include straw polls, provisional voting, and delay of voting (see Section 5.6.3 – *Voting Procedures to Address Lack of Unanimity* of the Coordination Agreement). Where the law or the Coordination Agreement require separate written approval by each of the Parties, such approval is evidenced in writing by providing the resolution, Motion, or Minutes of their respective Board of Directors to the Secretary of the Coordination Committee. Minutes of the Coordinate Committee are kept and prepared by the Secretary's appointee and maintained by the Secretary as Coordination Agreement records and are available to the Parties and the public upon request. Meeting agenda and minutes are posted on the Delta-Mendota website (www.deltamendota.org).

The Coordination Committee may appoint subcommittees, working groups, and otherwise direct staff made available by the Parties. Subcommittees or working groups may include qualified individuals possessing the knowledge and expertise to advance the goals of the Coordination Agreement on the topics being addressed by the subcommittee or working group, whether or not such individuals are GSP Group Representatives or Alternate Representatives. Tasks assigned to subcommittees, working groups, or staff made available by the Parties may include developing technical data, supporting information, and/or recommendations on specialized matters to the Coordination Committee. One GSP Group Representative or Alternate Representative is required to vote on behalf of the GSP Group at the subcommittee level. If no GSP Group Representative or Alternate Representative is present, one individual working on a subcommittee on behalf of the Parties in a GSP Group votes on behalf of the GSP Group. Subcommittees report voting results and provide information to the Coordination Committee but are not entitled to make determinations or decisions that are binding on the Parties.

The Coordination Committee is authorized to act upon the following items:

1. The Coordination Committee reviews, and consistent with the requirements of SGMA, approves the Technical Memoranda that compose the Common Chapter (see *Coordinated Data and Methodology*);
2. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda as needed; assuring submittal of annual reports; providing five-year assessments and recommending any needed revisions to the Coordination Agreement; and providing review and assistance with coordinated projects and programs, once the GSPs have been submitted to and approved by DWR;
3. The Coordination Committee reviews and approves work plans, and in accordance with the budgetary requirements of the respective Parties, approves annual budget estimates of Coordinated Plan Expenses presented by the Secretary and any updates to such estimates provided that such estimates or updates with supporting documentation are circulated to all Parties for comment at least thirty (30) days in advance of the meeting at which the Coordination Committee will consider approval of the annual estimate;
4. The Coordination Committee is authorized to approve changes to Exhibit “A” (Groundwater Sustainability Plan Groups including Participation Percentages) to the Agreement and to recommend amendments to terms of the Agreement;
5. The Coordination Committee may assign work to subcommittees and workgroups as needed, provide guidance and feedback and ensure that subcommittees and workgroups prepare work products in a timely manner;
6. The Coordination Committee directs the Plan Manager in the performance of its duties under SGMA; and
7. The Coordination Committee provides direction to its Officers concerning other administrative and ministerial issues necessary for the fulfillment of the above-enumerated tasks.

Additional information regarding the roles, responsibilities, and duties of the Coordination Committee can be found in Section 5 – *Responsibilities for Key Functions* of the Coordination Agreement.

Exchange of Information

Timely exchange of information is a critical aspect of GSP coordination. All parties to the Coordination Agreement have agreed to exchange public and non-privileged information through collaboration and/or informal requests made at the Coordination Committee level or through subcommittees designated by the Coordination Committee. To the extent it is necessary to make a written request for information to another Party, each Party designates a representative to respond to information requests and provides the name and contact information of the designee to the Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine, or other electronic means to the appropriate representative as named in the Coordination Agreement. The designated representative is required to respond in a reasonably timely manner. Nothing in the Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Coordination Committee.

The Parties agree that each GSP Group shall provide the data required to develop the Subbasin-wide coordinated water budget but, unless required by law, will not be required to provide individual well or parcel-level information in order to preserve confidentiality of individuals to the extent authorized by law, including but not limited to Water Code Section 10730.8, subdivision (b). To the extent that a court order, subpoena, or the California Public Records Act is applicable to a party, the Party in responding to a request made pursuant to that Act for release of information exchanged from another Party shall notify each other Party in writing of its proposed release of information in order to provide the other Parties with the opportunity to seek a court order preventing such release of information.

Dispute Resolution

Procedures for conflict resolution have been established within the Coordination Agreement. In the event that a dispute arises among Parties as it relates to the Coordination Agreement, the disputing Party or Parties are to provide written notice of the basis of the dispute to the other Parties within thirty (30) calendar days of the discovery of the events giving rise to the dispute. Within thirty (30) days after such written notice, all interested Parties are to meet and confer in good faith to informally resolve the dispute. All disputes that are not resolved informally shall be settled by arbitration. In such an event, within ten (10) days following the failed informal proceedings, each interested Party is to nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties are to rank their top three among all nominated arbitrators, awarding three points to the top choice, two points to the second choice, and one point to the third choice and zero points to all others. Each interested Party will then forward its tally to the Secretary, who tabulates the points and notifies the interested Parties of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The Secretary may also develop procedures for approval by the Parties for selection of an arbitrator in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines to act. The arbitration is to be administered in accordance with the procedures set forth in the California Code of Civil Procedure, Section 1280, *et seq.*, and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring legal action relating to the controversy.

Coordinated Data and Methodology

Pursuant to SGMA, the Coordination Agreement ensures that the individual GSPs utilize the same data and methodologies for developing assumptions used to determine: 1) groundwater elevation; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) changes in groundwater storage; 6) water budgets; and 7) sustainable yield. The Parties have agreed to develop agreed-upon methodologies and assumptions for the aforementioned items prior to or concurrent with the individual development of GSPs. This development is facilitated through the Coordination Committee's delegation to a subcommittee or working group of the technical staff provided by some or all of the Parties. The basis upon which the methodologies and assumptions have been developed includes existing data/information, best management practices, and/or best modeled or projected data available and may include consultation with DWR as appropriate.

The data and methodologies for assumptions described in Water Code §10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans are set forth in Technical Memoranda prepared by the Coordination Committee for each of the following elements: Data and Assumptions; Hydrogeologic Conceptual Model; Coordinated Water Budgets; Sustainable Management Criteria (SMC); Coordinated Monitoring Network; Coordinated Data Management System, and Adoption and Use of the Coordination Agreement. The Technical Memoranda have been subject to the unanimous approval of the Coordination Committee and once approved, have been attached to and incorporated by reference into the Coordination Agreement without formal amendment of the Coordination Agreement being required. The Parties have agreed that they will not submit this Coordination Agreement to DWR until the Technical Memoranda described herein have been added to the Coordination Agreement. The Technical Memoranda created pursuant to the Coordination Agreement are to be utilized by the Parties during the development and implementation of their individual GSPs in order to assure coordination of the GSPs is in compliance with SGMA. The Technical Memoranda have been included as an appendix to this GSP as a part of the Common Chapter.

Plan Implementation and Submittal

Under the Coordination Agreement, the Parties have agreed to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. Subject to the subsequent attachment of the Technical Memoranda as appendices to the Common Chapter, the Parties intend that the described Coordination Agreement fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy the requirements of SGMA for the entire Subbasin. The Coordination Agreement does not otherwise affect each Party's responsibility to implement the terms of its respective GSP in accordance with SGMA. Rather, this Coordination Agreement is the mechanism through which the Parties will coordinate their respective GSPs to the extent necessary to ensure that such GSP coordination complies with SGMA.

Each Party is responsible for ensuring that its own GSP complies with the statutory requirements of SGMA, including but not limited to the filing deadline. The Parties to this Coordination Agreement intend that their individual GSPs be coordinated together in order to satisfy the requirements of SGMA and to be in substantial compliance with the California Code of Regulations. The collective GSPs will satisfy the requirements of Water Code Sections 10727.2 and 10727.4 by providing a description of the physical setting and characteristics of the separate aquifer systems within the Subbasin, the measurable objectives for each such GSP, interim milestones (IMs), and monitoring protocols that together provide a detailed description of how the Subbasin as a whole will be sustainably managed.

The Parties agree to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. The Coordination Committee is responsible for assuring submittal of annual reports, five-year updates, and for providing assessments recommending any needed revisions to the Coordination Agreement.

Coordinated Data Management System

The Delta-Mendota Subbasin GSAs have developed and will maintain a coordinated Data Management System that is capable of storing and reporting information relevant to the reporting requirements and/or implementation of the GSPs and monitoring network of the Subbasin.

The Parties may also develop and maintain separate Data Management Systems. Each separate Data Management System developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

Adjudicated Areas and Alternative Plans

There are no adjudicated areas within the Delta-Mendota Subbasin, and no Alternative Plans have been submitted by the local agencies within the Subbasin.

Legal Bindings of the Delta-Mendota Subbasin Coordination Agreement

The Coordination Agreement, as contained herein, is reflected in the same manner and form as in the six Subbasin GSPs. All parties understand that the Delta-Mendota Subbasin Coordination Agreement is part of the GSPs for participating Subbasin GSAs and will be a primary mechanism by which the six Subbasin

GSPs will be implemented in a coordinated fashion. Further, all parties to the Coordination Agreement understand that DWR will evaluate the agreement for compliance with the procedural and technical requirements of GSP Regulations §357.4 (Coordination Agreement) to ensure that the agreement is binding on all parties and that provisions of the agreement are sufficient to address any disputes between or among parties to the agreement.

The Coordination Agreement will continue to be the framework under which the six Delta-Mendota Subbasin GSPs will be implemented and will be reviewed as part of the five-year assessment and revised as necessary, dated, and signed by all parties.

2.1.3 Inter-basin Agreements

SLDMWA, on behalf of the Northern and Central Delta-Mendota Regions, and the SJREC GSA executed inter-basin data sharing agreements with Westlands Water District (the lead entity encompassing the adjoining Westside Subbasin). The purpose of the agreement is to establish a set of common assumptions on groundwater conditions on either side of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin to be used for the development of GSPs in support of implementation of SGMA. In this agreement, the parties agree to provide each other with recorded, measured, estimated, and/or simulated modeling data located within five (5) miles of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin. A list of data types to be shared between the parties to the agreement can be found in **Appendix D**.

Data provided under this agreement are understood to be shared with consultants and other stakeholders in the respective basins (Delta-Mendota Subbasin and Westside Subbasin), and that the information will be made public through the development of the respective Parties' (meaning SLDMWA/SJREC and Westlands Water District) GSPs and the supporting documentation of the GSPs. Other than publishing information for those purposes, neither Party will disclose the other Party's information to any third party, except if the other Party determines, at its sole discretion, the disclosure is required by law. Each Party may review preliminary results before publishing the information.

It is recognized that many of the sustainability indicators, notably groundwater quality, inelastic land subsidence and change in storage, are regional issues that may require future inter-basin discussions and coordination. Memorandum of Intent (MOI) are being discussed with the surrounding subbasins to demonstrate/confirm the subbasins' desires to coordinate during GSP implementation. These agreements, to be discussed further following submittal of GSPs, will allow for thoughtful consideration of the intent, structure, and need for future coordination with respect to data collection, reporting, regular meetings, and updates prior to annual reporting.

3. DELTA-MENDOTA SUBBASIN PLAN AREA

This section describes the Delta-Mendota Subbasin, including major streams and creeks, institutional entities, agricultural and urban land uses, locations of state lands (including wetlands), and geographic boundaries of surface water runoff areas. The reader is referred to the individual Subbasin GSPs for descriptions of existing surface water and groundwater monitoring programs, existing water management programs, and general plans in the individual GSP Plan Areas. The information contained in this section reflects information from publicly available sources and may not reflect all information that will be used for GSP technical analysis.

This section of the GSP satisfies Section 354.8 of the SGMA regulations.

3.1 Plan Area Definition

The Plan Area for the six coordinated GSPs is the Delta-Mendota Subbasin (DWR Basin 5-022.07). As previously noted, the Delta-Mendota Subbasin is one of nine subbasins that lie completely within the San Joaquin Valley Hydrologic Region and adjoins the following subbasins (**Figure CC-8**):

- Tracy
- Eastern San Joaquin
- Modesto
- Turlock
- Merced
- Chowchilla
- Madera
- Kings
- Westside

As described in *California's Groundwater*, DWR Bulletin 1188 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley and includes portions of San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera Counties. The northern boundary begins just south of Tracy in San Joaquin County, and the eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin, and the Subbasin is bounded on the west by the Coast Range. The Subbasin boundaries are further described in Section 4.1.5, Basin Boundaries, and is shown in relation to each of the six counties in **Figure CC-9**.

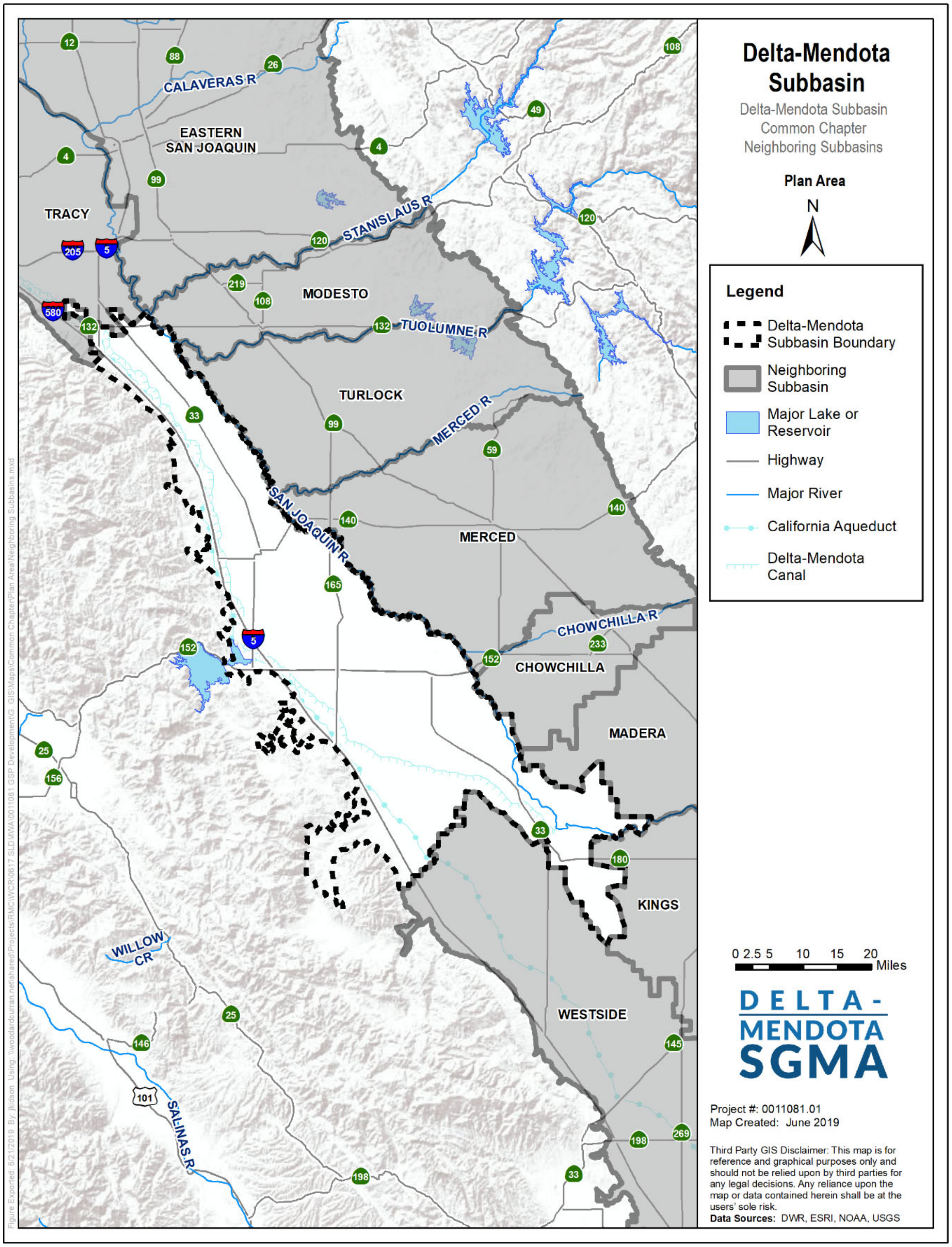


Figure CC-8: Neighboring Subbasins of the Delta-Mendota Subbasin

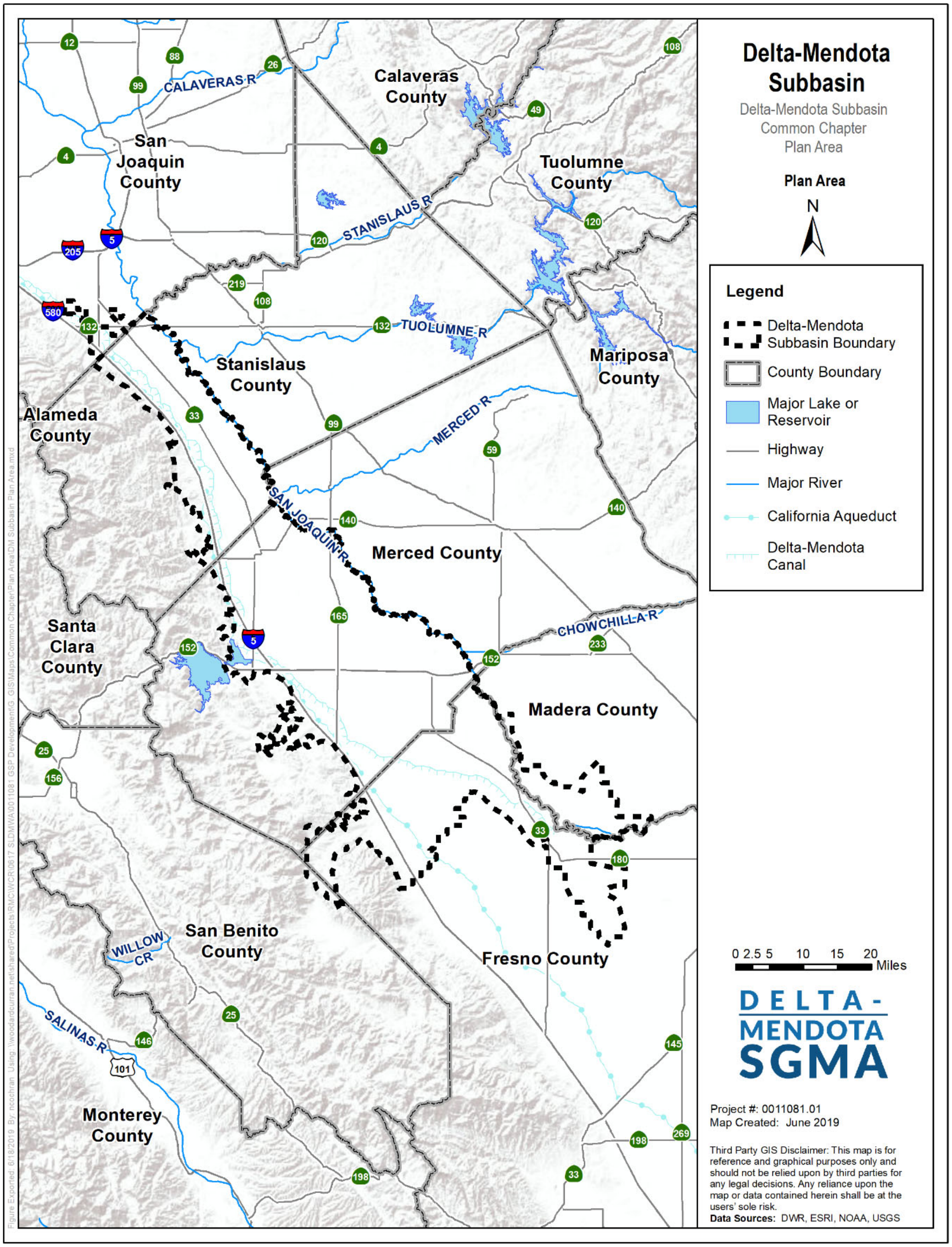


Figure CC-9: Delta-Mendota Groundwater Subbasin Plan Area

3.2 Plan Area Setting

As previously noted, the Delta-Mendota Subbasin lies along the western margin of the San Joaquin Valley. This valley is part of the large, northwest-to-southeast-trending asymmetric trough of the Central Valley, which has been filled with up to six vertical miles of sediment. This sediment includes both marine and continental deposits ranging in age from Jurassic to Holocene. The San Joaquin Valley lies between the Coast Range Mountains on the west and the Sierra Nevada on the east and extends northwestward from the San Emigdo and Tehachapi Mountains to the Sacramento-San Joaquin Delta (Delta) near the City of Stockton. The San Joaquin Valley is 250 miles long and 50 to 60 miles wide. The relatively flat alluvial floor is interrupted occasionally by low hills. Foothills adjacent on the west are composed of folded and faulted beds of mainly marine shale in the north and sandstone and shale in the south.

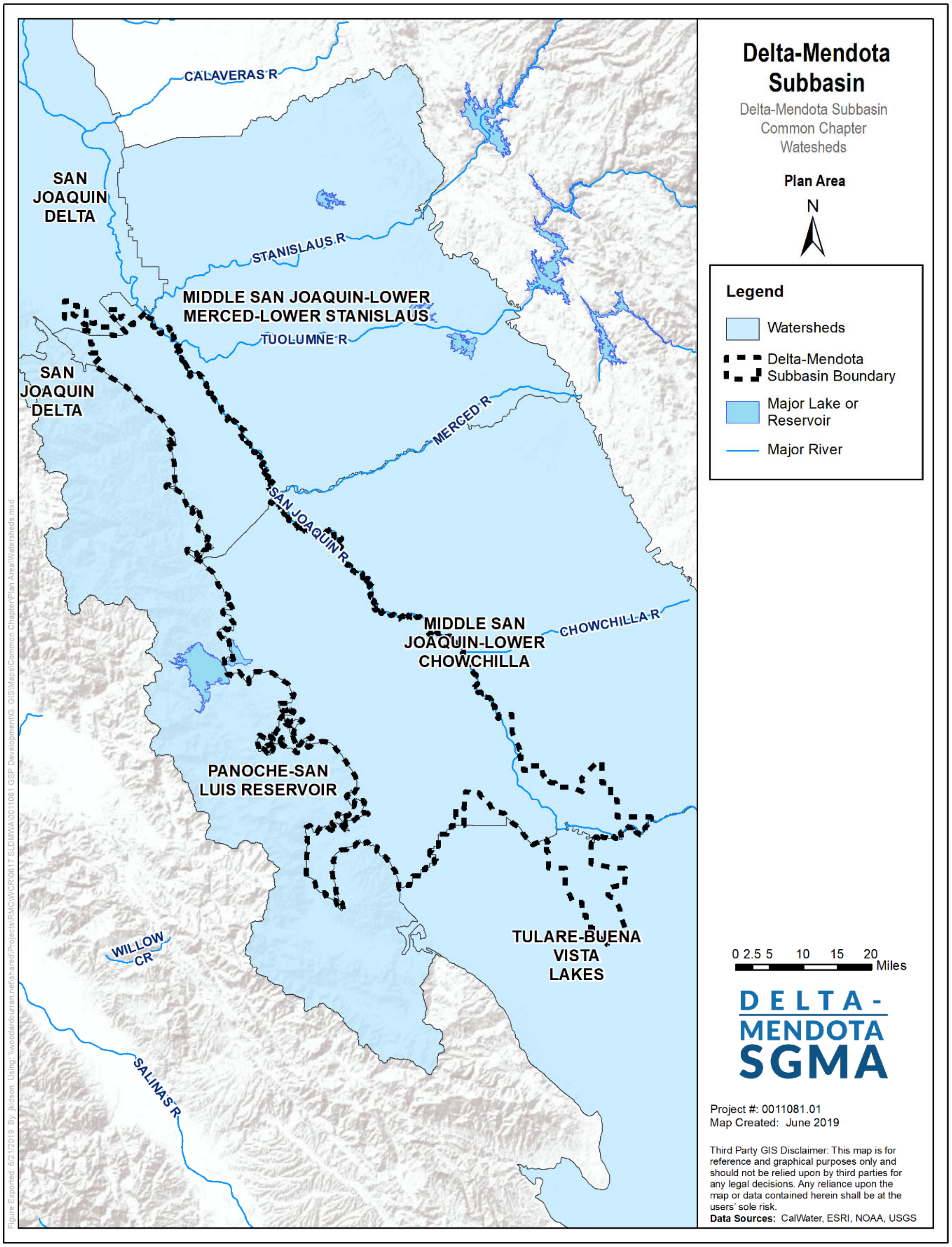
The San Joaquin Valley floor is divided into several geomorphic land types, including dissected uplands, low alluvial fans and plains, river floodplains and channels, and overflow lands and lake bottoms. Alluvial plains cover most of the valley floor and comprise some of the most intensely developed agricultural lands in the San Joaquin Valley. In general, alluvial sediments of the western and southern parts of the San Joaquin Valley tend to have lower permeability than east side deposits.

This section provides additional information relating to water resources in and around the Delta-Mendota Subbasin.

Watersheds

The Delta-Mendota Subbasin lies in the Middle San Joaquin-Lower Merced-Lower Stanislaus watershed and the Middle San Joaquin-Lower Chowchilla watershed (**Figure CC-10**). Historically, the San Joaquin Valley Basin was a large floodplain of the San Joaquin River that supported vast expanses of permanent and seasonal marshes, lakes, and riparian areas. Approximately 90 percent of the basin’s wetlands have been lost, with approximately 58,000 flooded acres remaining on State, federal and private wildlife refuges. Approximately 100,000 acres of managed wetland, upland and riparian habitat is found within the Grassland Plan area, and together with the 12,000-acre Mendota Wildlife Area (found in the Fresno County Plan area), encompasses the vast majority of the remaining wetlands found in the basin (**Figure CC-11**).

The San Joaquin River Basin (Basin) includes the entire area drained by the San Joaquin River. The San Joaquin River Basin drains 13,513 square miles (mi^2) before it flows into the Sacramento-San Joaquin Delta near the town of Vernalis. The Merced, Tuolumne and Stanislaus Rivers are the three major tributaries that join the mainstream San Joaquin River from the east before it flows into the Delta.



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Data Sources: CalWater, ESRI, NOAA, USGS

Figure CC-10: Local Watersheds

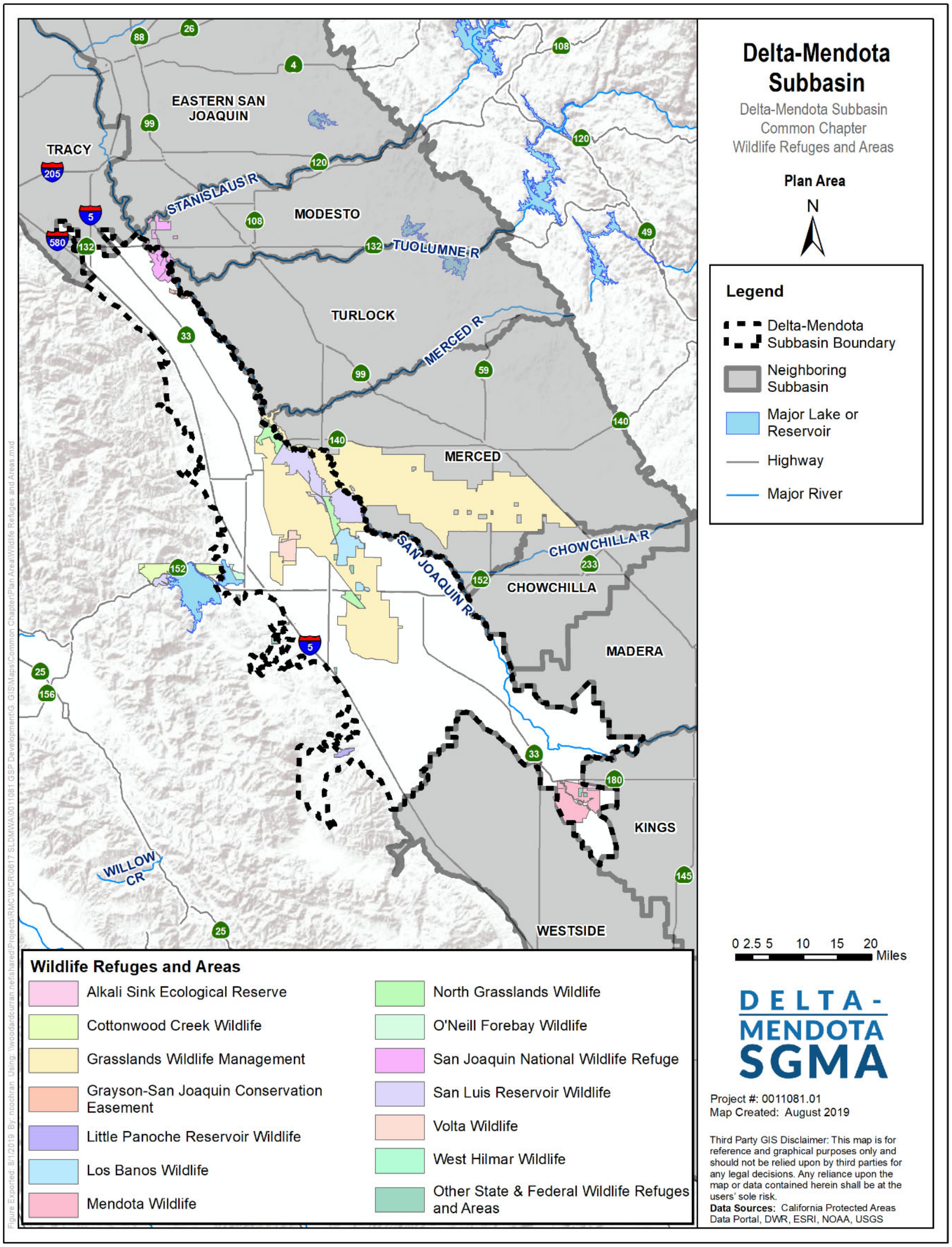


Figure CC-11: Wildlife Refuges and Wetland Habitat Areas in the Delta-Mendota Subbasin

Surface Water Use

Surface water is a primary water supply for agriculture within the Delta-Mendota Subbasin. Surface water supplies are brought into the Subbasin using an extensive series of water systems relied upon by multiple water agencies, cities, and private water users. Major water-related infrastructure in the Subbasin includes the facilities required to deliver Central Valley Project (CVP) supplies to CVP water supply contractors, in addition to key infrastructure of the State Water Project (SWP) utilized to deliver water to SWP water supply contractors and surface water diversions (e.g., intakes) to divert and distribute water from the San Joaquin and Kings Rivers.

The San Luis & Delta-Mendota Water Authority (SLDMWA) is a joint powers authority consisting of 28 member agencies that provide water to approximately 1.2 million acres of highly productive farmland, 2 million California residents, and millions of waterfowl dependent upon the nearly 200,000 acres of managed wetlands within this area of the Pacific Flyway. The SLDMWA operates and maintains portions of the CVP, including the Delta Cross Channel, the C.W. "Bill" Jones Pumping Plant, the Delta-Mendota Canal (DMC), O'Neill Pumping-Generating Plant, and the San Luis Drain, and provides emergency assistance when requested on the Delta Cross Channel and the Tracy Fish Collection Facility. The California Department of Water Resources (DWR) operates and maintains the SWP facilities, designed to deliver nearly 4.2 million acre-feet of water per year to 29 long-term SWP water supply contractors. Joint federal-state facilities include the California Aqueduct, Banks Pumping Plant, O'Neill Dam and Forebay, Sisk Dam and San Luis Reservoir, and Dos Amigos Pumping Plant. Surface water diversion facilities are owned and operated by individual water and irrigation districts and typically include some form of intake (e.g., fish screen, open water intake, flumes) plus facilities to convey the diverted surface water to a distribution system.

Groundwater Use

Groundwater is a key component of water supplies in the Delta-Mendota Subbasin. To protect the long-term sustainability of groundwater resources, pumping has significantly reduced in past years (2017-2019), allowing the groundwater levels in the Subbasin to recover to some extent. During the most recent drought period, groundwater was heavily relied upon throughout the Subbasin for irrigation as surface water deliveries were significantly severely reduced for many water users (especially those with junior surface water rights), resulting in increased groundwater pumping.

There are many communities within the Subbasin that are partially or completely reliant on groundwater for municipal and domestic water supplies, including the cities of Patterson, Newman, Gustine, Los Banos, Firebaugh, and Mendota and the communities of Grayson, Westley, Crows Landing, Santa Nella, Volta, Dos Palos Y, and Tranquillity (**Figure CC-12**). Other unincorporated areas of the Subbasin also rely on groundwater as the sole water supply source. There are several areas of *de minimis* groundwater extractors in the Subbasin, which are defined as well owners who extracts two acre-feet or less per year from a parcel for domestic purposes (SWRCB, n.d. (a)).

Figure CC-13, **Figure CC-14**, and **Figure CC-15** show the density per square mile (PLSS Section) of domestic, production, and public wells in the Delta-Mendota Subbasin as identified by DWR's Well Completion Report Map Application. Domestic wells are defined as individual domestic wells which supply water for the domestic needs of an individual residence or systems of four or less service connections (DWR, 1981). Within the Delta-Mendota Subbasin, the majority of PLSS Sections contain five or fewer domestic wells (**Figure CC-13**). Production well statistics include wells that are designated as irrigation, municipal, public, and industrial on well completion reports, generally indicating wells designed to obtain water from productive zones containing good-quality water (DWR, 1991). The majority of PLSS Sections in the Subbasin contain only zero, one, or two production wells (**Figure CC-**

14). The highest concentration of production wells can be found in the south of the Subbasin, near Mendota. Public wells are defined as wells that provide water for human consumption to 15 or more connections or regularly serves 25 or more people daily for at least 60 days out of the year (SWRCB, n.d. (b)). Compared to domestic and production wells, public wells are less common in the Subbasin. The status of the wells (e.g., active, abandoned, destroyed) contained in the DWR Well Completion Report Map Application has not been independently confirmed. Additionally, the reader is referred to each of the six Subbasin GSPs for more information regarding wells in the Delta-Mendota Subbasin.

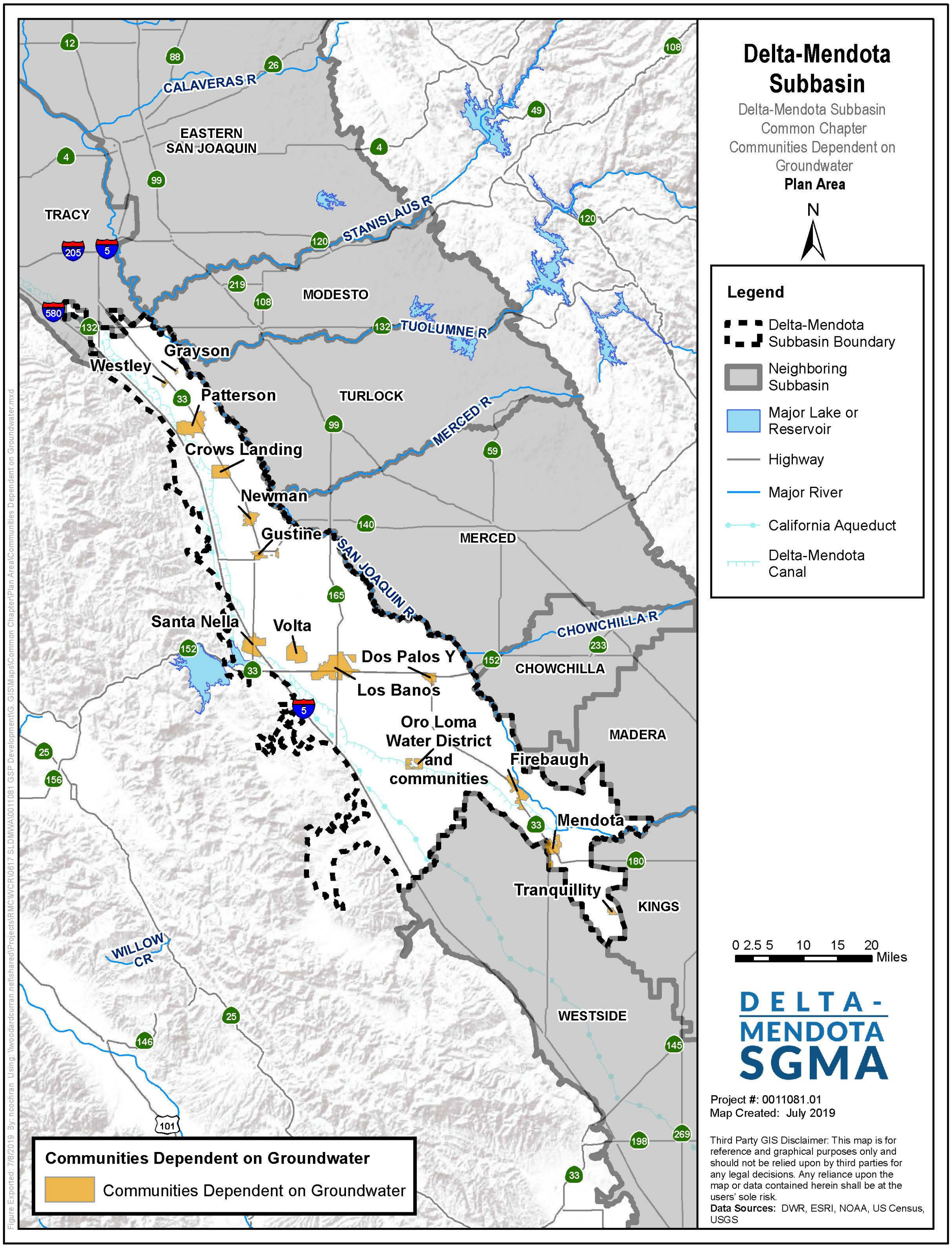


Figure CC-12: Communities Dependent on Groundwater

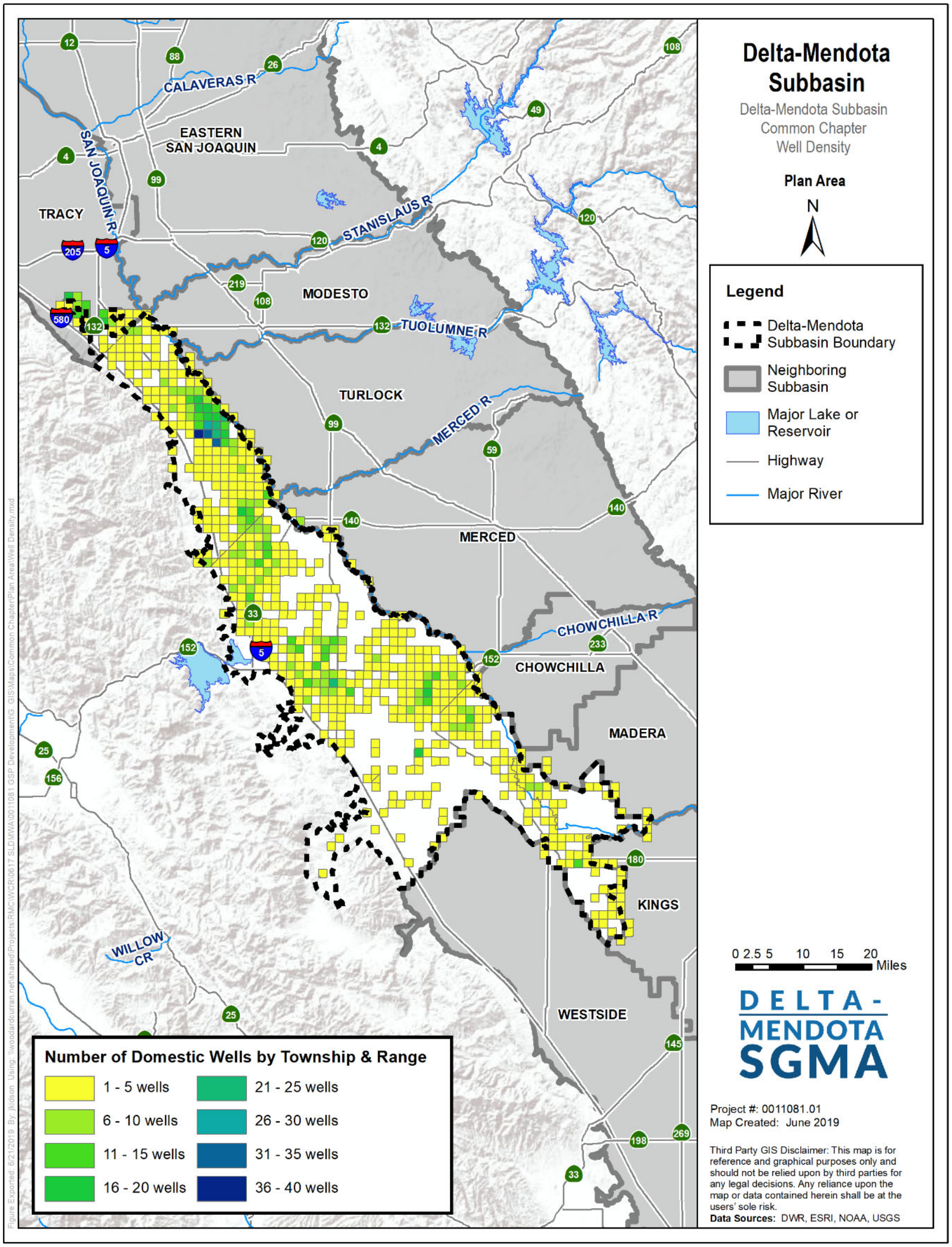


Figure CC-13: Domestic Well Density in the Delta-Mendota Subbasin

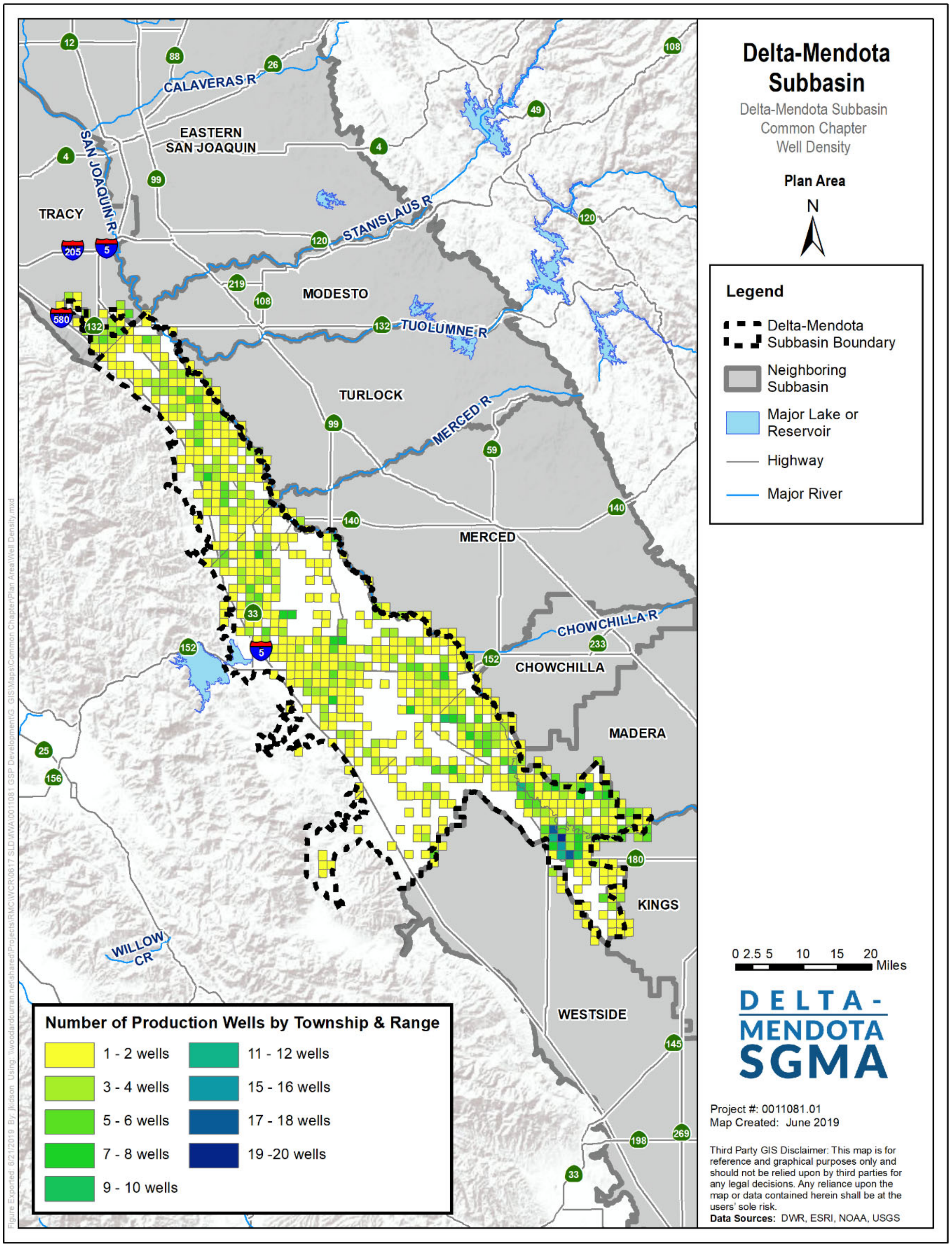


Figure CC-14: Production Well Density in the Delta-Mendota Subbasin

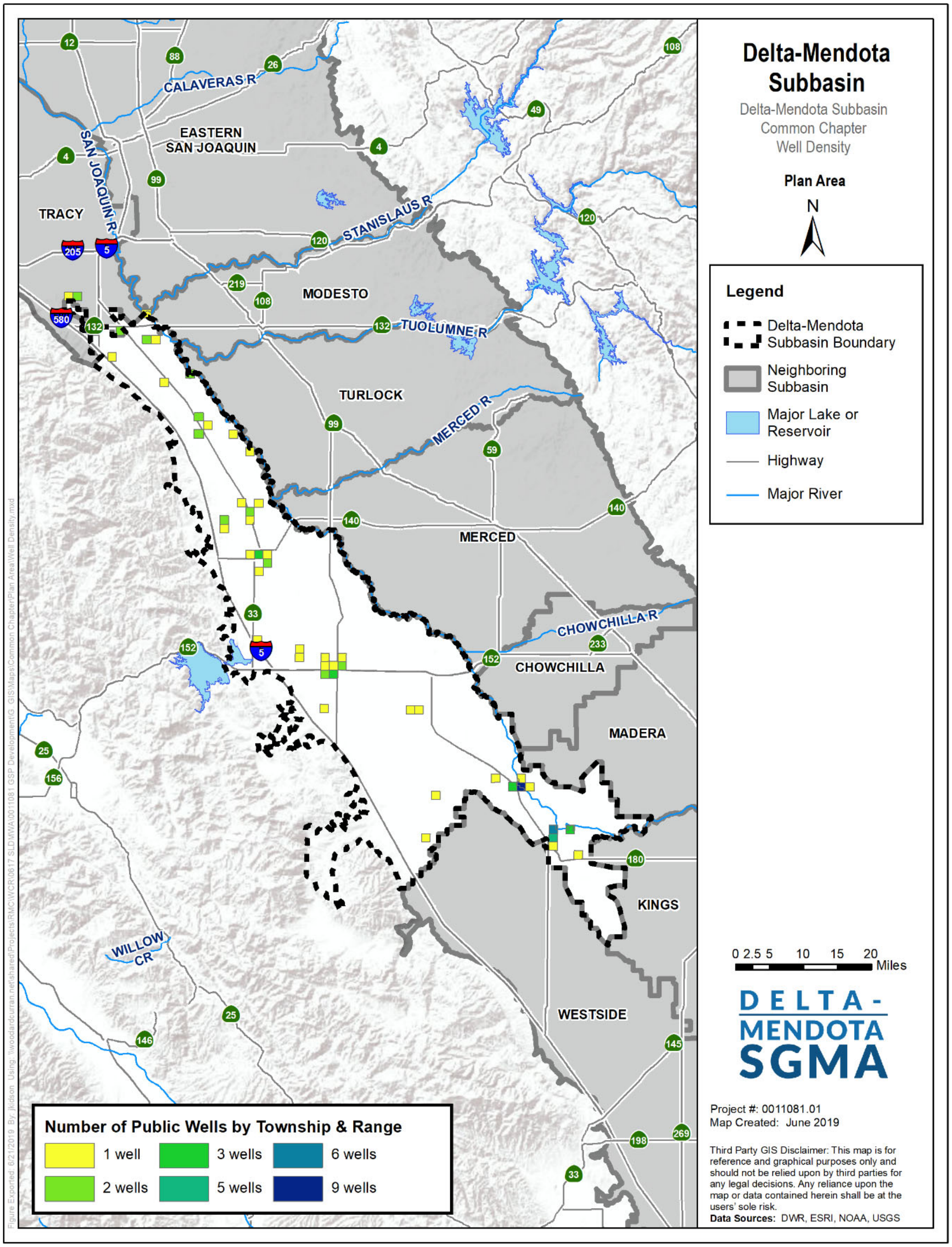


Figure CC-15: Public Well Density in the Delta-Mendota Subbasin

Flood Management

In general, the Delta-Mendota Subbasin slopes toward the San Joaquin River with steeper slopes along the western boundary (near the Coast Range), tapering off closer to the San Joaquin River. The flood management system in the San Joaquin Valley includes reservoirs to regulate snowmelt from elevations greater than 5,000 feet, bypasses at lower elevations, and levees that line major rivers.

Severe rain events in 1997/98, 2005/2006, 2011 and 2017 flooded communities, agricultural lands and refuges adjacent to the San Joaquin River in the Delta-Mendota Subbasin (specifically the communities of Firebaugh, Newman, Gustine and Mendota) and produced some localized flooding of farmland and refuges caused by runoff impoundment by elevated canal banks. Based on the recent historical events, the primary threat of flooding to urban areas will be for those along (and immediately adjacent to) the San Joaquin River. Areas within the 100-year floodplain within the Subbasin are shown in **Figure CC-16**.

Major Land Use Divisions

The Delta-Mendota Subbasin consists mostly of agricultural land use types (**Figure CC-17**). Typical land uses are described in the following sections and consist predominantly of the following:

- Pasture/Rangeland
- Agricultural Land (including rice, field crops and grains)
- Deciduous Forest
- Idle and Retired Farmland/Rangeland
- Riparian/Wetland
- Urban

The primary land use planning entities in the Delta-Mendota Subbasin include San Joaquin, Stanislaus, Merced, Fresno, and Madera Counties, as well as the cities of Patterson, Newman, Gustine, Los Banos, Dos Palos, Firebaugh, and Mendota, and Community of Santa Nella, as shown in **Figure CC-18**.

Pasture/Rangeland

Grasslands in the Central Valley were originally dominated by native perennial grasses such as needlegrass and alkali sacaton. Currently, grassland vegetation is characterized by a predominance of annual or perennial grasses in an area with few or no trees and shrubs. Annual grasses found in grassland vegetation include wild oats, soft chess, ripgut grass, medusa head, wild barley, red brome, and slender fescue. Perennial grasses found in grassland vegetation are purple needlegrass, Idaho fescue, and California oatgrass. Forbs commonly encountered in grassland vegetation include long-beaked filaree, redstem filaree, dove weed, clovers, Mariposa lilies, popcornflower, and California poppy. Vernal pools found in small depressions with an underlying impermeable layer are isolated wetlands within grassland vegetation. Pastures can consist of both irrigated and unirrigated lands dominated by perennial grasses used predominantly for grazing.

Rangeland communities are composed of similar grasses, grass-like plants, forbs, or shrubs which are grazed by livestock. Rangelands are classified into three basic types: shrub and brush rangeland, mixed rangeland, and herbaceous rangeland. The shrub and brush rangeland are dominated by woody vegetation and is typically found in arid and semiarid regions. Mixed rangelands are ecosystems where more than one-third of the land supports a mixture of herbaceous species and shrub or brush rangeland species. Herbaceous rangelands are dominated by naturally occurring grasses and forbs as well as some areas that have been modified to include grasses and forbs as their principal cover. Rangelands are, by definition, areas where a variety of commercial livestock are actively maintained.

Agricultural Land

General agricultural types occurring in the Delta-Mendota Subbasin include row crops, grains, orchards, and vineyards. Management of agricultural lands often includes intensive management, including soil preparation activities, crop rotation, grazing, and the use of chemicals.

Row Crops

Most row crops grown in the San Joaquin Valley and harvested for food are annual species and are managed with a crop rotation system. During the year, several different crops may be produced on a given parcel of land either concurrently or in succession. Typical crops grown in the Delta-Mendota Subbasin include tomatoes, melons, grain crops (such as barley, wheat, corn, and oats), rice, cotton, and beans.

Orchards and Vineyards

Orchard and vineyards consist of cultivated fruit or nut-bearing trees or grapevines. Orchards are typically open, single-species, tree-dominated habitats and are planted in a uniform pattern and intensively managed. Understory vegetation is usually sparse. Vineyards are typically managed in a similar manner for producing grapes for wine and/or direct consumption.

Deciduous Forest

Deciduous forests are composed of trees that lose their leaves in the winter. These include species such as the various California oaks, California buckeye, Fremont Cottonwoods, Goodding Willows, and California Sycamores. The interior live oak, which is not deciduous, is also found in deciduous forests. Valley oak woodlands are found in the Sacramento and San Joaquin Valleys and usually occur below elevations of 2,000 feet.

Idle or Retired Farmland/Rangeland

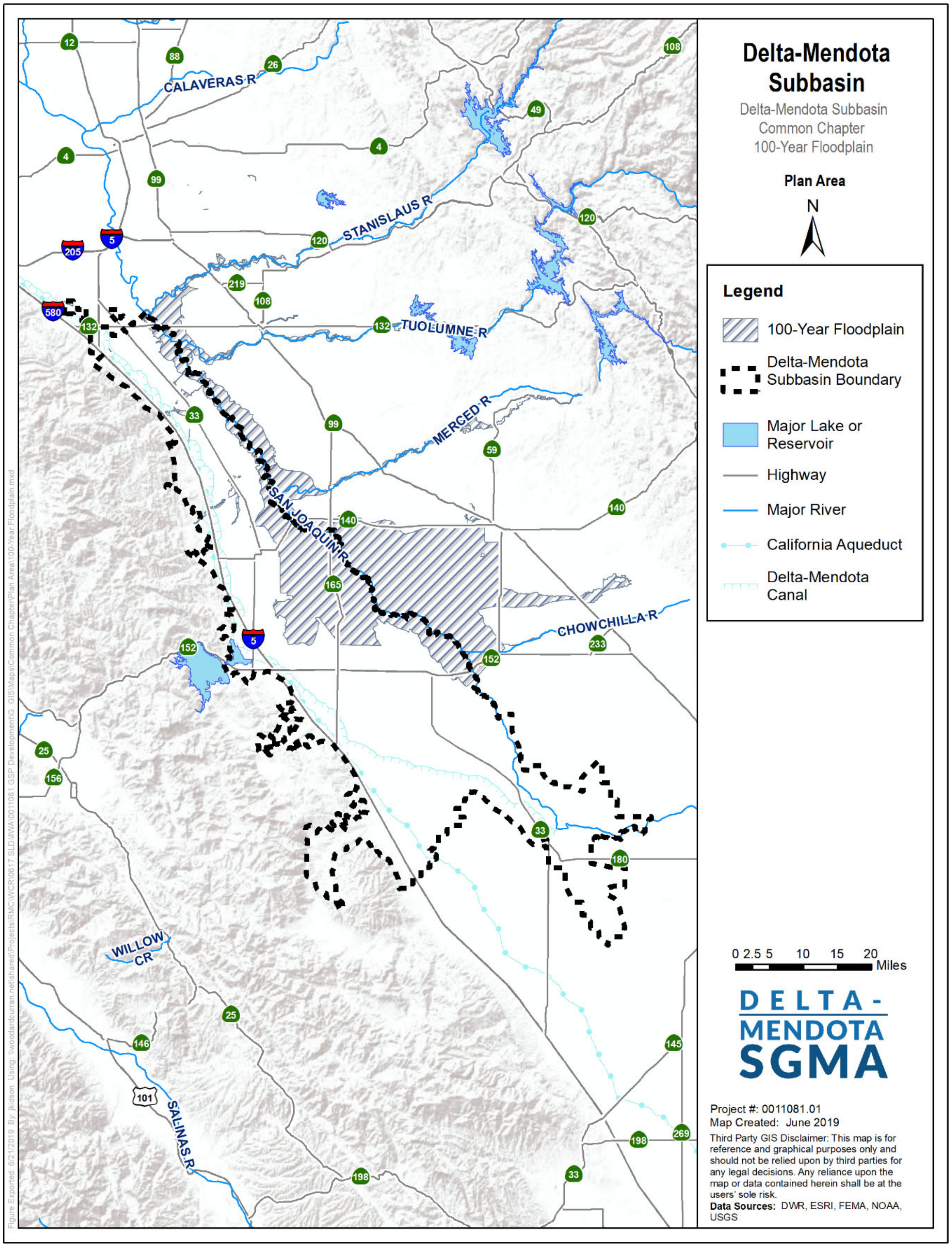
Lands of this category are similar to abandoned farmlands in ruderal (disturbed) areas. Plants on these parcels may consist of either native and/or non-native species.

Riparian/Wetland

Riparian and wetland communities are both natural and man-made. Managed wetlands are classified as riparian and are flooded for overwintering migratory bird habitat. In the spring the wetlands are drained to promote grasses such as swamp timothy and watergrass which are an important waterfowl food supply. Although some grazing continues on managed wetlands, historically, many of these lands were irrigated and used as rangeland throughout the summer months. Today, managed wetlands are irrigated in the spring to maximize wetland productivity and provide nesting and sensitive species habitat. Managed wetlands also contain emergent vegetation such as cattail and tule and are often adjacent to riparian corridors.

Urban

Urban land uses include cities and smaller communities, in addition to other lands used for industrial and/or commercial practices.



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Data Sources: DWR, ESRI, FEMA, NOAA, USGS

Figure CC-16: 100-Year Floodplain, Delta-Mendota Subbasin

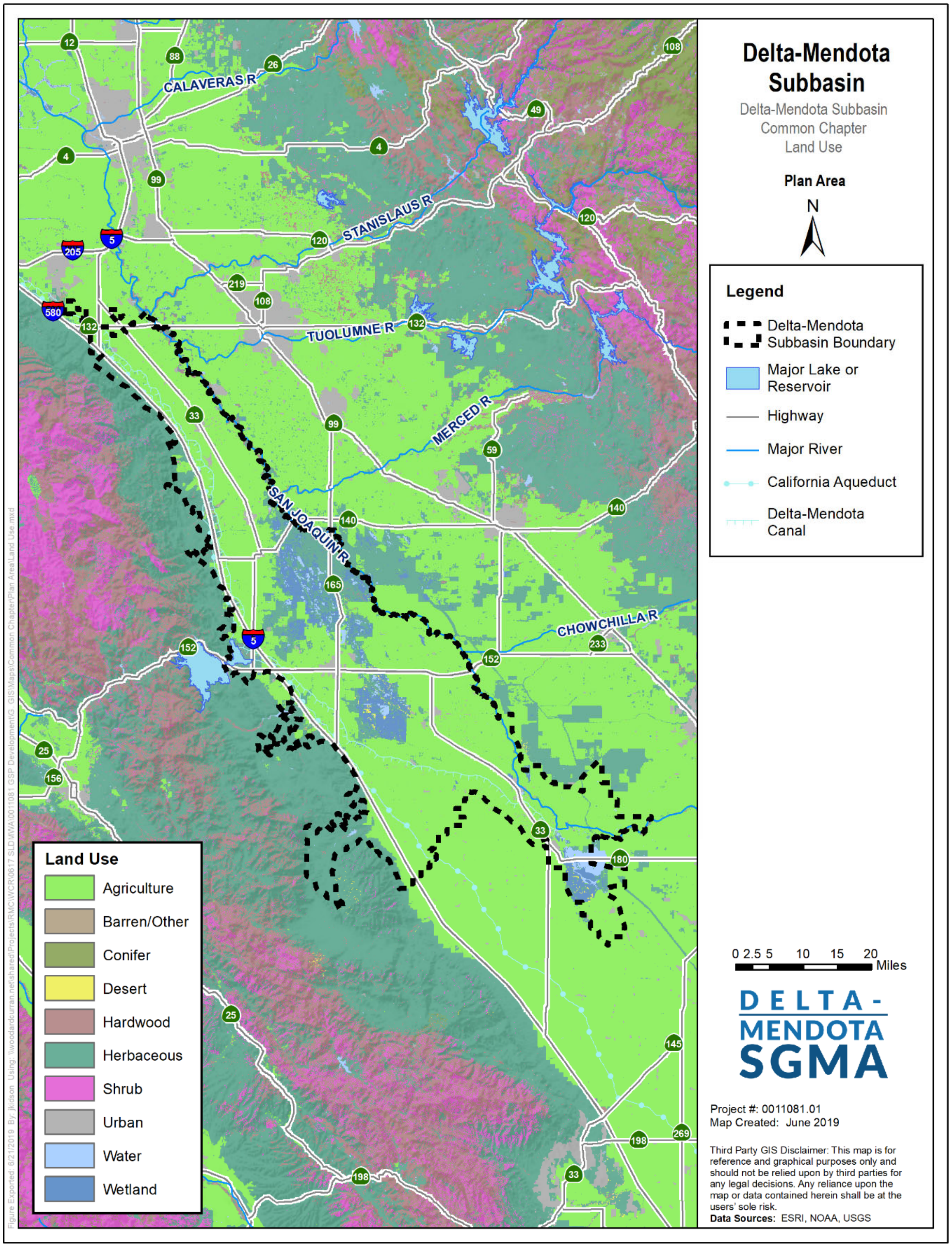
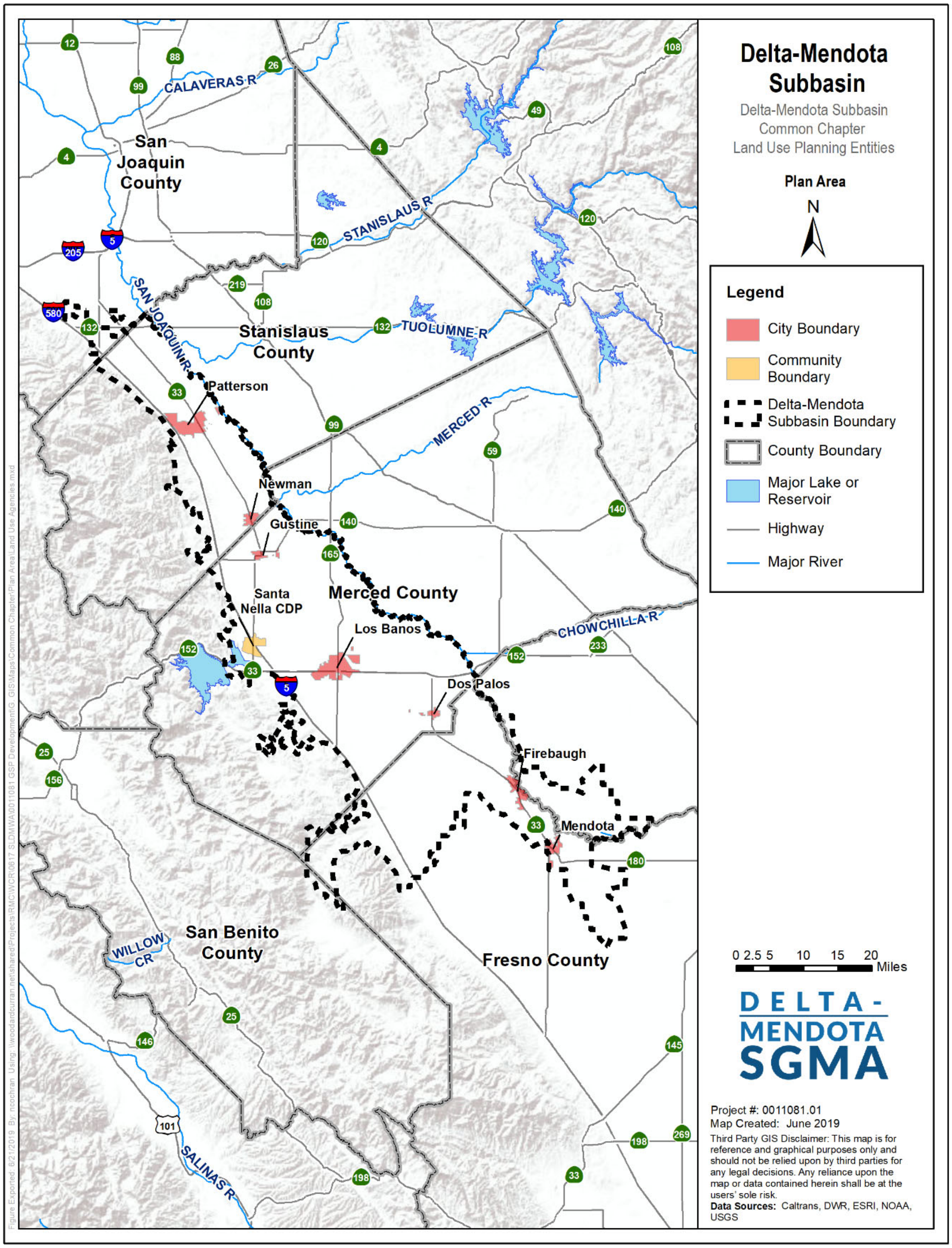


Figure CC-17: Typical Land Use



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Data Sources: Caltrans, DWR, ESRI, NOAA, USGS

Figure CC-18: Land Use Planning Entities

Regional Economic Issues and Trends

The western San Joaquin Valley is a highly agricultural region. There are no large cities or industries in the Subbasin to provide an alternative economic base. The economy of this region is predominately driven by agricultural production and therefore, the availability of surface water supplies (predominantly in the form of CVP agricultural water and diversions from the San Joaquin and Kings Rivers) is an essential element to the economic health of the region. Other uses of surface water in the Subbasin are used for M&I purposes and wildlife refuge water supply.

Depending on water supply conditions, about 800,000 acres in the Delta-Mendota Subbasin are partially or solely irrigated with surface water. Other economic base industries include travel on the Interstate 5 (I-5) corridor, some petroleum extraction, and tourism. State, federal, and private wildlife refuges benefit local economies by attracting hunters, anglers, outdoor recreationists to the region. Managed wetland water conveyance infrastructure is maintained and improved by many contractors and local agency staff. Large scale conveyance improvements and habitat restoration projects, including mitigation banks, are also common throughout the Subbasin. M&I water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities and smaller communities. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2018 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 22,352) and Los Banos (population 30,074) (U.S. Census Bureau, 2017).

All communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Patterson, Tranquillity, Grayson, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, and Westley. All of these communities are strongly affected by the reliability of agricultural water supplies. Some of them are dependent upon groundwater for M&I use.

Plan Area Jurisdictional Boundaries

Jurisdictional areas within the Delta-Mendota Subbasin include counties, cities, water districts, irrigation districts, mutual water companies, and federal and state agencies. There are no federal- or state-recognized tribal communities in the Subbasin. Federal and State Lands are shown in **Figure CC-19**. More detail on specific jurisdictional areas within each GSP area can be found in the respective GSP.

In general, all municipal, water/irrigation districts and counties within the Delta-Mendota Subbasin are participating in GSP development either as a separate GSA or as members of a GSA. The California Department of Fish and Wildlife boundaries and the U.S. Fish and Wildlife Service boundaries overlay the wildlife refuges and areas and state parks within the Subbasin. DWR manages the SWP and the California Aqueduct, and the U.S. Bureau of Reclamation (USBR), through the SLDMWA, manages the CVP and the Delta-Mendota Canal. The California Department of Transportation (Caltrans) is responsible for managing the State and Interstate highways in the Subbasin, including Interstate- (I-) 5, and State Highways 132, 33, 140, 152, and 165.

Figure CC-9 depicts the Subbasin’s extent relative to the boundaries of the various counties that overlie the Subbasin. Merced County has jurisdiction over the largest portion of the Subbasin (525 square miles), in the central portion of the Subbasin. Stanislaus County has jurisdiction over most of the area on the northern end of the Subbasin (covering 223 square miles). Fresno and Madera Counties have jurisdiction over the southern extent of the Delta-Mendota Subbasin (400 square miles). Finally, San Benito County covers the smallest portion of the Subbasin (5 square miles) in the southwestern portion of the Subbasin near San Luis Reservoir.

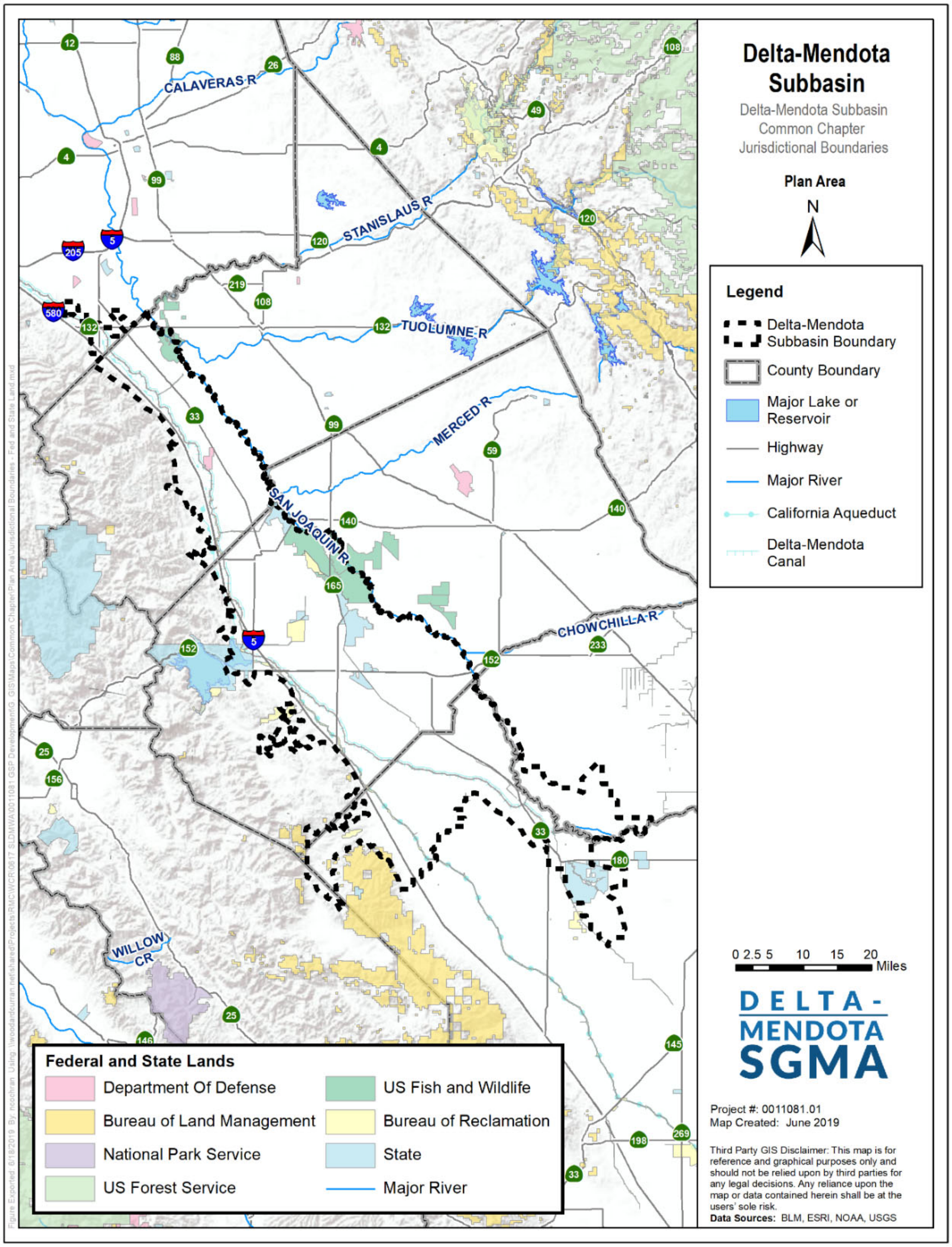

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Figure CC-19: Federal and State Lands

Land Use Elements

Land use in the Delta-Mendota Subbasin is predominantly agricultural with wildlife habitat areas and areas of municipal, industrial, and commercial use. Predominant crops grown in the region include grain and hay crops, nut and fruit trees, and row crops. **Figure CC-20** shows the distribution of different land use types across the Delta-Mendota Subbasin.

Conjunctive use of surface water and groundwater is practiced throughout much of the Delta-Mendota Subbasin. Urban centers, such as the City of Patterson, and most unincorporated county areas rely solely on groundwater for their water supplies. Several water and irrigation districts hold water rights to divert from the San Joaquin River and/or the Kings Rivers. Other water purveyors receive water from the CVP and use groundwater and non-CVP-acquired surface waters to supplement demand, while some water districts rely solely on groundwater for their supplies. Refer to each GSP for detailed discussions of the water sources used by each agricultural, wetland, and urban water supplier.

Agriculture is the predominant water use sector throughout the Delta-Mendota Subbasin (**Figure CC-20**). Urban water uses are mostly concentrated within and surrounding cities (such as Patterson and Los Banos). Non-irrigated land includes any idle or native riparian land classifications, which are scattered throughout the Regions.

3.3 General Plans in Plan Area

Within each GSP, General Plans and/or Community Specific Plans overlie the area. These include County general plans for Fresno, Merced, San Benito, San Joaquin, Stanislaus, and Madera Counties, and specific plans for cities and communities. Each GSP contains a detailed list of General Plan policies and objectives relevant to water resources management in the applicable GSP area. Refer to discussions in the individual GSPs which satisfy §354.8(f) of the GSP Emergency Regulations under SGMA.

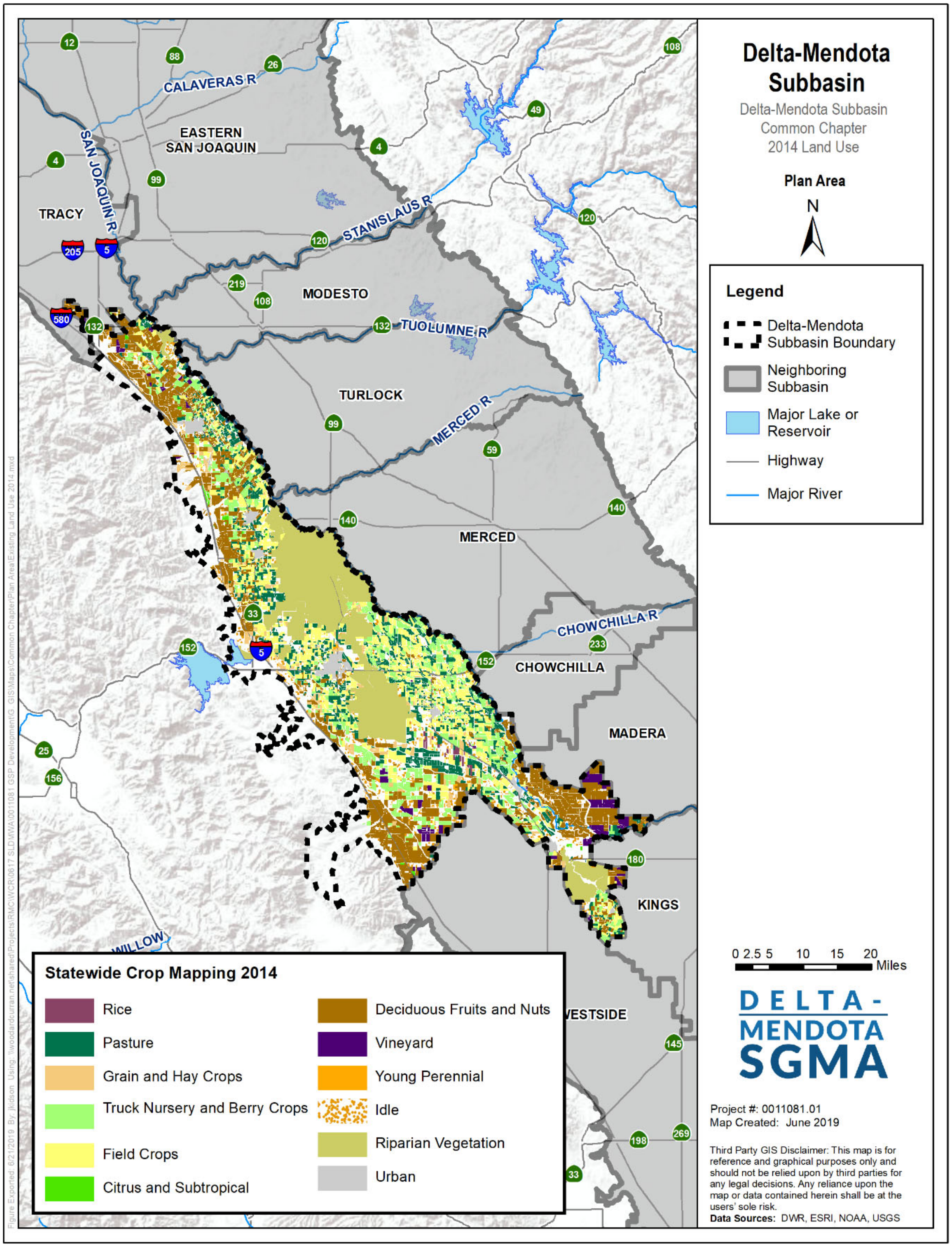


Figure CC-20: 2014 Land Use in the Delta-Mendota Subbasin

3.4 Existing Land Use Plans and Impacts to Sustainable Groundwater Management

Numerous policies in each County's and Community's General Plan compliment the GSPs' plans to conserve and sustainably manage groundwater resources. In general, the County and City General Plans guide future growth and development (and associated demands) within their respective jurisdictional areas. This additional growth may impact groundwater sustainability by placing additional demands on groundwater resources in an area where surface water resources are scarce or are otherwise unavailable. The General Plans also promote water conservation (in both the urban and agricultural sectors), which could potentially offset the additional demands associated with future urban development. In addition to conservation, some (though not all) General Plans promote groundwater recharge, the protection of recharge areas and wetlands, and the use of water transfers to further benefit groundwater sustainability.

Most General Plans within the Delta-Mendota Subbasin include goals focused on preserving agriculture, efficient use of existing and future water sources in both the urban and agricultural sectors, connecting smaller rural communities to larger water systems, and water quality protection. With respect to the protection of water quality and groundwater dependent ecosystems, the General Plans generally protect riparian and wetland habitats, encourage the protection of water quality (including through the remediation of contamination that may impact groundwater quality, requiring the use of septic systems in rural areas that are designed to be protective of groundwater quality and/or the use of community wastewater systems in urban areas), and promote flood control and management (including the associated impacts of erosion and sedimentation of surface water-courses).

The Fresno County General Plan, in particular, promotes sustainability by managing new wells in urban areas, supporting monitoring of water resources and associated habitats, and through the formation of a water resources document repository.

While the magnitude of impacts of these policies over the planning and implementation horizon are not known, such policies have been considered in this GSP, primarily through the use of the General Plans and associated zoning maps to identify future land use types and projected growth areas. These General Plans and mapping were used along with available water master plans, urban water management plans, agricultural water management plans, and other relevant planning documents to determine projected future land use and estimate future water demands by land use sector for use in the projected future water budgets.

Just as the General Plans complement the GSPs, the GSPs in the Delta-Mendota Subbasin may influence the General Plans' goals and policies. Sustainable management of groundwater resources through a GSP may change the pace, location, and type of development and/or land use that will occur in the Subbasin. GSP implementation is anticipated to be consistent with the General Plans' goals to sustainably manage land development and water resources in the Subbasin.

3.5 Existing Water Resources Monitoring and Management Programs

As required by §354.8I and (d) of the GSP Emergency Regulations, the following section describes key existing water resources-related management and monitoring programs, and a discussion of how these programs will either impact GSP implementation and/or will be incorporated into the GSPs. The information shown below is a high-level summary of key existing programs; please see the individual GSPs for additional relevant management and monitoring programs.

Irrigated Lands Regulatory Program (ILRP)

In 1999, the California Legislature passed Senate Bill 390, which eliminated a blanket waiver of water quality regulations for agricultural waste discharges. The Bill required the Regional Water Quality Control Boards to develop a program to regulate agricultural lands under the Porter-Cologne Water Quality Control Act. In 2003, the Central Valley Regional Water Quality Control Board (CV-RWQCB) issued an order that sets Waste Discharge Requirements (WDRs) for irrigated lands to protect both surface and groundwater throughout the Central Valley, primarily to address nitrates, pesticides, and sediment discharge. The resulting Irrigated Lands Regulatory Program (ILRP) regulates wastes from commercial irrigated lands that discharge into surface and groundwater. The program is administered by the CV-RWQCB working directly with a regional or crop-based coalition as well as directly with irrigators. The goal of the ILRP is to protect surface water and groundwater and to reduce impacts of irrigated agricultural discharges to waters of the State. As a result of the ILRP, monitoring reports, assessment reports, management plans, surface water quality data, and groundwater quality data are made available to the public.

Implementation of the IRLP in the Delta-Mendota Subbasin is managed primarily by the Westside San Joaquin River Watershed Coalition and the Grassland Drainage Area Coalition under the San Joaquin Valley Drainage Authority, a California Joint Powers Authority (JPA). This region specifically emphasizes nitrogen, sediment, and erosion control.

CV-SALTS

The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) is an initiative to reduce salt and nitrate impacts, restore groundwater quality, and provide safe drinking water supplies. Developed by a group of stakeholders (federal, state, and local agencies, dischargers and growers, and environmental groups) called the Central Valley Salinity Coalition, the Central Valley Salt and Nitrate Management Plan (SNMP) was released in 2017.

The Central Valley SNMP recommends revised and flexible regulations for existing Basin Plans and includes recommended interim solutions for salt and nutrient management in high priority basins in addition to long-term salt management strategies. Under the Central Valley SNMP, dischargers are provided two compliance pathways: (1) traditional permitting as an individual discharger or as a coalition (i.e., irrigated lands coalition), or (2) groundwater management zone permitting. Zone permitting allows dischargers to work as a collective in collaboration with the CV-RWQCB to provide safe drinking water with the option to extend time to achieve nitrogen balance. At this time, the Central Valley SNMP is not currently enforced.

Integrated Regional Water Management Program

Three Integrated Regional Water Management Plans (IRWMPs) overlie the Delta-Mendota Subbasin. The Westside-San Joaquin IRWMP covers most of the Subbasin, while smaller portions of the Subbasin are covered by the East Stanislaus and Madera IRWM Plans.

Integrated Regional Water Management (IRWM) is a collaborative effort to identify and implement water management solutions on a regional scale that increase regional self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives. Developed by Regional Water Management Groups, the IRWMPs seek to deliver higher value for investments in water resources and management by considering all interests, providing multiple benefits, and working across jurisdictional boundaries. Examples of multiple benefits include improved water quality, better flood management, restored and enhanced ecosystems, and more reliable surface and groundwater supplies.

Please see the individual GSPs for additional details regarding the IRWM program in their GSP Plan areas.

California State Groundwater Elevation Monitoring Program (CASGEM)

Since 2009, the California Statewide Groundwater Elevation Monitoring (CASGEM) Program has tracked seasonal and long-term groundwater elevation trends in groundwater basins statewide. The program's mission is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. This early attempt to monitor groundwater continues to exist as a tool to help achieve the goals set out under the Sustainable Groundwater Management Act (SGMA) with mandatory annual water elevation monitoring and reporting.

San Joaquin River Restoration Program (SJRR)

The San Joaquin River Restoration Program (SJRRP) is a comprehensive, long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from Restoration Flows. The program has two general goals resulting from the San Joaquin River Restoration Settlement reached in 2006:

- **Restoration:** To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.
- **Water Management:** To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The program includes the implementation of projects, reintroduction activities and associated monitoring to assess progress towards achieving the Settlement goals.

USGS Land Subsidence Monitoring

The USGS maintains and monitors a large system of monitoring locations nationwide using interferometric synthetic aperture radar (InSAR), continuous GPS (CGPS) measurements, campaign global positioning system (GPS) surveying, and spirit-leveling surveying. Aquifer-system compaction is measured by using extensometers to aid in the understanding of the depths at which compaction is occurring. The USGS shares these results to support decision making relative to groundwater basin management with the goal of minimizing future inelastic land subsidence.

3.6 County Well Construction/Destruction Standards and Permitting

DWR has developed well standards for the state per California Water Code Sections 13700 to 13806. These standards have been adopted by the State Water Resources Control Board (SWRCB) into a statewide model well ordinance (Resolution No. 89-98) for use by the Regional Boards for enforcing well construction standards where no local well design ordinance exists that meets or exceeds the DWR standards. DWR's Well Standards are presented in Bulletin 74-81 and Bulletin 74-90.

Each GSP lists the counties within their GSP Plan areas and the respective permitting agencies and local ordinances for well construction and destruction standards. Discussion of these standards and the respective permitting process as well as well abandonment and destruction procedures can be found in the individual GSPs.

3.7 Existing and Planned Conjunctive Use Programs

Conjunctive use programs in the Subbasin are currently implemented and planned by single agencies as well as through multi-agency partnerships. Maximizing the beneficial use of surface water, groundwater, and recycled water resources is of critical concern to water managers throughout the Delta-Mendota Subbasin with the ultimate goal of using all of these water sources more efficiently to avoid overdraft and to sustainably manage groundwater resources. Each GSP describes efforts to utilize existing water resources conjunctively and demonstrate feasibility to continue to implement conjunctive use projects in the future. These may include projects such as groundwater recharge and conveyance facilities, new wells, improved monitoring systems, improved delivery efficiency, water recycling, and water quality improvements and treatment.

Underground recharge and storage occur throughout the Delta-Mendota Subbasin through stormwater applied water and managed wetland recharge. Stormwater collects both naturally and artificially and eventually percolates through the ground and into aquifers for beneficial use for both urban and agriculture. Recharge from agricultural and wetland water conveyance and irrigation percolates into the ground and eventually into aquifers where it can be pumped again for use. This natural and unmanaged recharge creates future opportunities for conjunctive use programs; however, this recharge may decline as farmers move toward more precise and water efficient irrigation methods.

3.8 Plan Elements from California Water Code Section 10727.4

Each GSP may contain, as deemed appropriate, a detailed discussion of the additional plan elements as identified in California Water Code (CWC) Section 10727.4. These elements are:

- Control of saline water intrusion
- Wellhead protection areas and recharge areas
- Migration of contaminated groundwater
- Well abandonment and well destruction programs
- Activities implementing, opportunities for, and removing impediments to conjunctive use or underground storage
- Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects
- Efficient Water Management Practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use
- Efforts to develop relationships with state and federal regulatory agencies
- Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risk to groundwater quality or quantity
- Impacts on Groundwater Dependent Ecosystems

4. SUBBASIN SETTING

This Delta-Mendota Subbasin Settings section contains three main subsections as follows:

- **Hydrogeologic Conceptual Model (HCM)** – The HCM section (Section 4.1) provides the geologic information needed to understand the framework that water moves through in the Subbasin. It focuses on geologic formations, aquifers, structural features, and topography.
- **Groundwater Conditions** – The Groundwater Conditions section (Section 4.2) describes and presents groundwater trends, levels, hydrographs and level contour maps, estimates changes in groundwater storage, identifies groundwater quality issues, addresses subsidence, and addresses surface water interconnection.
- **Water Budget** – The Water Budget section (Section 4.3) describes the data used to develop the water budget. Additionally, this section discusses how the budget was calculated, provides water budget estimates for historical conditions, and current conditions and projected conditions

4.1 Hydrogeologic Conceptual Model

This section describes the hydrogeologic conceptual model (HCM) for the Delta-Mendota Subbasin based on technical studies and qualified maps that characterize the physical components and interaction of the surface water and groundwater systems, pursuant to Article 5, Plan Contents, Subarticle 2, Basin Setting, § 354.14 Hydrogeologic Conceptual Model of the GSP Emergency Regulations. The physical description of the Delta-Mendota Subbasin is based on information originally published in the *Western San Joaquin River Watershed Groundwater Quality Assessment Report* (GAR) (LSCE, 2015), *Grassland Drainage Area Groundwater Quality Assessment Report* (LSCE, 2016), and *Groundwater Overdraft in the Delta-Mendota Subbasin* (KDSA, 2015).

4.1.1 Regional Geologic and Structural Setting

The Delta-Mendota Subbasin is located in the northwestern portion of the San Joaquin Valley Groundwater Basin within the southern portion of the Central Valley (**Figure CC-21**). The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding Sierra Nevada and Coast Range mountains, respectively (DWR, 2006). Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is slightly west of the series of rivers, lakes, sloughs, and marshes which mark the current and historic axis of surface drainage in the San Joaquin Valley.

The Delta-Mendota Subbasin (DWR Basin No. 5-22.07) is bounded on the west by the tertiary and older marine sediments of the Coast Ranges, on the north generally by the San Joaquin-Stanislaus County line, on the east generally by the San Joaquin River and Fresno Slough, and on the south by the Tranquillity Irrigation District boundary near the community of San Joaquin. Surface waters converge from the Fresno, Merced, Tuolumne, and Stanislaus Rivers into the San Joaquin River, which drains to the north toward the Sacramento-San Joaquin Delta.

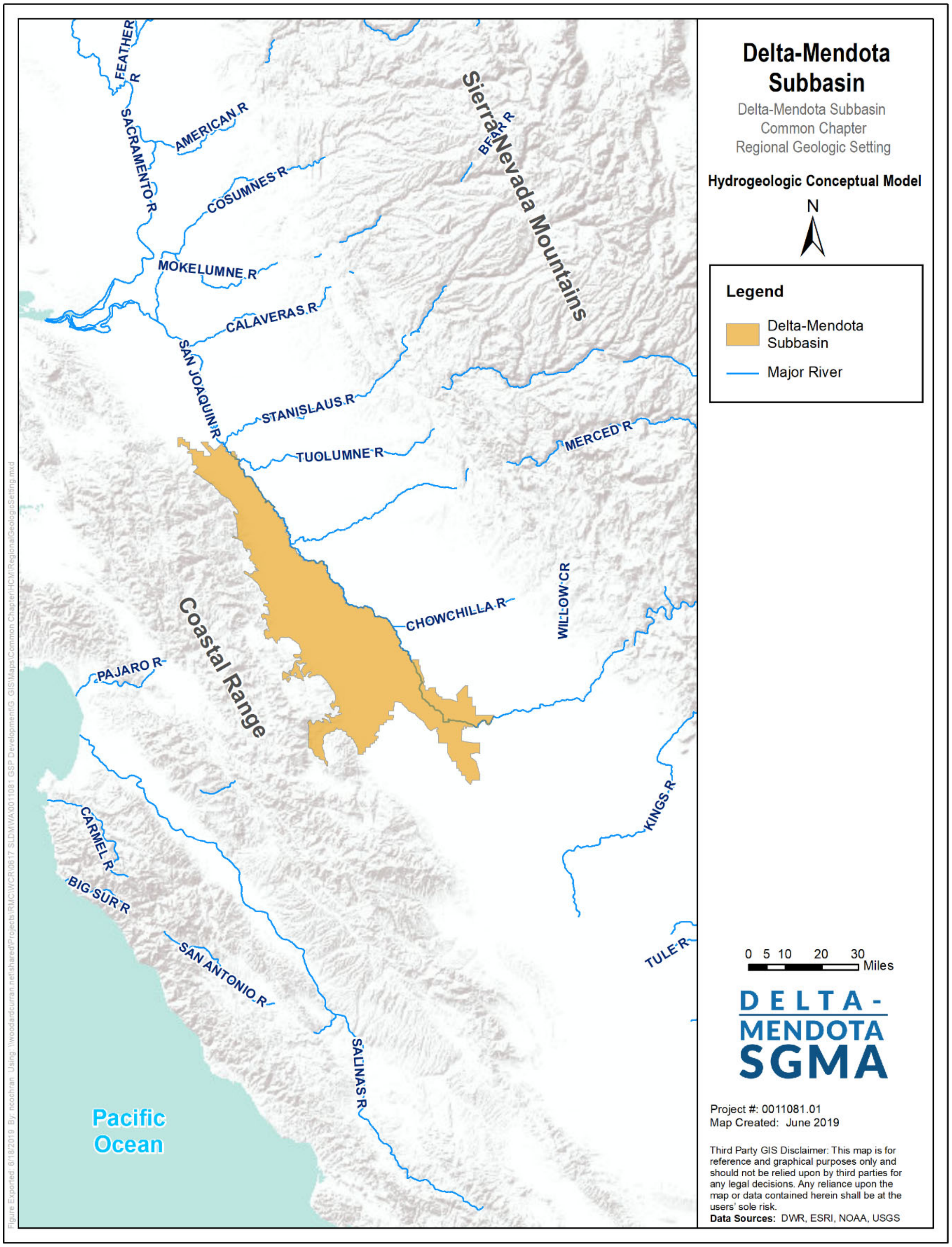
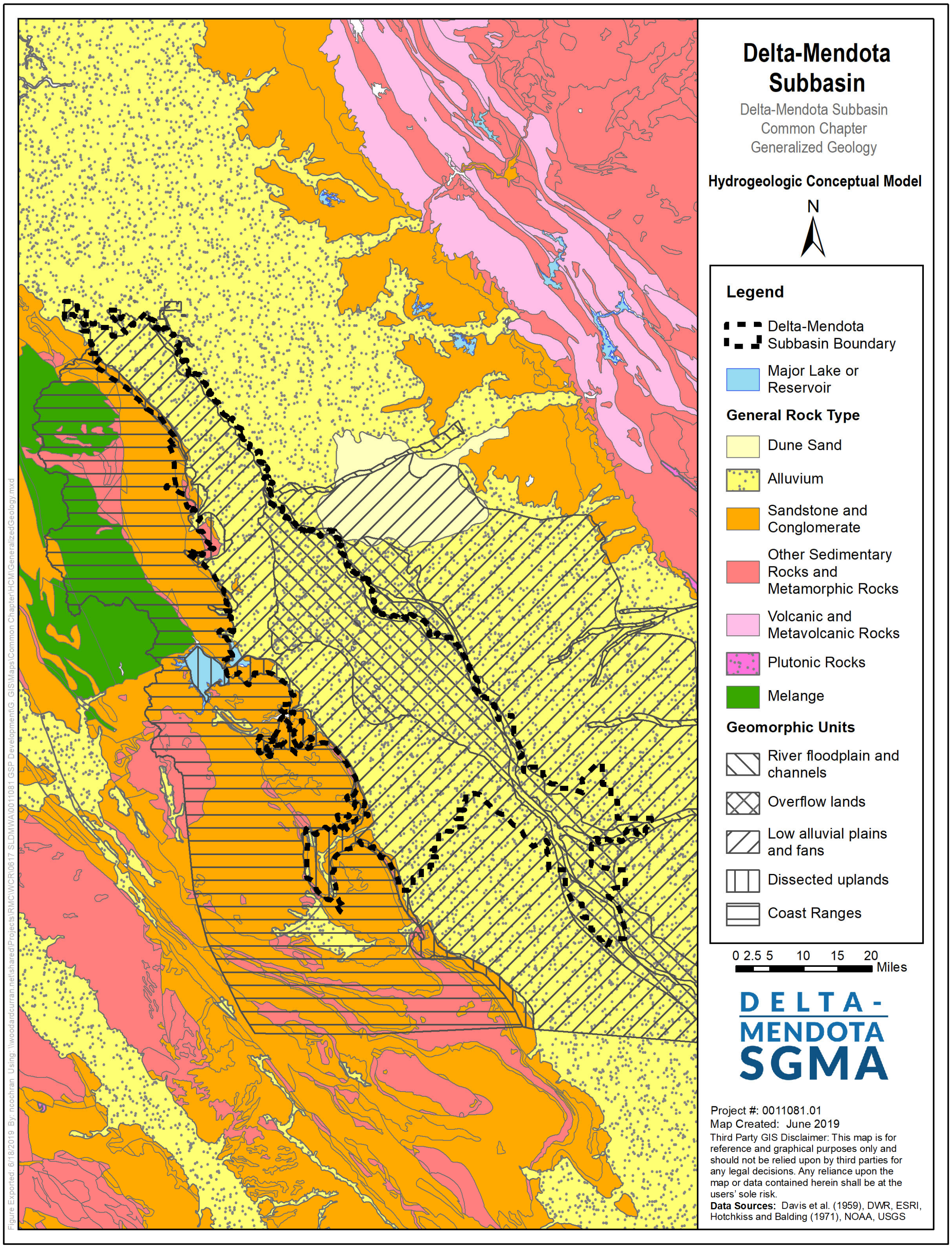


Figure CC-21: Regional Geologic Setting

4.1.2 Geologic History

Approximately three million years ago, tectonic movement of the Oceanic and Continental plates associated with the San Andreas Fault system resulted in the formation of the Coast Range which sealed off the Central Valley from the Pacific Ocean (LSCE, 2015). As this occurred, the floor of the San Joaquin Valley began to transition from a marine depositional environment to a freshwater system with ancestral rivers bringing alluvium to saltwater bodies (Mendenhall et al., 1916). The Coast Ranges on the western side of the San Joaquin Valley consist mostly of complexly folded and faulted consolidated marine and non-marine sedimentary and crystalline rocks ranging from Jurassic to Tertiary age, dipping eastward and overlying the basement complex in the region (Croft, 1972; Hotchkiss and Balding, 1971). The Central Valley Floor, in which the Delta-Mendota Subbasin lies, consists of Tertiary and Quaternary-aged alluvial and basin fill deposits (**Figure CC-22**). The fill deposits mapped throughout much of the valley extend vertically for thousands of feet, and the texture of sediments varies in the east-west direction across the valley. Coalescing alluvial fans have formed along the sides of the valley created by the continuous shifting of distributary stream channels over time. This process has led to the development of thick fans of generally coarse texture along the margins of the valley and a generally fining texture towards the axis of the valley (Faunt et al., 2009 and 2010).

Deposits of Coast Range and Sierra Nevada sources interfinger within the Delta-Mendota Subbasin. Steeper fan surfaces, with slopes as high as 80 feet per mile, exist proximal to the Coast Range, whereas more distal fan surfaces consist of more gentle slopes of 20 feet per mile (Hotchkiss and Balding, 1971). In contrast to the east side of the valley, the more irregular and ephemeral streams on the western side of the valley floor have less energy and transport smaller volumes of sediment resulting in less developed alluvial features, including alluvial fans which are less extensive, although steeper, than alluvial fan features on the east side of the valley (Bertoldi et al., 1991). Lacustrine and floodplain deposits also exist closer to the valley axis as thick silt and clay layers. Lakes present during the Pleistocene epoch in parts of the San Joaquin Valley deposited great thicknesses of clay sediments.



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Data Sources: Davis et al. (1959), DWR, ESRI, Hotchkiss and Balding (1971), NOAA, USGS

Figure CC-22: Generalized Geology

4.1.3 Geologic Formations and Stratigraphy

Distinct geomorphic units exist within the Delta-Mendota Subbasin defining areas of unique hydrogeologic environments. The geomorphic units are mapped and described by Hotchkiss and Balding (1971) and Davis et al. (1959) and are shown in **Figure CC-22**. The two primary geomorphic units within the Central Valley Floor area of the Delta-Mendota Subbasin include the overflow lands geomorphic unit and the alluvial fans and plains geomorphic unit. Overflow lands are defined as areas of relatively poorly draining soils with a shallow water table. The overflow lands geomorphic unit is located in the southeastern portion of the Subbasin and is dominated by finer-grained floodplain deposits that are the result of historical episodic flooding of this low-land area. This has formed poorly-draining soils with generally low hydraulic conductivity characteristics. In contrast, the alluvial fans and plains geomorphic unit is characterized by relatively better drainage conditions, with sediments comprised of coalescing and somewhat coarser-grained alluvial fan materials deposited by higher-energy streams flowing out of the Coast Range (Hotchkiss and Balding, 1971). The alluvial fans and plains geomorphic unit covers much of the Delta-Mendota Subbasin along the western margins of the Central Valley Floor at the base of the Coast Range.

The primary groundwater bearing units within the Delta-Mendota Subbasin consist of Tertiary and Quaternary-aged unconsolidated continental deposits and older alluvium of the Tulare Formation. Subsurface hydrogeologic materials covering the Central Valley Floor consist of lenticular and generally poorly sorted clay, silt, sand, and gravel that make up the alluvium and Tulare Formation. These deposits are thickest along the axis of the valley with thinning along the margins towards the Coast Range mountains (DWR, 2003; Hotchkiss and Balding, 1971). A zone of very shallow groundwater, generally within 25 feet of the ground surface, exists throughout large areas of the Subbasin, with considerable amounts (greater than 50 percent) of farmland in the area estimated to have very shallow depths to groundwater of less than 10 feet (Hotchkiss and Balding, 1971). Many of these areas are naturally swampy lands adjacent to the San Joaquin River.

The Tulare Formation extends to several thousand feet in depth and to the base of freshwater throughout most of the area and consists of interfingered sediments ranging in texture from clay to gravel of both Sierra Nevadan and Coast Range origin. The formation is composed of beds, lenses, and tongues of clay, sand, and gravel that have been alternatively deposited in oxidizing and reducing environments (Hotchkiss and Balding, 1971).

Terrace deposits of Pleistocene age lie up to several feet higher than present streambeds and are comprised of yellow, tan, and light-to-dark brown silt, sand, and gravel with a matrix that varies from sand to clay (Hotchkiss and Balding, 1971). The water table generally lies below the bottom of the terrace deposits; however, the relatively large grain size of the terrace deposits suggests their value as possible recharge sites. Alluvium is composed of interbedded, poorly to well-sorted clay, silt, sand, and gravel and is divided based on its degree of dissection and soil formation. The flood-basin deposits are generally composed of light-to-dark brown and gray clay, silt, sand, and organic material with locally high concentrations of salt and alkali. Stream channel deposits of coarse sand and gravel are also included.

The Tulare Formation also includes the Corcoran Clay (E-Clay) member, a diatomaceous clay or silty clay of lakebed origin which is a prominent aquitard in the San Joaquin Valley, separating the upper zone from the lower zone and distinguishing the semi-confined Upper Aquifer from the confined Lower Aquifer (Hotchkiss and Balding, 1971). The depth and thickness of the Corcoran Clay are variable within the Central Valley Floor, and it is not present in peripheral areas (outside the Central Valley Floor) of the Subbasin. Within the Upper Aquifer, additional clay layers exist and also provide varying degrees of confinement, including other clay members of the Tulare Formation and layers of white clay identified by Hotchkiss and Balding (1971). These clays are variable in extent and thickness, but the white clay is noted to be as much as 60 feet thick in areas providing very effective confinement of underlying zones (Croft, 1972; Hotchkiss and Balding, 1971). The Tulare Formation is hydrologically the most important geologic formation in the Delta-Mendota Subbasin because it contains most of the fresh water-bearing deposits. Most of the natural recharge that occurs in the Subbasin is in the alluvial fan apex areas along Coast Range stream channels (Hotchkiss and Balding, 1971).

4.1.4 Faults and Structural Features

The valley floor portion of the Delta-Mendota Subbasin contains no known major faults and is fairly geologically inactive. There are few faults along the western boundary of the Subbasin within the Coast Range mountains, but they are not known to inhibit groundwater flow or impact water conveyance infrastructure (**Figure CC-23**).

4.1.5 Basin Boundaries

The Delta-Mendota Subbasin is defined by both geological and jurisdictional boundaries. The Delta-Mendota Subbasin borders all subbasins within the San Joaquin Valley Hydrologic Region with the exception of the Cosumnes Subbasin. The following subsections describe the lateral boundaries of the Subbasin, boundaries with neighboring subbasins, and the definable bottom of the Delta-Mendota Subbasin.

Lateral Boundaries

The Delta-Mendota Subbasin is geologically and topographically bounded to the west by the Tertiary and older marine sediments of the Coast Ranges, and to the east generally by the San Joaquin River. The northern, central, and southern portion of the eastern boundary are dictated by jurisdictional boundaries of water purveyors within the Delta-Mendota Subbasin.

As described in *California's Groundwater*, DWR Bulletin 118 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley. The northern boundary begins just south of Tracy in San Joaquin County. The eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin. The subbasin is bounded on the west by the coast range. The Subbasin boundary is defined by 20 segments detailed in the descriptions below. The Delta-Mendota Subbasin extends into six (6) counties: San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera and is shown in relation to each of the six counties in **Figure CC-9**.

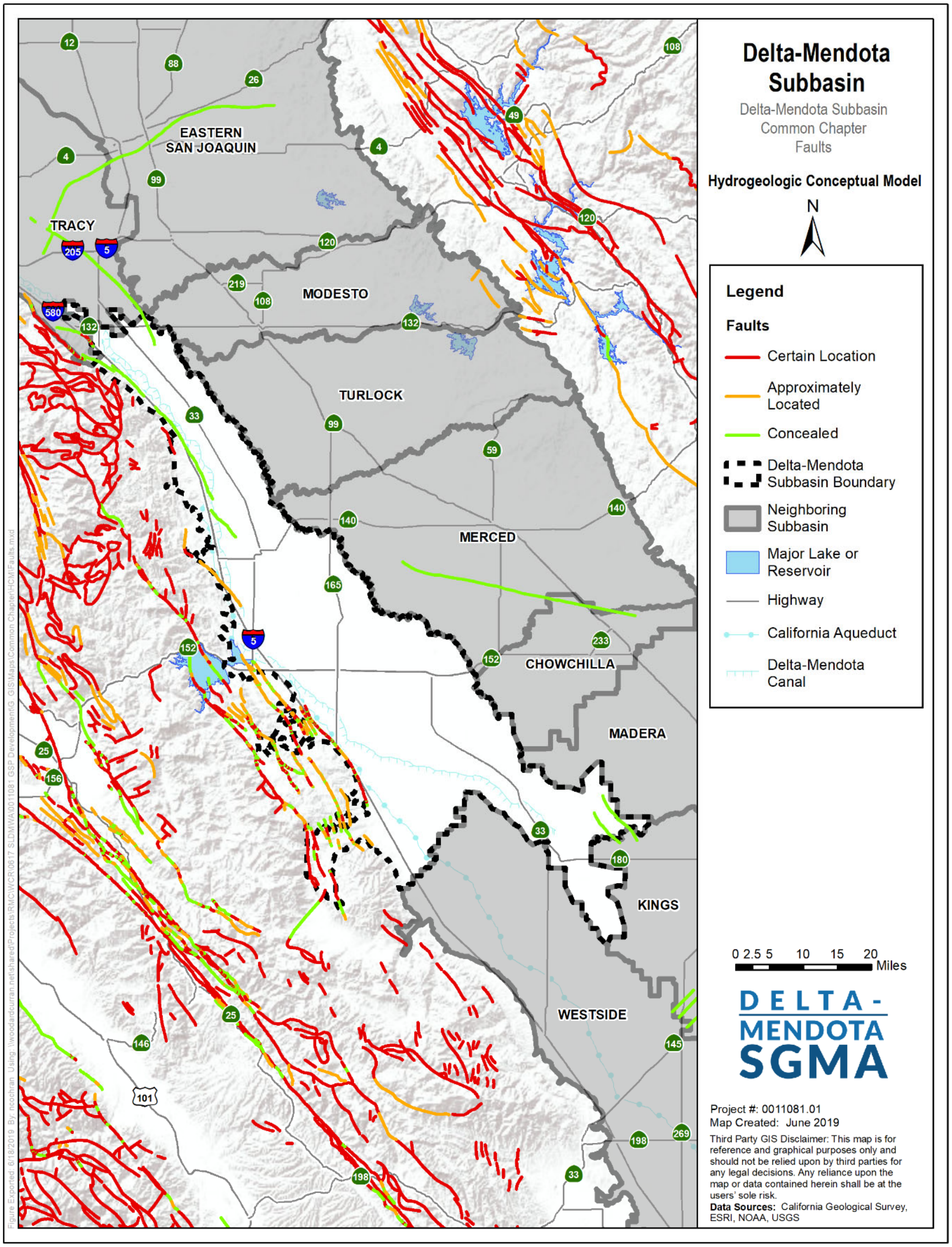


Figure CC-23: Subbasin Faults

4.1.6 Definable Bottom of Basin

In the San Joaquin Valley, the bottom of the Delta-Mendota Subbasin is defined as the interface of saline water of marine origin (base of fresh water) within the uppermost beds of the Tulare Formation. The Tulare Formation is characterized by blue and green fine-grained rocks and principally composed of fine-grained silty sands, silt, and clay (Foss and Blaisdell 1968). The Tulare Formation is predominantly marine in origin and is considered late Pliocene and possibly early Pleistocene in age. This formation is the upper shaley part of the Pliocene sequence. The top of the Tulare Formation is generally encountered around -2,000 feet mean sea level throughout the Delta-Mendota Subbasin. As agreed upon by the Delta-Mendota Subbasin GSP Groups, the base of freshwater is specifically defined by an electrical conductivity of 3,000 micromhos per centimeter at 25 °C, as presented by Page (1973). If and when significant use of water beyond the defined bottom takes place, the definition of the bottom will be revised appropriately.

4.1.7 Principal Aquifers and Aquitards

DWR’s Groundwater Glossary defines an aquifer as “a body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells, and springs”. There are two primary aquifers within the Delta-Mendota Subbasin: a semi-confined aquifer above the Corcoran Clay and a confined aquifer below the Corcoran Clay, with the Corcoran Clay acting as the principal aquitard within the Delta-Mendota Subbasin. **Figure CC-24** shows the locations of the representative cross-sections for the Delta-Mendota Subbasin, where **Figure CC-25** through **Figure CC-30** show the hydrostratigraphy of the representative cross-sections.

While the two-aquifer system described above is generally true across the Delta-Mendota Subbasin, there are portions of the Subbasin where the Corcoran Clay does not exist (predominantly along the western margin of the Subbasin) and hydrogeology is generally controlled by localized interfingering clays, and/or where local hydrostratigraphy results in shallow groundwater conditions that differ, to some extent, from that seen in the Subbasin as a whole. Additionally, in the southern portion of the Subbasin in the Mendota, Aliso and Tranquillity areas, there are A and C Clay layers in addition to the Corcoran Clay that inhibit vertical groundwater flow. However, while there are localized complexities throughout the Subbasin, the Corcoran Clay (or E Clay) extends through much of the Delta-Mendota Subbasin, generally creating a two-aquifer system.

Principal Aquifers

In the Delta-Mendota Subbasin, there are two primary aquifers composed of alluvial deposits separated by the Corcoran Clay (KDSA, 2015): a semi-confined Upper Aquifer (generally the ground surface to the top of the Corcoran Clay), and a confined Lower Aquifer starting at the bottom of the Corcoran Clay to the base of fresh water. However, as previously described, the localized presence of the A and C Clay layers in the southern portion of the Subbasin, the absence of the Corcoran Clay at the western margin of the Subbasin, and/or local hydrostratigraphy result in differing shallow groundwater conditions and/or perched groundwater conditions in some portions of the Subbasin. See the individual GSPs for more detailed descriptions of hydrostratigraphy in the respective Plan areas.

Upper Aquifer

The Upper Aquifer is represented by materials extending from the upper groundwater table to the top of the Corcoran Clay. The Upper Aquifer includes shallow geologic units of younger and older alluvium and upper parts of the Tulare Formation. Sediments within the upper Tulare Formation have variable sources, and subdivision of units can be distinguished between eastern and western sourced materials. Alluvial fan materials above the Corcoran Clay in the Delta-Mendota Subbasin are generally more extensive than older alluvial fan deposits within the Tulare Formation below the Corcoran Clay. As shown in Figure CC-31 by the depth to the top of the Corcoran Clay, the Upper Aquifer extends to depths ranging between approximately 150 feet and greater than 350 feet. Other notable mapped clay units also exist within the upper part of the Tulare Formation in the Delta-Mendota Subbasin, including the A and C Clay members of the Tulare Formation and a white clay mapped by Hotchkiss and Balding (1971).

Lower Aquifer

The Lower Aquifer is the portion of the Tulare Formation that is confined beneath the Corcoran Clay, extending downward to the underlying San Joaquin Formation and the interface of saline water of marine origin within its uppermost beds. The Lower Aquifer is generally characterized by groundwater that tends to be dominantly sodium-sulfate type, which is often of better quality than the Upper Aquifer (Davis et al., 1957; Hotchkiss and Balding, 1971). Exceptions to this quality do exist in the Subbasin, particularly in the southwestern portion of the Subbasin. Because of its relatively shallow depth within the Delta-Mendota Subbasin and lower salinity in areas when compared to other groundwater resources, the Lower Aquifer is heavily utilized as a source of groundwater for agricultural and drinking water uses within the Subbasin.

The base of the Lower Aquifer generally decreases from south to north, changing in depth from about 1,100 to 1,200 feet deep in the south to about 600 feet to the north. Depth to the top of the Corcoran Clay ranges from less than 100 feet on the west near Interstate 5 (I-5) to more than 500 feet in the area near Tranquillity. The Corcoran Clay pinches out or is above the water level near the California Aqueduct in the western part of the Subbasin, where the Upper and Lower Aquifers merge into interfingered layers of sand, gravel, and clay.

Corcoran Clay

The Corcoran Clay, as a regional aquitard, is a notable hydrogeologic feature throughout most of the Delta-Mendota Subbasin, impeding vertical flow between the Upper and Lower Aquifers. The Corcoran Clay is present at varying depths across most of the Central Valley floor (**Figure CC-31** and **Figure CC-33**). The depths to the top of the Corcoran Clay ranges between approximately 100 and 500 feet below the ground surface throughout most of the Subbasin, with a general spatial pattern of deepening to the south and east. In the far southeastern area of the Subbasin, in the vicinity of Mendota and Tranquillity, the top of the Corcoran Clay is at depths of greater than 350 feet (**Figure CC-31**). The thickness of the Corcoran Clay, which likely influences the degree of hydraulic separation between the Upper and Lower Aquifers, is greater than 50 feet across most of the Delta-Mendota Subbasin with thicknesses of more than 75 feet in central Subbasin areas in the vicinity of Los Banos and Dos Palos, and 140 feet in the eastern portions of the Subbasin. The Corcoran Clay appears thinner in areas north of Patterson, between Patterson and Gustine, and also in the vicinity of Tranquillity to the south (**Figure CC-33**). Along the westernmost portions of the Delta-Mendota Subbasin, the Corcoran Clay layer is generally non-existent or it exists as Corcoran-equivalent clays (clays existing at the same approximate depth but not part of the mapped aquitard).

Aquifer Properties

The following subsections include discussion of generalized aquifer properties within the Delta-Mendota Subbasin. These include hydraulic conductivity, transmissivity, specific yield and specific storage.

DWR defines hydraulic conductivity as the “measure of a rock or sediment’s ability to transmit water” and transmissivity as the “aquifer’s ability to transmit groundwater through its entire saturated thickness” (DWR, 2003). High hydraulic conductivity values correlate with areas of transmissive groundwater conditions with transmissivity generally equaling hydraulic conductivity times the saturated thickness of the formation. Storage of water within the aquifer system can be quantified in terms of the specific yield for unconfined groundwater flow and the storage coefficient for confined flow, respectively (Faunt et al., 2009). Specific yield represents gravity-driven dewatering of shallow, unconfined sediments at a declining water table, but also accommodates a rising water table. The specific yield is dimensionless and represents the volume of water released from or taken into storage per unit head change per unit area of the water table. Specific yield is a function of porosity and specific retention of the sediments in the zone of water-table fluctuation.

Where the aquifer system is confined, storage change is governed by the storage coefficient, which is the product of the thickness of the confined-flow system and its specific storage. The specific storage is the sum of two component specific storages – the fluid (water) specific storage and the matrix (skeletal) specific storage, which are governed by the compressibility of the water and skeleton, respectively (Jacob, 1940). Specific storage has units of 1 over length and represents the volume of water released from or taken into storage in a confined flow system per unit change in head per unit volume of the confined flow system (Faunt et al., 2009). Therefore, the storage coefficient of a confined flow system is dimensionless and, similar to specific yield, represents the volume of water released from or taken into storage per unit head change.

Hydraulic Conductivity

Figure CC-34 shows the saturated C-horizon hydraulic conductivity of surficial soils within the Delta-Mendota Subbasin based on the National Resource Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO). Soil survey data for counties within the Subbasin were combined using the weighted harmonic mean of these representative layers to depict the saturated hydraulic conductivity of the C-horizon for each soil map unit. The soil profile represented by these data is variable but commonly extends to a depth of six or more feet.

Floodplain deposits are evident as soils with relatively low hydraulic conductivity (less than 0.5 feet per day [ft/day]) blanket much of the Central Valley Floor, although localized areas of soils with higher hydraulic conductivity are present in association with modern and ancient surface waterways and alluvial fan features (**Figure CC-34**). Coarse soils of distributary alluvial fan sediments deposited by Del Puerto Creek, Orestimba Creek, Los Banos Creek, Ortigalita Creek, and Little Panoche Creek, in addition to other ephemeral northeasterly creek flows off the Coast Ranges, are notably apparent as areas of soils of high hydraulic conductivity located along active and inactive stream channels extending eastward from the fan apex areas along the Valley Floor margins to the current alignment of the San Joaquin River in the valley axis. Additionally, soils in areas adjacent to the active channel of the San Joaquin River also exhibit high hydraulic conductivities, including values of greater than 4 ft/day which are particularly apparent in an area north of Mendota. Soils of similarly high hydraulic conductivity trending as linear features in a general northwest-southeast alignment to the north of Dos Palos and Los Banos are likely the result of historical depositional processes and paleochannels associated with the San Joaquin River (**Figure CC-34**). In areas peripheral to the Central Valley floor, soils tend to be characterized by relatively low hydraulic conductivity, although soils of somewhat higher hydraulic conductivity associated with distinct geologic units are mapped across much of the peripheral area to the west of Patterson and Gustine and also in localized bands associated with surface water courses.

Transmissivity

Transmissivity varies greatly above the Corcoran Clay, within the Corcoran Clay, and below the Corcoran Clay within the Delta-Mendota Subbasin, with transmissivities in the confined Lower Aquifer generally being larger than those in the semi-confined Upper Aquifer. Based on testing conducted at multiple locations within both the Upper and Lower Aquifers of the Delta-Mendota Subbasin, average transmissivities in the Subbasin are approximately 109,000 gallons per day per square foot (gpd/ft^2) (KDSA, 1997b).

Specific Yield

DWR defines specific yield as the "amount of water that would drain freely from rocks or sediments due to gravity and describes the proportion of groundwater that could actually be available for extraction" (DWR, 2003). Specific yield is a measurement specific to unconfined aquifers.

The estimated specific yield of the Delta-Mendota Subbasin is 0.118 (DWR, 2006). Within the southern portion of the Delta-Mendota Subbasin, specific yield ranges from 0.2 to 0.3 (Belitz et al., 1993). Specific yield estimates for the Delta-Mendota Subbasin are fairly limited in literature since the Upper Aquifer above the Corcoran Clay is semi-confined and the Lower Aquifer below the Corcoran Clay is confined. Therefore, specific yield values only characterize the shallow, unconfined groundwater within the Subbasin.

Specific Storage

Values for specific storage were extracted from the Central Valley Hydrologic Model 2 (CVHM2), which is currently under development by the United States Geological Survey (USGS) and includes refinements for the Delta-Mendota Subbasin. Specific storage varies above, within, and below the Corcoran Clay with CVMH2. Above the Corcoran Clay, specific storage ranges from 1.34×10^{-6} to 6.46×10^{-2} meters^{-1} (m^{-1}) with average values ranging from 6.16×10^{-3} to 1.97×10^{-2} m^{-1}. Specific storage within the Corcoran Clay is considerably smaller than above the Corcoran Clay, ranging between 1.41×10^{-6} and 2.35×10^{-6} m^{-1} and average values between 1.96×10^{-6} and 2.02×10^{-6} m^{-1}. Below the Corcoran Clay, specific storage is comparable to within the Corcoran Clay with overall ranges the same as within the Corcoran Clay and average values ranging from 1.86×10^{-6} to 2.01×10^{-6} m^{-1}. Therefore, specific storage is greatest within the semi-confined aquifer overlying the Corcoran Clay layer, with considerably smaller specific storage values within the low permeability Corcoran Clay and confined aquifer underlying the Corcoran Clay layer.

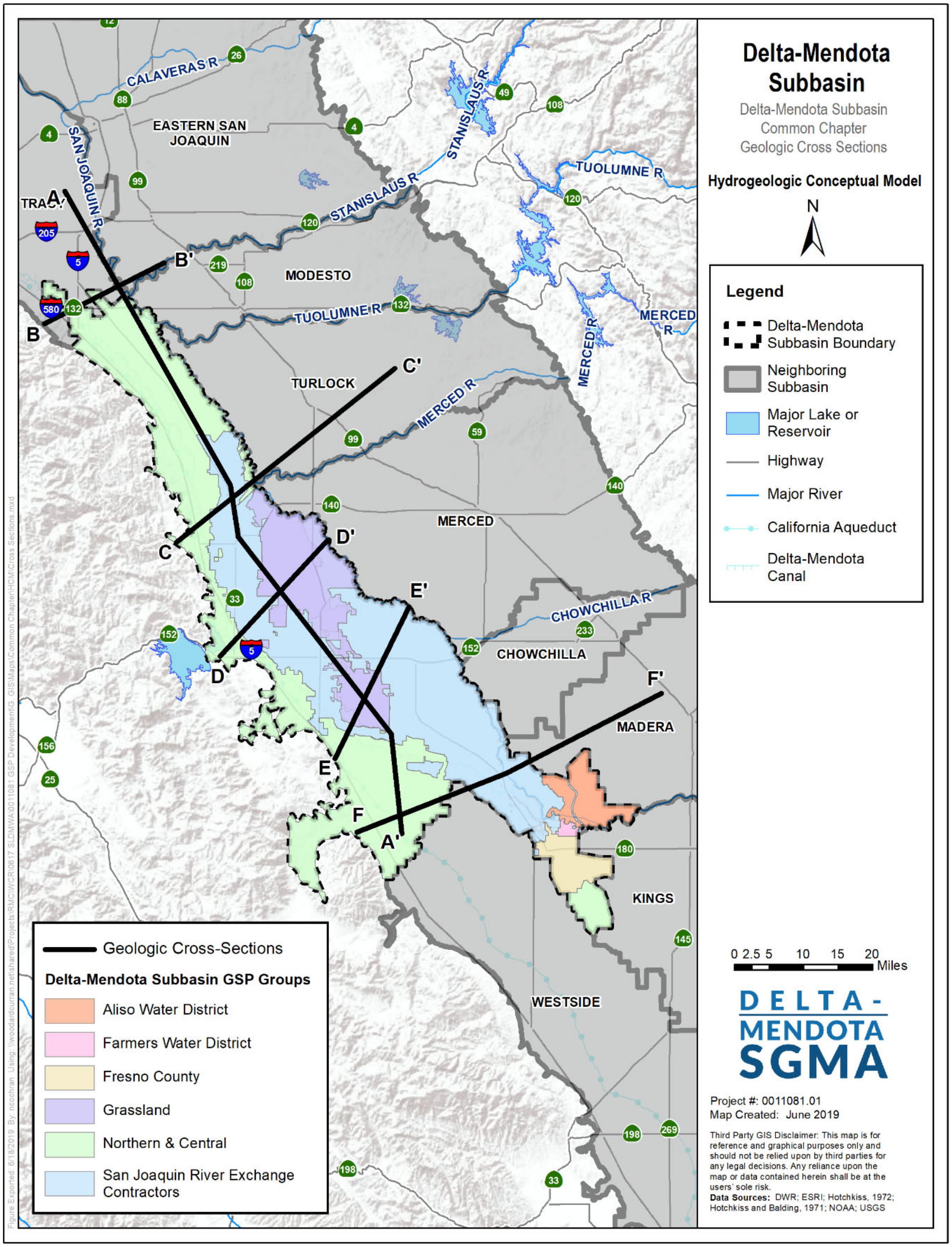


Figure CC-24: Representative Cross-Sections

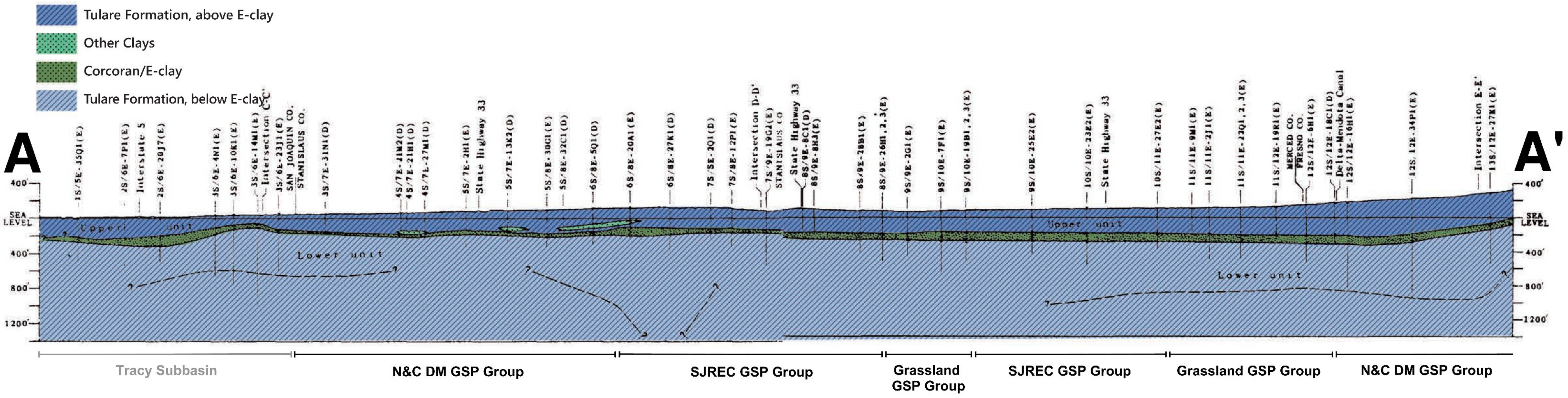


Figure CC-25: Cross-Section A-A' (Hotchkiss, 1972)

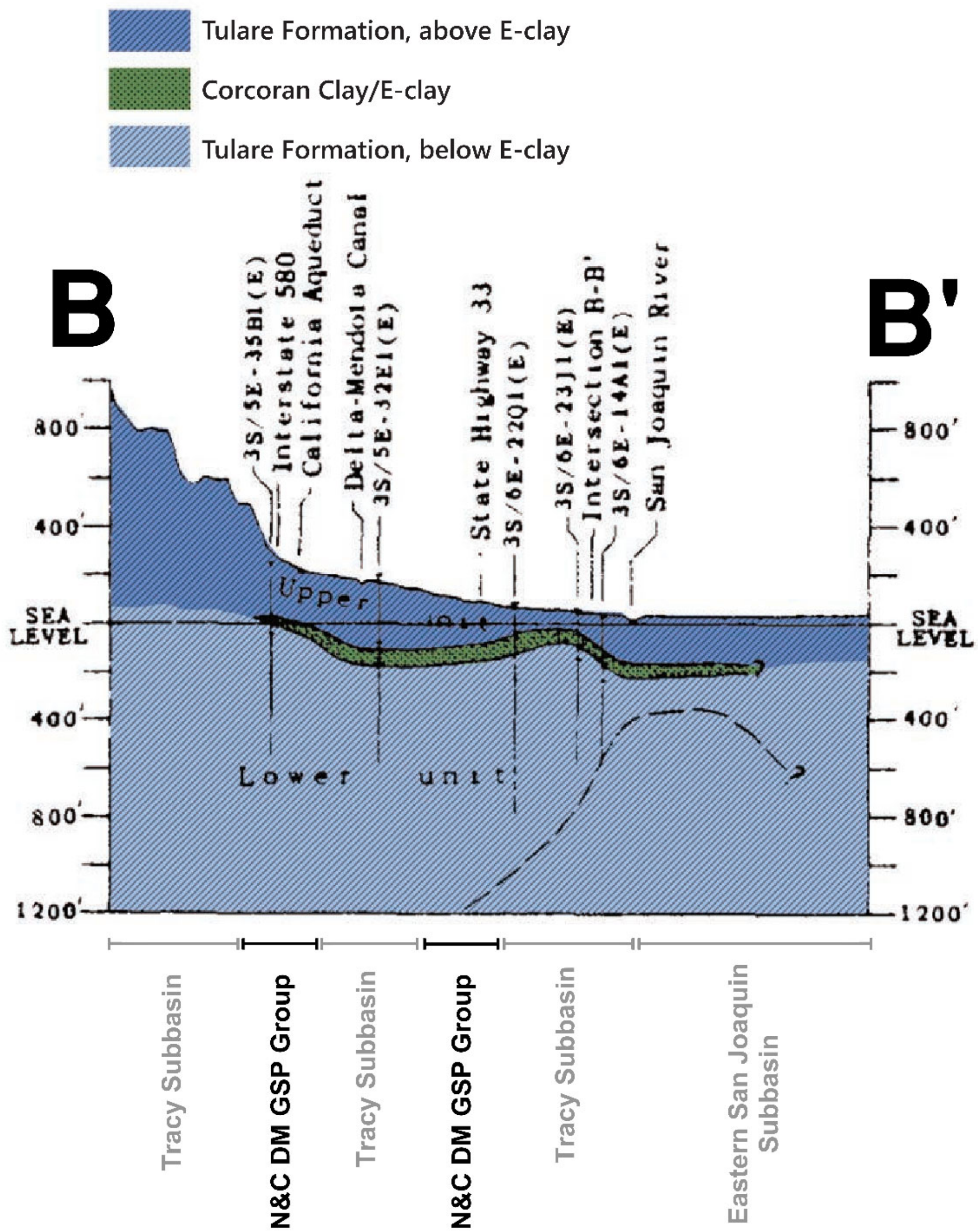


Figure CC-26: Cross-Section B-B' (Hotchkiss, 1972)

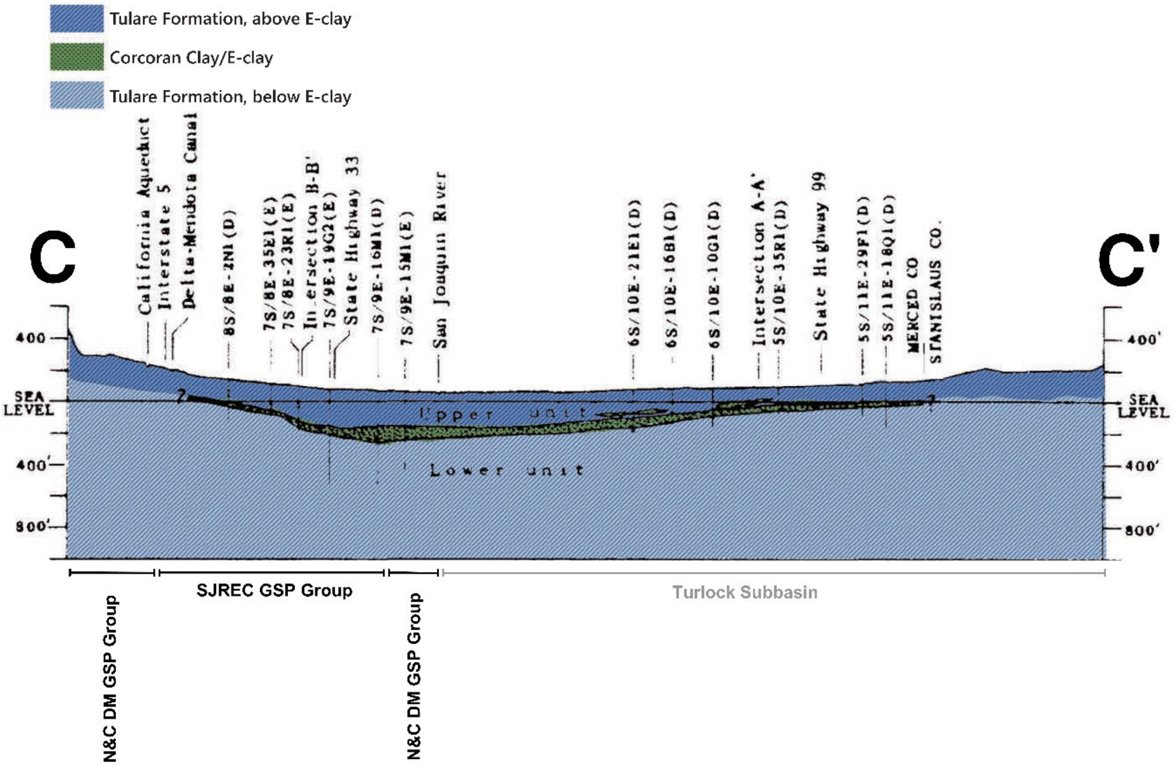


Figure CC-27: Cross-Section C-C' (Hotchkiss, 1972)

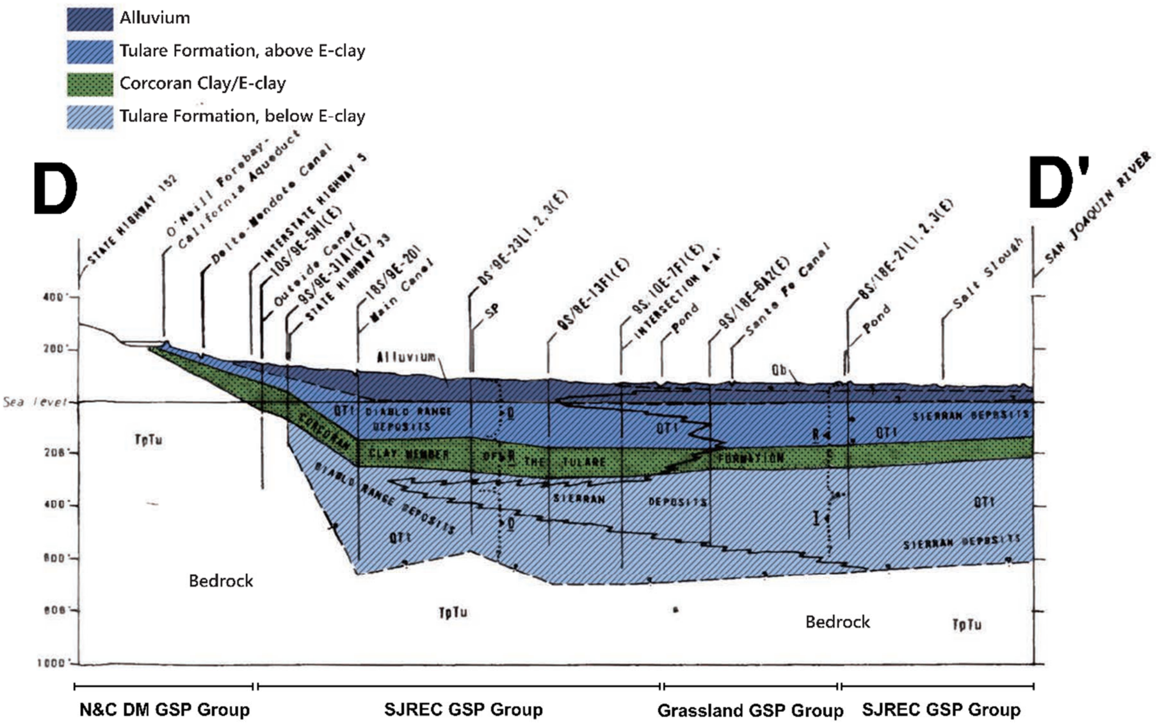


Figure CC-28: Cross-Section D-D' (Hotchkiss & Balding, 1971)

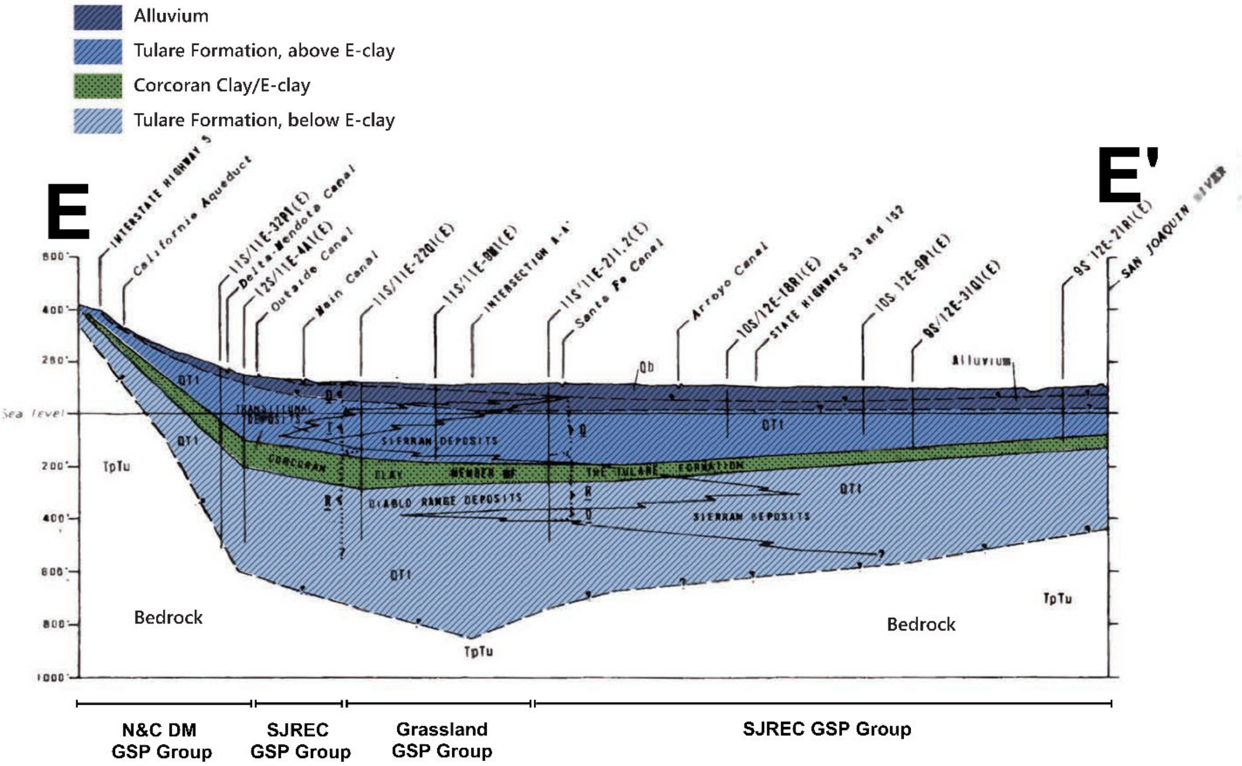


Figure CC-29: Cross-Section E-E' (Hotchkiss & Balding, 1971)

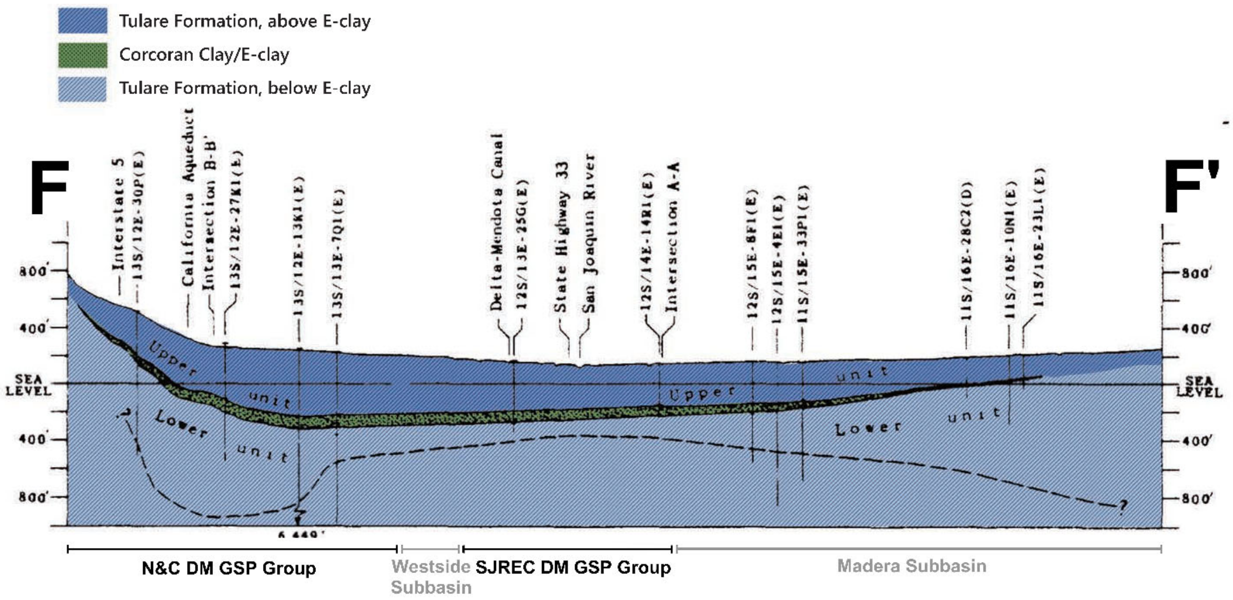


Figure CC-30: Cross-Section F-F' (Hotchkiss, 1972)

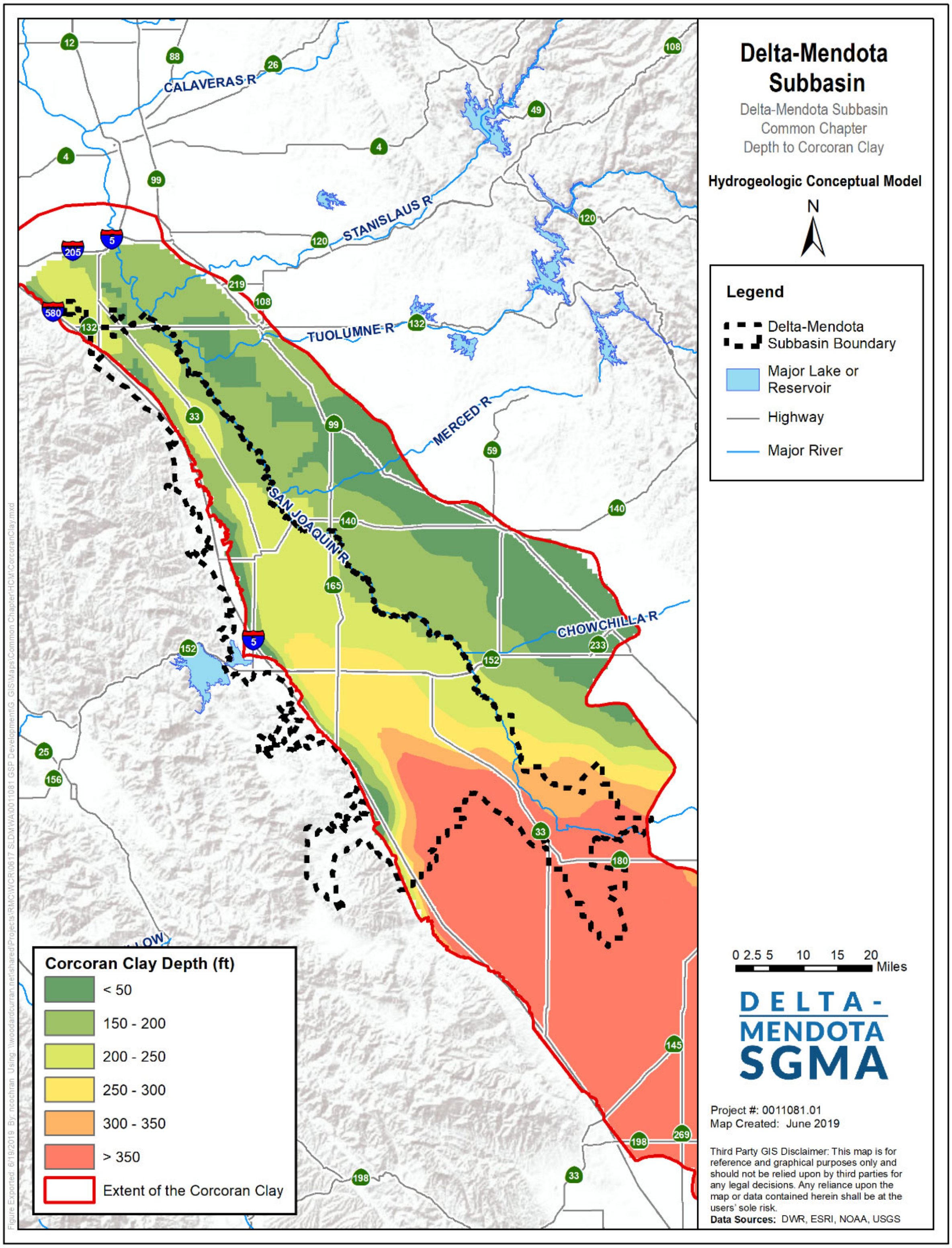
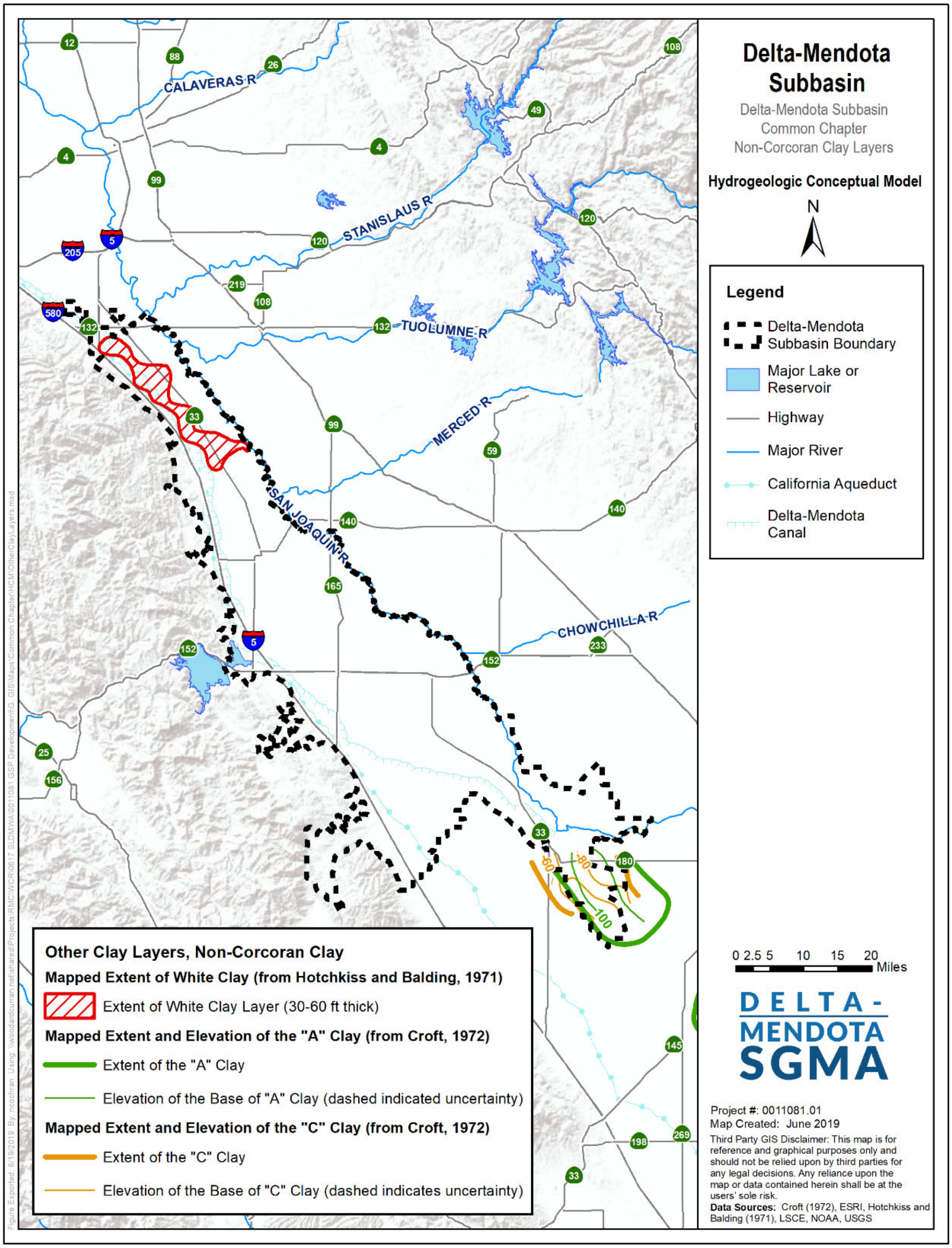


Figure CC-31: Depth to Corcoran Clay



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Data Sources: Croft (1972), ESRI, Hotchkiss and Balding (1971), LSCE, NOAA, USGS

Figure CC-32: Non-Corcoran Clay Layers

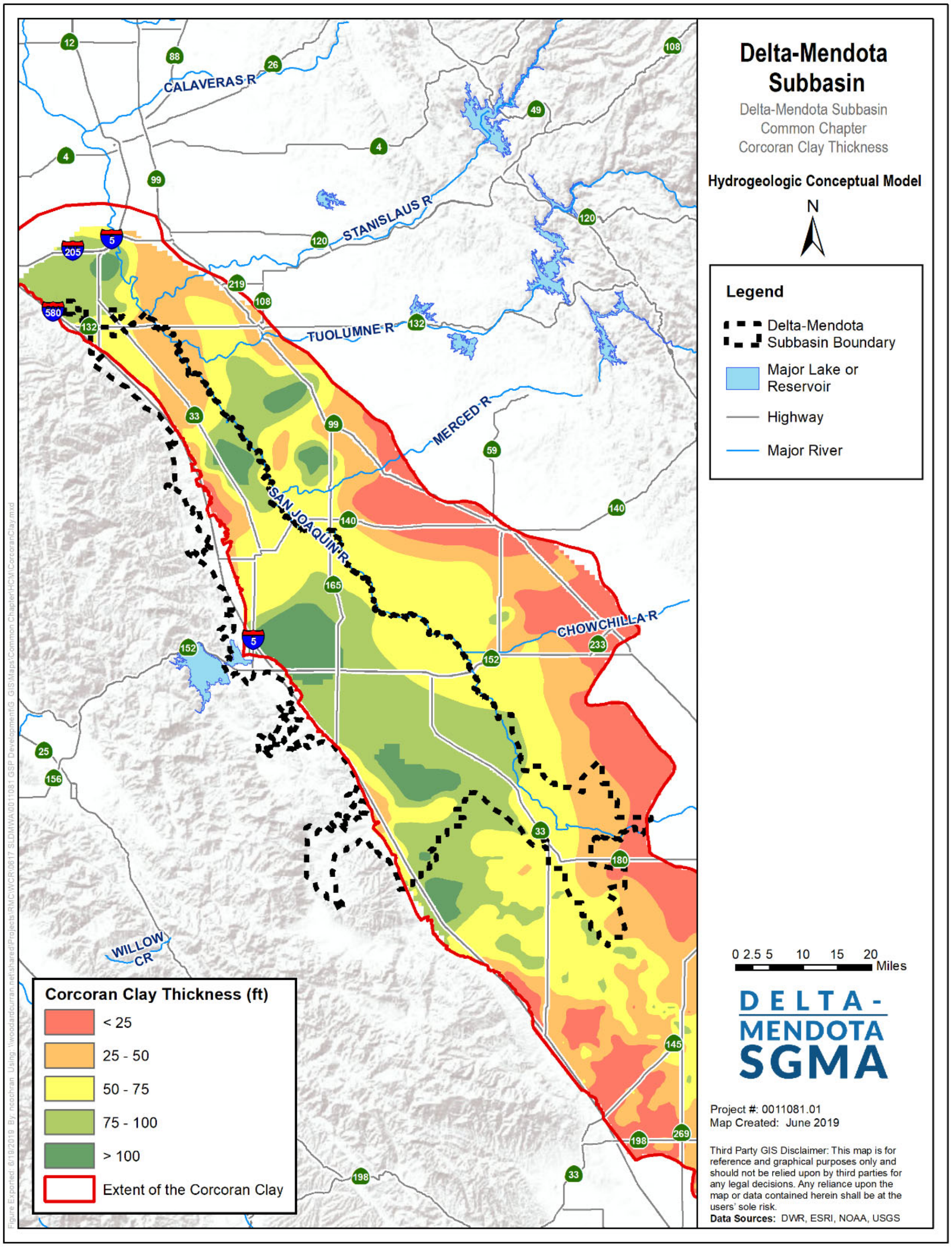
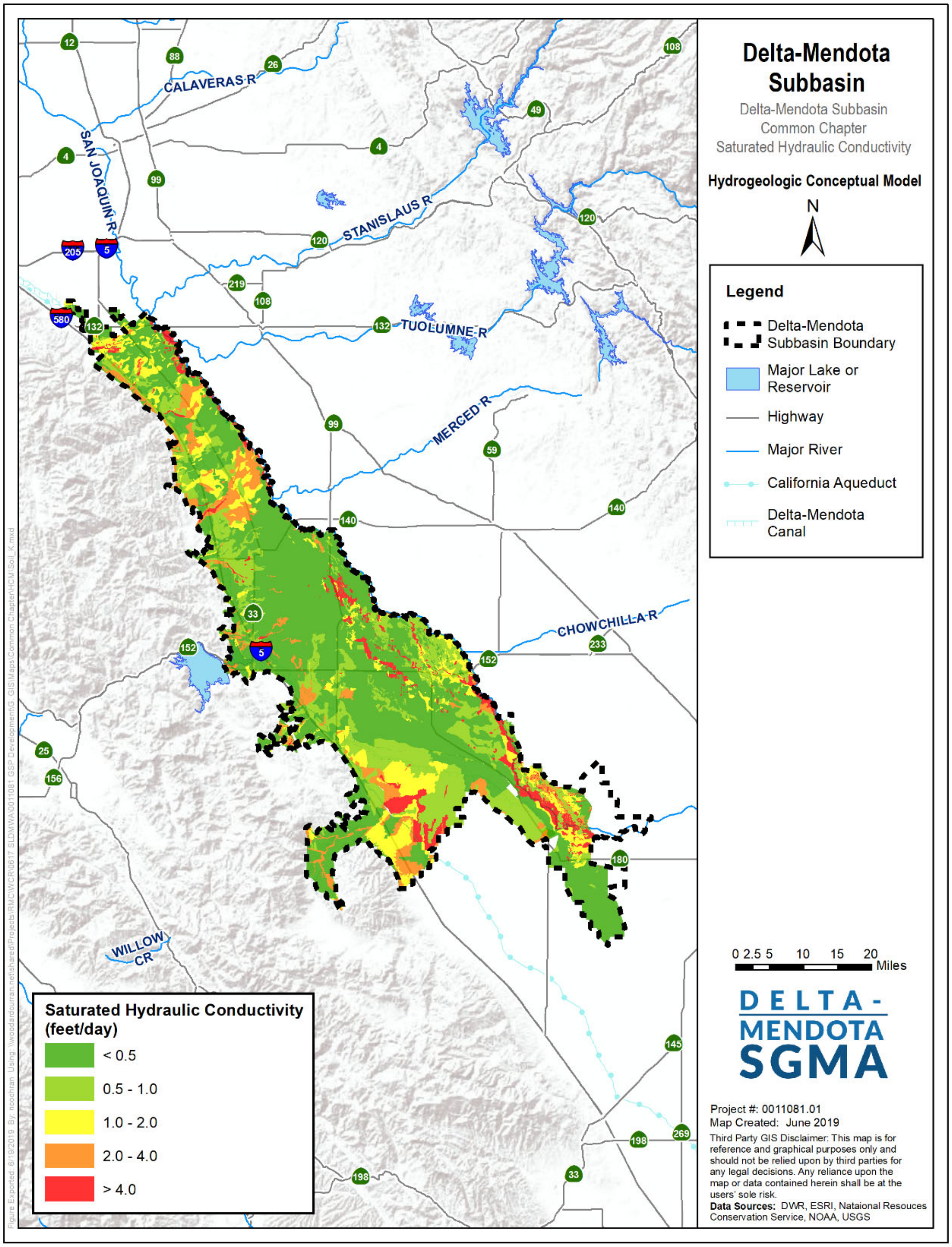


Figure CC-33: Thickness of Corcoran Clay



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Data Sources: DWR, ESRI, Nataional Resouces Conservation Service, NOAA, USGS

Figure CC-34: Soil Hydraulic Conductivity

4.1.8 Structural Properties and Restricted Groundwater Flow

Under natural (pre-development) conditions, the prevailing groundwater flow within the Upper and Lower Aquifer systems of the western San Joaquin Valley was predominantly in a generally northeasterly direction from the Coast Range towards and parallel to the San Joaquin River and the Sacramento-San Joaquin Delta (LSCE, 2015; Hotchkiss and Balding, 1971; KDSA, 2015). Historically, numerous flowing artesian wells within the Lower Aquifer existed throughout the Delta-Mendota Subbasin (Mendenhall et al., 1916) and the pressure gradient for groundwater flow was upward from the Lower Aquifer to the Upper Aquifer. These flowing artesian conditions have disappeared in many areas as a result of increased development of groundwater resources within the Tulare Formation (Hotchkiss and Balding, 1971). Additionally, the Delta-Mendota Subbasin has experienced periods of considerable decline in groundwater levels during which hydraulic heads in the Lower Aquifer decreased considerably in some areas due to heavy pumping (Bertoldi et al., 1991).

Despite the presence of local pumping depressions within parts of the Subbasin, the prevailing northeastward flow direction for groundwater in the Upper Aquifer within the region has remained (AECOM, 2011; DWR, 2010; Hotchkiss and Balding, 1971). Groundwater generally flows outward from the Delta-Mendota Subbasin, except along the southern and western margins where there is some recharge from local streams and canal seepage (KDSA, 2015), in addition to northward subbasin boundary flows. Within the Upper Aquifer, there are similar groundwater flow directions in most of the Subbasin with groundwater outflow to the northeast or towards the San Joaquin River in much of the Subbasin during wet and normal periods. One exception is in the Orestimba Creek area west of Newman where groundwater flows to the west during drought conditions and east during wet periods. Calculations based on aquifer transmissivity indicate the net groundwater outflow in the Upper Aquifer has been about three times greater during drought periods than during normal periods (KDSA, 1997a and 1997b).

Within the Lower Aquifer, there is a groundwater divide generally in the area between Mendota and the point near the San Joaquin River in the Turner Island area, northeast of Los Banos. Groundwater southwest of this divide generally flows southwest toward Panoche Water District and Westlands Water District. Groundwater northeast of this divide flows to the northeast into Madera and Merced Counties. Net groundwater outflow in the Lower Aquifer under drought conditions has been about two and a half times greater than for normal conditions (KDSA, 1997a and 1997b). Based on current and historical groundwater elevation maps, groundwater barriers do not appear to exist in the Delta-Mendota Subbasin (DWR, 2006).

The combined effect of pumping below the Corcoran Clay and increased leakage from the Upper Aquifer to the Lower Aquifer where the Corcoran Clay does not exist or has been perforated has developed a generally downward flow gradient in the Tulare Formation which changes with variable pumping and irrigation over time (Bertoldi et al., 1991). Periods of great groundwater level declines have also resulted in inelastic compaction of fine-grained materials in some locations, particularly between Los Banos and Mendota, potentially resulting in considerable decreases (between 1.5 and 6 times) in permeability of clay members within the Tulare Formation, including the Corcoran Clay (Bertoldi et al., 1991). However, the number of wells penetrating the Corcoran Clay may be enabling vertical hydraulic communication across the Corcoran Clay aquitard and other clay layers (Davis et al., 1959; Davis et al., 1964).

4.1.9 Water Quality

Groundwater in the Delta-Mendota Subbasin is characterized by mixed sulfate to bicarbonate water types in the northern and central portion of the Subbasin, with areas of sodium chloride and sodium sulfate waters in the central and southern portions (DWR, 2003). Total Dissolved Solids (TDS) values range from 400 to 1,600 mg/L in the northern portion, and 730 to 6,000 mg/L in the southern portion of the

Delta-Mendota Subbasin (Hotchkiss and Balding, 1971). The Department of Health Services (currently the Division of Drinking Water), which monitors Title 22 water quality standards, reports TDS values in 44 public supply wells in the Subbasin ranging in value from 210 to 1,750 mg/L, with an average value of 770 mg/L. Shallow, saline groundwater also occurs within about 10 feet of the ground surface over a large portion of the Delta-Mendota Subbasin. There are also localized areas of high iron, fluoride, nitrate, selenium, and boron in the Delta-Mendota Subbasin (Hotchkiss and Balding, 1971).

Alluvial sediments derived from west-side streams are composed of material from serpentine, shale, and sandstone parent rock, which results in soil and groundwater types entirely different from those on the east side of the San Joaquin Valley (LSCE, 2015). In contrast with the siliceous mineralogy of the alluvial sands and gravels on the eastern side of the Central Valley that are derived from the Sierra granitic rocks (which are coarser and more resistant to chemical dissolution), the sulfate and carbonate shales and sandstones of Coast Range sediments on the western side are more susceptible to dissolution processes. Some soils and sediments within the western San Joaquin Valley that are derived from marine rocks of the Coast Range have notably high concentrations of naturally-occurring nitrogen, with particularly higher nitrate concentrations in younger alluvial sediments (Strathouse and Sposito, 1980; Sullivan et al., 1979). These naturally-occurring nitrogen sources may contribute to nitrate concentrations in groundwater within the Delta-Mendota Subbasin, although it is not well known where this may occur and to what degree. Naturally high concentrations of TDS in groundwater are known to have existed historically within parts of the Subbasin due to the geochemistry of the Coast Range rocks and the marine depositional environment, the resulting naturally-high TDS of recharge derived from Coast Range streams, the dissolvable materials within the alluvial fan complexes, and the naturally-poor draining conditions which tend to concentrate salts in the system. The chemical quality of waters in the Coast Range streams can be closely correlated with the geologic units within their respective catchments. Groundwater flows discharging from these marine and non-marine rocks into streams introduce a variety of dissolved constituents resulting in variable groundwater types. The water quality and chemical makeup in westside streams can be highly saline, especially in more northern streams, including Corral Hollow, Panoche and Del Puerto Creeks, where historical baseflow TDS concentrations have typically exceeded 1,000 mg/L with measured concentrations as high as 1,790 mg/L (Hotchkiss and Balding, 1971). This is in contrast with TDS concentrations typically below 175 mg/L in streams draining from the Sierras. The contribution of water associated with these Coast Range sediments has resulted in naturally high salinity in groundwater within and around the Delta-Mendota Subbasin, which has been recognized as early as the 1900s (Mendenhall et al., 1916). Groundwater in some areas within the immediate vicinity of the San Joaquin River is influenced by lower-salinity surface water discharging from the east side of the San Joaquin Valley Groundwater Basin (Davis et al., 1957).

Areas of historical high saline groundwater documented by Mendenhall *et al*. (1916) indicate somewhat high TDS concentrations approaching or greater than 1,000 mg/L in wells sampled throughout many parts of the Delta-Mendota Subbasin. Areas of locally higher TDS concentrations (1,500-2,400 mg/L) have existed between Mendota and Los Banos; whereas the trend in deeper groundwater (average well depth of 450 feet) south of Mendota near Tranquillity indicates slightly lower historical salinity conditions, but still somewhat high with an average TDS concentration of greater than 1,000 mg/L. In the northern part of the Subbasin, north of Gustine, the average historical TDS concentration of wells was also relatively high (930 mg/L). Historically low TDS concentrations (<500 mg/L) existed in groundwater from wells with an average depth of 209 feet in the central Subbasin area between Los Banos and Gustine.

The general chemical composition of groundwater in the Subbasin is variable based on location and depth. Groundwater within the Upper Aquifer is largely characterized as transitional type with less area characterized as predominantly of chloride, bicarbonate, and sulfate water types. Transitional water types, in which no single anion represents more than 50 percent of the reactive anions, occurs in many different combinations with greatly ranging TDS concentrations. Chloride-type waters occur generally in grassland areas east of Gustine and around Dos Palos, with sodium chloride water present in northern areas near Tracy and also extending south from Dos Palos. These waters also exhibit greatly varying salinity with typical TDS concentrations, ranging from less than 500 mg/L to greater than 10,000 mg/L and of high sodium makeup (50-75 percent of cations present) (Hotchkiss and Balding, 1971). Areas of bicarbonate groundwater within the Upper Aquifer of relatively lower TDS concentrations are directly associated with intermittent streams of the Coast Range near Del Puerto, Orestimba, San Luis, and Los Banos Creeks. Sulfate water in the central and southern Subbasin areas has TDS concentrations decreasing from west (1,200 mg/L) to east (700 mg/L) towards the San Joaquin River, similar to the bicarbonate water areas, although areas of sulfate water south of Dos Palos have much higher TDS concentrations (1,900 to 86,500 mg/L) (Hotchkiss and Balding, 1971).

Groundwater in the Lower Aquifer below the Corcoran Clay is also spatially variable, consisting of mostly transitional sulfate waters in the northern part of the Delta-Mendota Subbasin to more sodium-rich water further south in the grassland areas. In the northern part of the Delta-Mendota Subbasin, the Lower Aquifer exhibits relatively lower TDS concentrations, ranging from 400 to 1,600 mg/L, with a sulfate-chloride type makeup near the valley margin trending to sulfate-bicarbonate type near the valley axis. Farther south, TDS concentrations in the Lower Aquifer increase (Hotchkiss and Balding, 1971).

Natural conditions of groundwater salinity exist throughout the Upper and Lower Aquifers as a result of the contribution of salts from recharge off the Coast Range mountains. Surface water and groundwater flowing over and through Coast Range sediments of marine origin have dissolved naturally-occurring salts, contributing to the historical and current presence of salinity in groundwater within the Delta-Mendota Subbasin. In addition to natural salinity contributed from the Coast Range sediments, a number of other mechanisms are believed to further contribute to increased salinity in the groundwater in the region. Poorly draining soil conditions are extensive within some of the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine, and these types of soil, combined with a shallow water table, contribute to a build-up of soil salinity.

4.1.10 Topography, Surface Water, Recharge, and Imported Supplies

This section describes the topography, surface water, soils, and groundwater recharge potential in the Delta-Mendota Subbasin.

Topography

As previously described, the Delta-Mendota Subbasin lies on the western side of the Central Valley and extends from the San Joaquin River on the east, along the axis of the Valley, to the Coast Range on the west side (LSCE, 2015). The Subbasin has ground surface elevations ranging from less than 100 feet above mean sea level (msl) along parts of the eastern edge to greater than 1,600 feet msl in the Coast Range mountains (**Figure CC-35**). Most of the lower elevation areas occur east of Interstate 5, in the eastern parts of the Delta-Mendota Subbasin; although some lower elevation areas also extend westward into the Coast Range, such as in Los Banos Creek Valley. Low elevation areas generally coincide with the extent of the Central Valley floor. Topography within the Delta-Mendota Subbasin consists largely of flat areas across the Central Valley floor, where slopes are generally less than 2 percent, with steepening slopes to the west. The topography outside of the Central Valley floor in the Coast Range mountains is characterized by steeper slopes, generally greater than 6 percent.

Surface Water Bodies

The San Joaquin River and its tributaries is the primary natural surface water feature within the Delta-Mendota Subbasin, flowing from south to north along the eastern edge of the Subbasin (LSCE, 2015).

During the 1960s, the San Joaquin River exhibited gaining flow conditions through much of the Subbasin (Hotchkiss and Balding, 1971). Numerous intermittent streams from the Coast Range enter the Delta-Mendota Subbasin from the west; however, none of these maintain perennial flow and only Orestimba Creek, Los Banos Creek and Del Puerto Creek have channels that extend eastward to a junction with the San Joaquin River. Most of the flow in other notable west-side creeks, including Quinto Creek, San Luis Creek, Little Panoche Creek, and Ortigalita Creek, is lost to infiltration (Hotchkiss and Balding, 1971). Flow from Los Banos and San Luis Creeks are impounded by dams on their respective systems. When flood releases are made from Los Banos Creek Reservoir, the vast majority of flows pass through Grassland Water District to the San Joaquin River as they tend to occur during times when agricultural and wetland demand is low. San Luis Reservoir on San Luis Creek, which is located along the western boundary of the Delta-Mendota Subbasin, is an artificial water storage facility for the Central Valley Project and California State Water Project and has no notable natural surface water inflows. Outflows from the reservoir go into the system of federal- and state-operated canals and aqueducts comprising the Central Valley and State Water Projects. Surface water use within the Delta-Mendota Subbasin is derived largely from water deliveries provided by these projects, including from the California Aqueduct (referred to as San Luis Canal in the joint-use area of the California Aqueduct) and Delta-Mendota Canal, and also from the San Joaquin River (**Figure CC-36**).

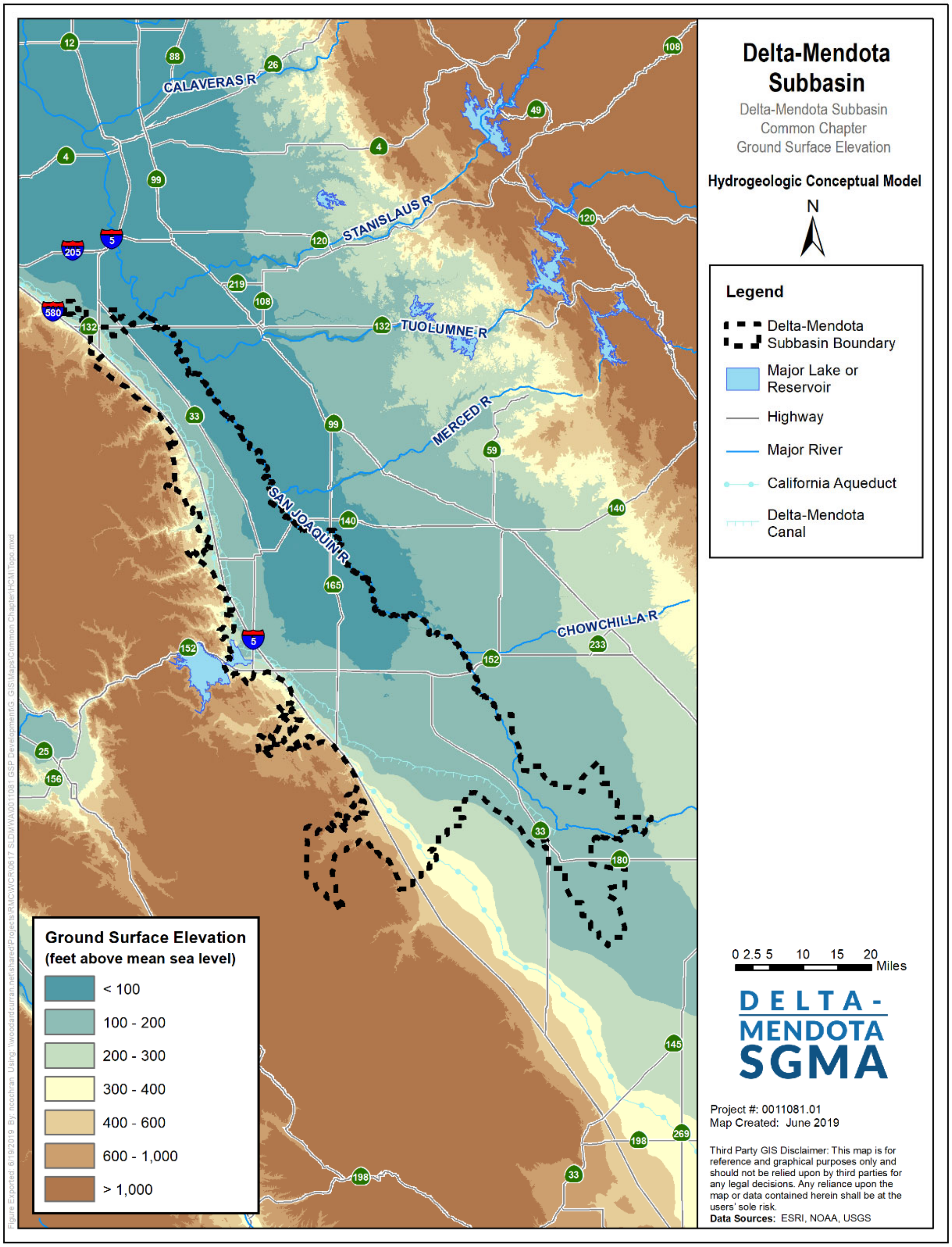

Figure CC-35: Ground Surface Elevation

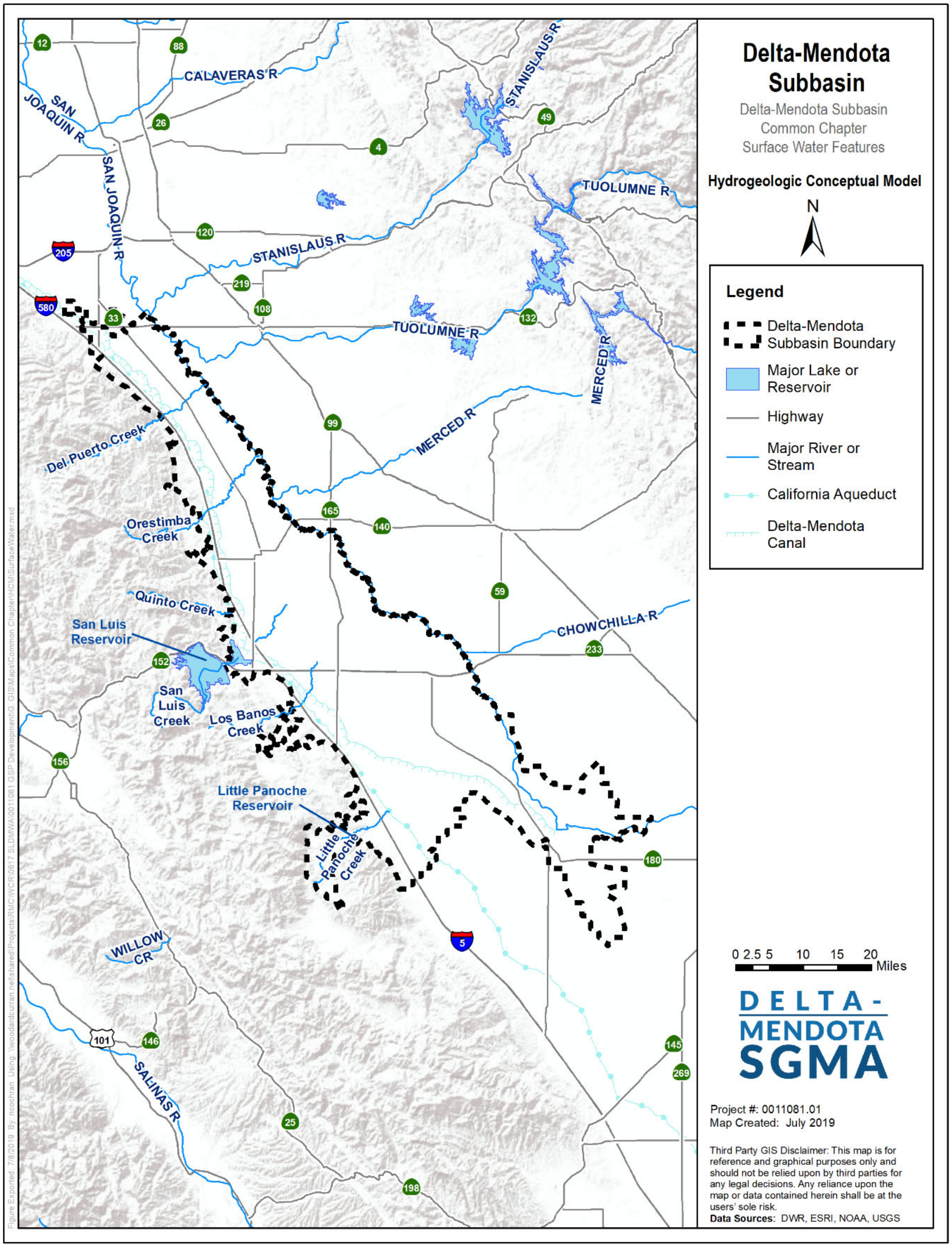

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Figure CC-36: Surface Water Features

Soils

The NRCS provides soil mapping in the region. One of the combining soil groupings mapped includes hydrologic groups. The predominant soil hydrologic groups within the Delta-Mendota Subbasin are soil types C and D (**Figure CC-37**). Group C soils have moderately high runoff potential when thoroughly wet (NRCS, 2009) with water transmission through the soil somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Group D soils have a high runoff potential when thoroughly wet and water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

Soil hydraulic conductivity groups are closely related to soil drainage characteristics and hydraulic conductivity. The fine-grained floodplain deposits present across much of the southeastern area of the Subbasin are evidenced as soils with lower hydraulic conductivity in **Figure CC-37** and accordingly, these characteristics also make these areas poorly drained. Poorly draining soil conditions are extensive within the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine (Fio, 1994; Hotchkiss and Balding, 1971). Soils in the northern and western parts of the Delta-Mendota Subbasin exhibit better drainage characteristics, although areas of poorly drained soils are also present in the north and west in proximity to surface water courses, including most notably directly adjacent to portions of the San Joaquin River and Los Banos Creek channels. Many of the upland soils, which are of generally coarser texture and located proximal to sediment sources derived from the Coast Range hill slopes, are characterized as moderately well drained.

In areas with low hydraulic conductivity, corresponding to areas without adequate natural drainage, tile drains are present to remove shallow groundwater from the rooting zone. Known tile drain locations are shown in **Figure CC-38,** which are primarily located along the eastern boundary of the Delta-Mendota Subbasin as well as the southern portion of the Subbasin in the Grassland Drainage Area. The Grassland Drainage Area contains a tile drainage system connected to the San Joaquin River Improvement Project, which uses tile drainage water for irrigated agriculture with a high salinity tolerance.

Areas of Recharge, Potential Recharge, and Groundwater Discharge Areas

The primary process for groundwater recharge within the Central Valley floor area is from percolation of applied irrigation water and seepage from canals and stream beds, although some groundwater recharge does occur in the Delta-Mendota Subbasin along the western boundary of the Subbasin due to mountain front recharge. In sandier areas, recharge ponds have been constructed within certain districts (CCC, Aliso Water District, CCID and Del Puerto Water District) to promote managed aquifer recharge.

Groundwater recharge potential on agricultural land based on the Soil Agricultural Groundwater Banking Index (SAGBI) is shown in **Figure CC-39**. The SAGBI is based on five major factors: deep percolation, root zone residence time, topography, chemical limitations, and soil surface conditions. Within the Delta-Mendota Subbasin, SAGBI data categorizes 160,248 acres out of 744,237 acres (21%) of agricultural and grazing land within the regions as having Excellent, Good, and Moderately Good (**Figure CC-39**) recharge properties, and 571,573 acres out of 744,237 acres (or 77%) of agricultural and grazing land as having Moderately Poor, Poor, or Very Poor recharge properties. "Modified" SAGBI data shows higher potential for recharge than unmodified SAGBI data because the modified data assumes that soils have been or will be ripped to a depth of six feet, which can break up fine grained materials at the surface to improve percolation. The modified data set was determined to more accurately represent the Delta-Mendota Subbasin due to the heavy presence of agriculture. In almost all cases, recharge from applied water on irrigated lands recharges the Upper Aquifer of the Subbasin. However, the use of percolation ponds and other managed aquifer recharge techniques must consider existing water quality in addition to soil composition and may be limited in areas where poor water quality currently exists.

The Corcoran Clay is a known barrier restricting vertical flow between the Upper and Lower Aquifers; therefore, natural recharge of the Lower Aquifer from downward percolating water is most likely restricted where the Corcoran Clay is present, including across most of the Central Valley floor. Primary recharge areas to the Lower Aquifer are most likely in western parts of the Central Valley floor where percolating water can enter formations feeding the Lower Aquifer, particularly in the vicinity and west of Los Banos, Orestimba, and Del Puerto Creeks, along the western margin of the Subbasin.

Groundwater discharge areas are identified as springs located within the Delta-Mendota Subbasin and the San Joaquin River. **Figure CC-39** shows the location of historic springs identified by USGS. There are only six springs/seeps identified by USGS in their National Hydrograph Dataset, which are located in the southwestern corner of the Subbasin. The springs shown represent a dataset collected by USGS and are not a comprehensive map of springs in the Subbasin.

Imported Supplies

Both the California Aqueduct and Delta-Mendota Canal run the length of the Delta-Mendota Subbasin, primarily following the Interstate 5 corridor (**Figure CC-40**). The following water purveyors in the Delta-Mendota Subbasin are SLDMWA Member Agencies and thus receive water from the Central Valley Project via the Delta-Mendota Canal: California Department of Fish and Wildlife, Central California Irrigation District, Columbia Canal Company, Del Puerto Water District, Eagle Field Water District, Firebaugh Canal Water District, Fresno Slough Water District, Grassland Water District, Laguna Water District, Mercy Springs Water District, Oro Loma Water District, Pacheco Water District, Panoche Water District, Patterson Irrigation District, San Luis Canal Company, San Luis Water District, Tranquillity Irrigation District, Turner Island Water District, U.S. Fish and Wildlife Service, and West Stanislaus Irrigation District. Oak Flat Water District is the only recipient of State Water Project (SWP) water in the Delta-Mendota Subbasin; Oak Flat Water District initially bought into the SWP in 1968.

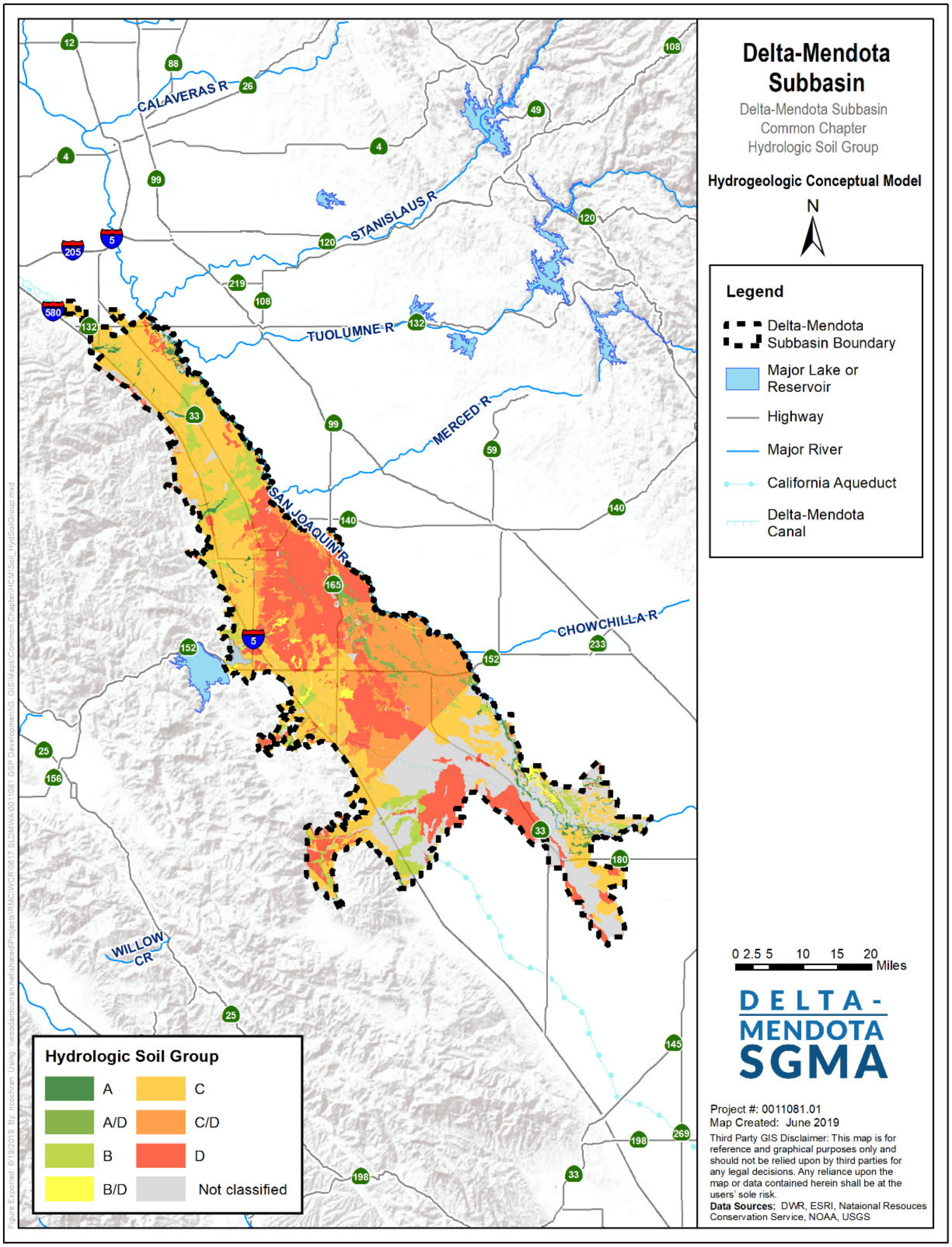


Figure CC-37: SAGBI Soils Map

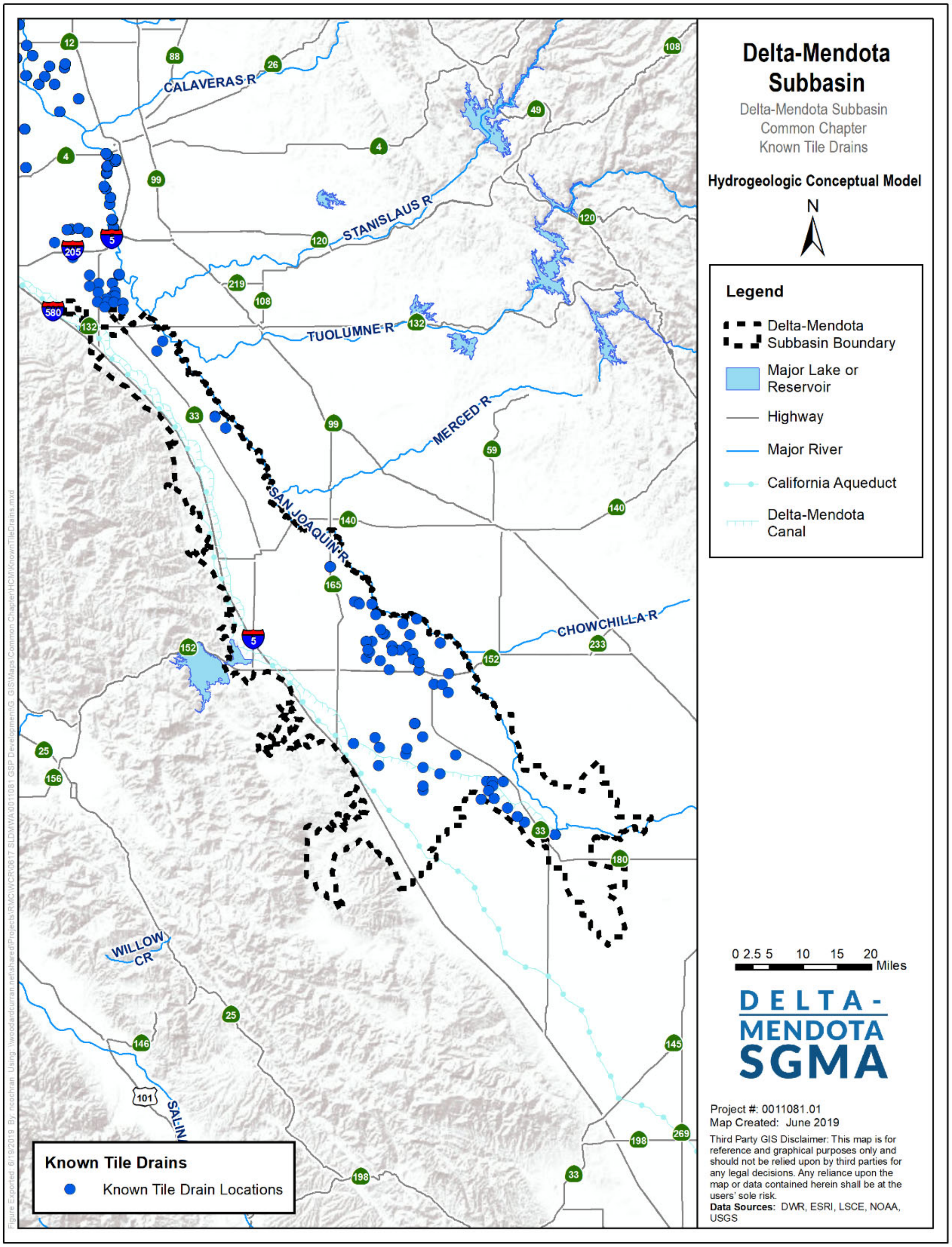


Figure CC-38: Tile Drains

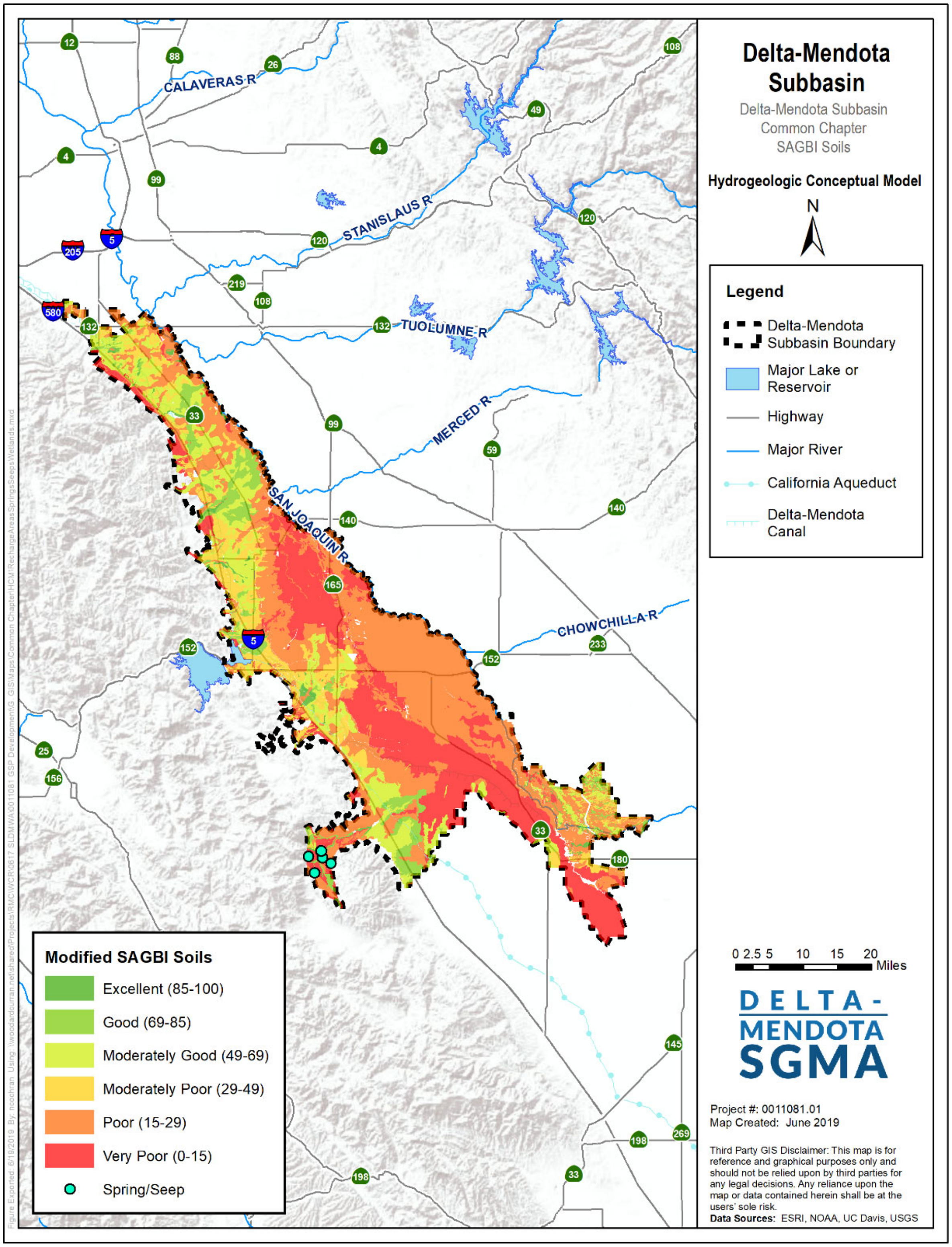


Figure CC-39: Recharge Areas, Seeps and Springs

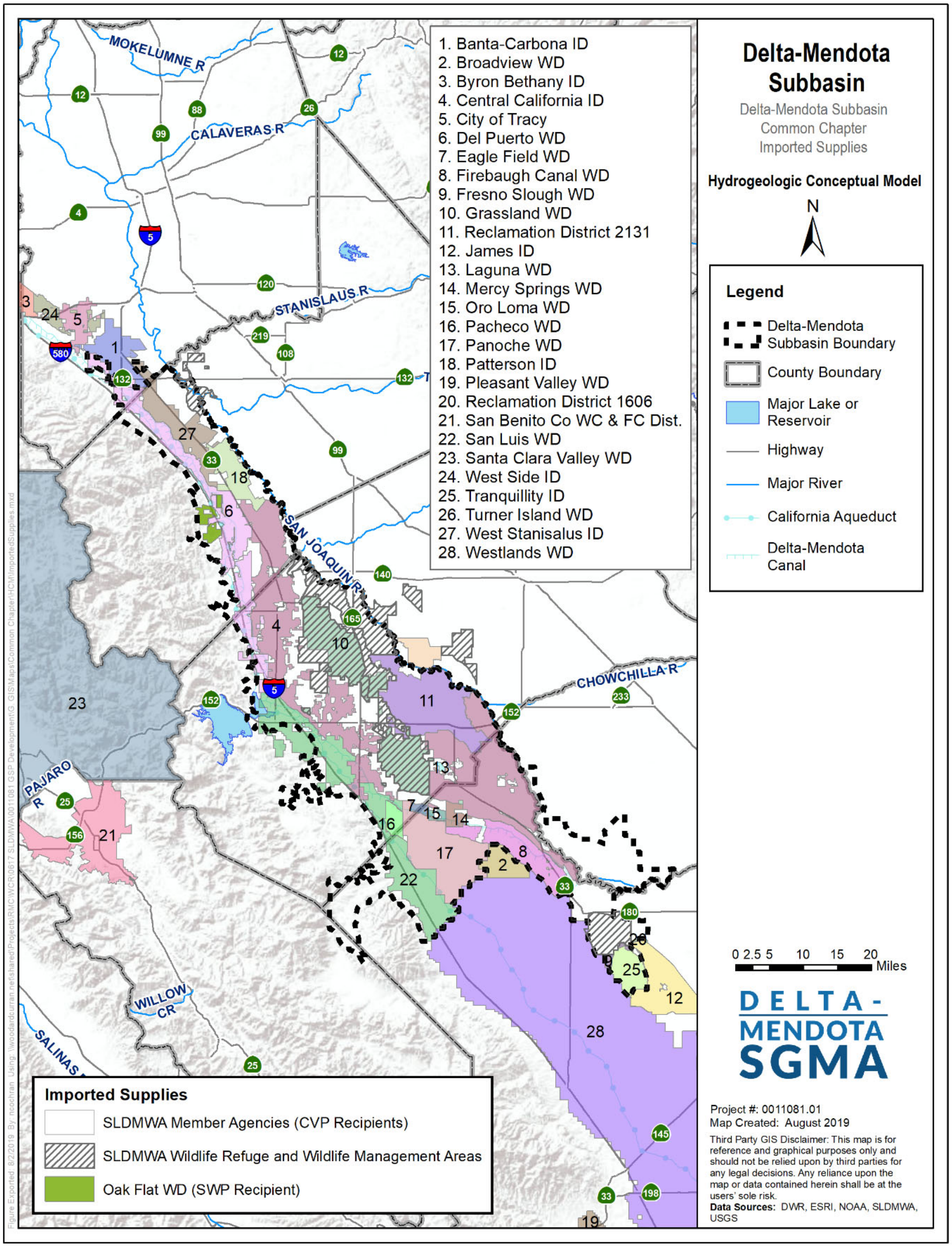


Figure CC-40: Imported Supplies

4.2 Delta-Mendota Subbasin Groundwater Conditions

This section describes the current and historic groundwater conditions in the Delta-Mendota Subbasin, including data from January 1, 2015 to recent conditions for the following parameters: groundwater elevations, groundwater storage, groundwater quality, land subsidence, interconnected surface water systems, and groundwater dependent ecosystems (GDEs) (pursuant to Article 5 Plan Contents, Subarticle 2 Basin Setting, § 354.16 Groundwater Conditions of the GSP Emergency Regulations). Seawater intrusion is not discussed herein as the Delta-Mendota Subbasin is inland and is not impacted by seawater intrusion. For the purposes of this GSP, "current conditions" is represented by Water Year (WY) 2013 conditions, which is consistent with the year representing the Current Conditions Water Budget (see Section 4.3 for more information about Water Budgets). Data post-WY 2013 through present day are presented when available.

The purpose of describing groundwater conditions, as contained in this section and described in the individual GSPs, is to establish baseline conditions that will be used to monitor changes relative to measurable objectives (MOs) and minimum thresholds (MTs). Therefore, these established baseline conditions will help support monitoring to demonstrate measurable efforts in achieving the sustainability goal for the Delta-Mendota Subbasin.

4.2.1 Useful Terminology

This groundwater conditions section includes descriptions of the amounts, quality, and movement of groundwater, among other related components. A list of technical terms and a description of the terms are listed below. The terms and their descriptions are identified here to guide readers through the section and are not a definitive definition of each term:

- **Depth to Groundwater** – The distance from the ground surface to first-detected non-perched groundwater, typically reported at a well.
- **Upper Aquifer** – The alluvial aquifer above the Corcoran Clay (or E-clay) layer.
- **Lower Aquifer** – The alluvial aquifer below the Corcoran Clay (or E-clay) layer.
- **Horizontal gradient** – The slope of the groundwater surface from one location to another when one location is higher or lower than the other. The gradient is shown on maps with an arrow showing the direction of groundwater flow in a horizontal direction.
- **Vertical gradient** – Describes the movement of groundwater perpendicular to the ground surface. Vertical gradient is measured by comparing the elevations of groundwater in wells that are of different depths. A downward gradient is one where groundwater is moving down into the ground towards deeper aquifers and an upward gradient is one where groundwater is upwelling towards the ground surface.
- **Contour Map** – A contour map shows changes in groundwater elevations by interpolating groundwater elevations between monitoring sites. The elevations are shown on the map with the use of a contour line, which represents groundwater being at the indicated elevation along the contour line. Contour maps can be presented in two ways:
    - Elevation of groundwater above mean sea level (msl), which can be used to identify the horizontal gradients of groundwater, and
    - Depth to water (i.e., the distance from the ground surface to groundwater), which can be used to identify areas of shallow or deep groundwater.
- **Hydrograph** – A graph that shows the changes in groundwater elevation or depth to groundwater over time at a specific location. Hydrographs show how groundwater elevations change over the years and indicate whether groundwater is rising or descending over time.

- **Maximum Contaminant Level (MCL)** – MCLs are standards that are set by the State of California and the U.S. Environmental Protection Agency for drinking water quality. MCLs are legal threshold limits on the amount of an identified constituent that is allowed in public drinking water systems. At both the State and Federal levels, there are Primary MCLs, set to be protective of human health, and Secondary MCLs for constituents that do not pose a human health hazard but do pose a nuisance through either smell, odor, taste, and/or color. MCLs are different for different constituents and have not been established for all constituents potentially found in groundwater.
- **Elastic Land Subsidence** – Reversible and temporary fluctuations in the elevation of the earth's surface in response to seasonal periods of groundwater extraction and recharge.
- **Inelastic Land Subsidence** – Irreversible and permanent decline in the elevation of the earth's surface resulting from the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system. This form of subsidence is what is required by SGMA to be monitored and reported.
- **Gaining Stream** – A stream in which groundwater flows into a streambed and contributes to a net increase in surface water flows across an identified reach.
- **Losing Stream** – A stream in which surface water is lost through the streambed to the groundwater, resulting in a net decrease in surface water flows across an identified reach.
- **Conjunctive Use** – The combined use of surface water and groundwater supplies, typically with more surface water use in wet years and more groundwater use in dry years.

4.2.2 Groundwater Elevations

This section describes groundwater elevation data utilized and elevation trends in the Delta-Mendota Subbasin. Groundwater conditions vary widely across the Subbasin. Historic groundwater conditions through present day conditions, the role of imported surface water in the Subbasin, and how conjunctive use has impacted groundwater trends temporally and spatially are discussed. Groundwater elevation contour maps associated with current seasonal high and seasonal low for each principal aquifer, as well as hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients (both horizontal and vertical), are also described.

Available Data

Groundwater elevation data, and accompanying well construction information, within the Delta-Mendota Subbasin from the following sources and associated programs were utilized in the development of the Delta-Mendota Subbasin GSPs:

- California Department of Water Resources (DWR)
    - California Statewide Groundwater Elevation Monitoring Program (CASGEM)
    - Water Data Library (WDL)
- Water level data from local monitoring programs

Data provided by these sources included well information (such as location, well construction, owner, ground surface elevation and other related components), as well as groundwater elevation data (including information such as date measured, depth to water, groundwater surface elevation, questionable measurement code, and comments). At the time that these analyses were performed, groundwater elevation data were available for the time period from 1930 through 2018. There are many wells with monitoring data from some time in the past but no recent data, while a small number of wells have monitoring data recorded for periods of greater than 50 years.

Not all groundwater elevation data received were used in preparing the groundwater elevation contour maps for both principal aquifers (defined in this Common Chapter as the Upper and Lower Aquifers which are divided by the Corcoran Clay or E-clay layer). Some groundwater elevation data were associated with wells with unknown screened depths and/or composite well screens constructed across the Corcoran Clay. Groundwater elevation data associated with wells with composite screens and/or unknown screened depths were removed from the data set in most instances, along with any data point that appears to be an outlier when compared with surrounding data from the same period. Select wells with unknown construction were evaluated for inclusion in contour mapping efforts in areas of limited data. Duplicate well measurements were also removed prior to contouring and only one observation for a given well was used for the identified season, rather than averaging all measurements at a given well during the same season.

Figure CC-41 shows the locations of wells with known screened depths within the Delta-Mendota Subbasin as well as known spatial gaps where no well information is currently available. These wells include those monitored under CASGEM, the Delta-Mendota Canal Well Pump-in Program, and by local owners or agencies. Monitoring data available for these wells varies by local owner and agency. Well locations were provided by local agencies to the best of their knowledge at the time of writing and may include wells that have been destroyed or are no longer in service.

Historic Conditions

Historic groundwater trends changed significantly with the first deliveries of imported water deliveries to the Delta-Mendota Subbasin. Construction of the Delta-Mendota Canal and the California Aqueduct heralded the introduction of significant surface water supplies into the Subbasin and reduced dependence on groundwater as the primary water supply. These conveyance systems have resulted in significant increases in the conjunctive use of surface water and groundwater throughout the Subbasin. Various drought periods and regulations reducing delivery of supplies from the Sacramento-San Joaquin Delta also punctuate critical understandings of groundwater use patterns throughout the Subbasin, as well as what is known regarding response and recovery of groundwater levels following notable droughts.

Prior to Imported Water Deliveries (1850-1950s)

Prior to 1850, the majority of agriculture and development in the San Joaquin Valley consisted of rain-fed grain and cattle production, with irrigated development beginning sporadically during this time via river (primarily San Joaquin River) and perennial stream diversions (SWRCB, 2011). Construction of the railroad through the San Joaquin Valley from 1869 through 1875 increased demand for more extensive agriculture, making markets in larger coastal cities more accessible to valley farmers. Significant irrigation sourced from surface water and resulting production began in the western side of the San Joaquin Valley in 1872 when the San Joaquin River was diverted through the Miller and Lux canal system west of Fresno (DWR, 1965). By the 1890s and early 1900s, sizable areas of the southern San Joaquin Valley were being forced out of production by salt accumulation and shallow water tables. Much of this land lay idle until the 1920s when development of reliable electric pumps and the energy to power them accelerated the expansion of irrigated agriculture with the availability of vast groundwater resources. The resultant groundwater pumping lowered the water table in many areas (SWRCB, 1977 and Ogden, 1988) and allowed the leaching of salts, particularly near the valley trough and western side of the valley. Groundwater pumping for irrigation from around 1920 to 1950 drew the water table down as much as 200 feet in areas along the westside of the San Joaquin River (Belitz and Heimes, 1990). Declining water tables were causing higher pumping costs and land subsidence, and farmers were finding poorer quality water as water tables continued to decline. These issues created a desire for new surface water supplies, which would be fulfilled by the Central Valley Project.

Post-Imported Water Deliveries (1950s-2012)

Surface water deliveries from the Central Valley Project via the DMC began in the early 1950s, and from the State Water Project via the California Aqueduct in the early 1970s (Sneed et al., 2013). The CVP is the primary source of imported surface water in the Delta-Mendota Subbasin, where only Oak Flat Water District receives deliveries from the SWP. Introduction of imported water supplies to the Delta-Mendota Subbasin resulted in a decrease in groundwater pumping from some parts of the Subbasin and the greater Central Valley, which was accompanied by a steady recovery of water levels. During the droughts of 1976-1977 and 1987-1992, diminished deliveries of imported surface water prompted increased pumping of groundwater to meet irrigation demands, bringing water levels to near-historic lows. Following periods of drought, recovery of pre-drought water levels has been rapid, especially in the Upper Aquifer. This trend has been observed in historic hydrographs for wells across the Subbasin.

Current Conditions

Trends similar to historic drought and subsequent recovery conditions were observed during the 2012 to 2016 drought and the 2016 to present recovery period.

Recent Drought (2012-2016)

During the most recent drought, from 2012 through 2016, similar groundwater trends were observed as during the 1976-1977 and 1987-1992 droughts. With diminished imported surface water deliveries, groundwater pumping increased throughout the Subbasin to meet irrigation needs. This resulted in historic or near-historic low groundwater levels during the height of the drought in 2014 and 2015, when CVP and SWP allocations for agricultural water service contractors were 0%, Exchange Contractors and refuge deliveries were less than 75%, and post-1914 surface water rights in the San Joaquin River watershed were curtailed. In June 2015, senior water rights holders with a priority date of 1903 or later in the San Joaquin and Sacramento watersheds and the Delta were ordered by the State Water Resources Control Board to curtail diversions (State of California, 2015). This marked the first time in recent history that pre-1914 water rights holders were curtailed.

Post-Drought (2016-present)

With wetter conditions following the 2012-2016 drought, groundwater levels began to recover. This was largely a result of increased surface water availability with CVP allocations reaching 100% and full water rights supplies available for diversion from the San Joaquin River in 2017. Additionally, inelastic land subsidence rates also drastically decreased in 2017 as imported water supplies were once again available, resulting in decreased groundwater pumping particularly from the Lower Aquifer. This pattern of increased drought-driven groundwater pumping, accompanied by declining groundwater elevations, followed by recovery is a predominant factor to be considered in the sustainable management of the Delta-Mendota Subbasin. Furthermore, subsidence mitigation projects were developed which drastically reduced the observed subsidence rate on the eastern and southern boundaries of the Subbasin.

Groundwater Trends

Groundwater levels can fluctuate greatly throughout time due to various natural and anthropogenic factors, including long-term climatic conditions, adjacent well pumping, nearby surface water flows, and seasonal groundwater recharge or depletion (LSCE, 2015). As discussed in the Hydrogeologic Conceptual Model section of this Common Chapter (Section 4.1), the Delta-Mendota Subbasin is generally a two-aquifer system consisting of an Upper and Lower Aquifer that are subdivided by the Corcoran Clay layer, a regional aquitard. The Corcoran Clay layer, or E-Clay equivalent, restricts flow between the upper semi-confined aquifer and lower confined aquifer. The presence of a tile drain network along the Grassland Drainage Area and the Subbasin's eastern boundary affects the lateral and vertical water movement in the shallow groundwater zone (LSCE, 2016).

The Delta-Mendota Subbasin has a general flow direction to the east in the Upper Aquifer, where it loses groundwater to the San Joaquin River and its neighboring subbasins. Most recharge throughout the Subbasin is attributed to applied irrigation water, where other sources of recharge include local streams, canal seepage, and infiltration along the western margin of the Subbasin from the Coast Range. The figures that follow were developed for inclusion in the Western San Joaquin River Watershed Groundwater Quality Assessment Report (LSCE, 2015) and the Grassland Drainage Area Groundwater Quality Assessment Report (LSCE, 2016) and are included herein with the intent of demonstrating general trends in groundwater elevations around the Delta-Mendota Subbasin. These figures are not to scale.

Please see the individual GSPs for more specific information relating to similar trends in those respective GSP Plan areas. Additionally, it is important to note that groundwater trends, such as these, are dependent on climatic conditions and are not necessarily representative of the historic and current water budgets for those respective GSP Plan areas.

Upper Aquifer

For the Upper Aquifer, **Figure CC-42** presents select hydrographs illustrating temporal groundwater level trends in the Upper Aquifer wells within the Subbasin. Hydrographs shown on **Figure CC-42** are displayed with different ranges of elevation values on the vertical axes. Wells in the Upper Aquifer exhibit decreasing trends to somewhat stable water levels until the mid-1980s, and increasing or stable water levels thereafter.

Similarly, **Figure CC-43** presents select hydrographs illustrating temporal groundwater level trends in the areas covered by the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSAs in the Northern & Central Delta-Mendota Region GSP Group at various depths. The three select hydrographs representing wells in the Upper Aquifer each show less than 10 years of available data with two wells showing slight declines of about 10 feet or less from about 2003 through 2013, and one well showing a more drastic elevation change, ranging from 100 feet above mean sea level (ft msl) to -20 ft msl over a 5-year period from 2010 to 2016.

Lower Aquifer

Figure CC-44 presents select hydrographs illustrating temporal groundwater level trends in Lower Aquifer wells within the Subbasin. Note, hydrographs shown on **Figure CC-44** displayed different ranges of elevation on the vertical axes. In the Lower Aquifer, piezometric head typically increased or remained relatively stable during the period from the 1980s through the early 2000s.

Again, similarly, **Figure CC-43** presents select hydrographs illustrating temporal groundwater level trends in the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSA areas of the Northern & Central Delta-Mendota Region GSP Group at various depths. The two select hydrographs representing wells in the Lower Aquifer each show similar elevation patterns post-2010 with a total elevation change of 50 ft msl or more. USGS1000489 shows stable and increasing groundwater elevation trends from the late 1950s through the mid-1980s with a data gap from the mid-1980s through 2010, whereafter 2010 groundwater levels have a steep decline through 2016.

Vertical Gradients

Throughout most of the Delta-Mendota Subbasin, the Corcoran Clay layer acts as a regional aquitard, limiting the vertical migration of groundwater. In areas outside the Corcoran Clay layer (along the western margin of the Subbasin), localized interfingered clays minimize the downward migration of groundwater; although in areas where the clay layers are not competent or non-existent, groundwater migrates from shallower to deeper groundwater zones. Similarly, in areas where the Corcoran Clay has been compromised (due to well construction across the clay), groundwater generally flows from the Upper Aquifer to the Lower Aquifer, especially in areas where the Lower Aquifer is actively used as a water supply (lowering the potentiometric head in that zone).

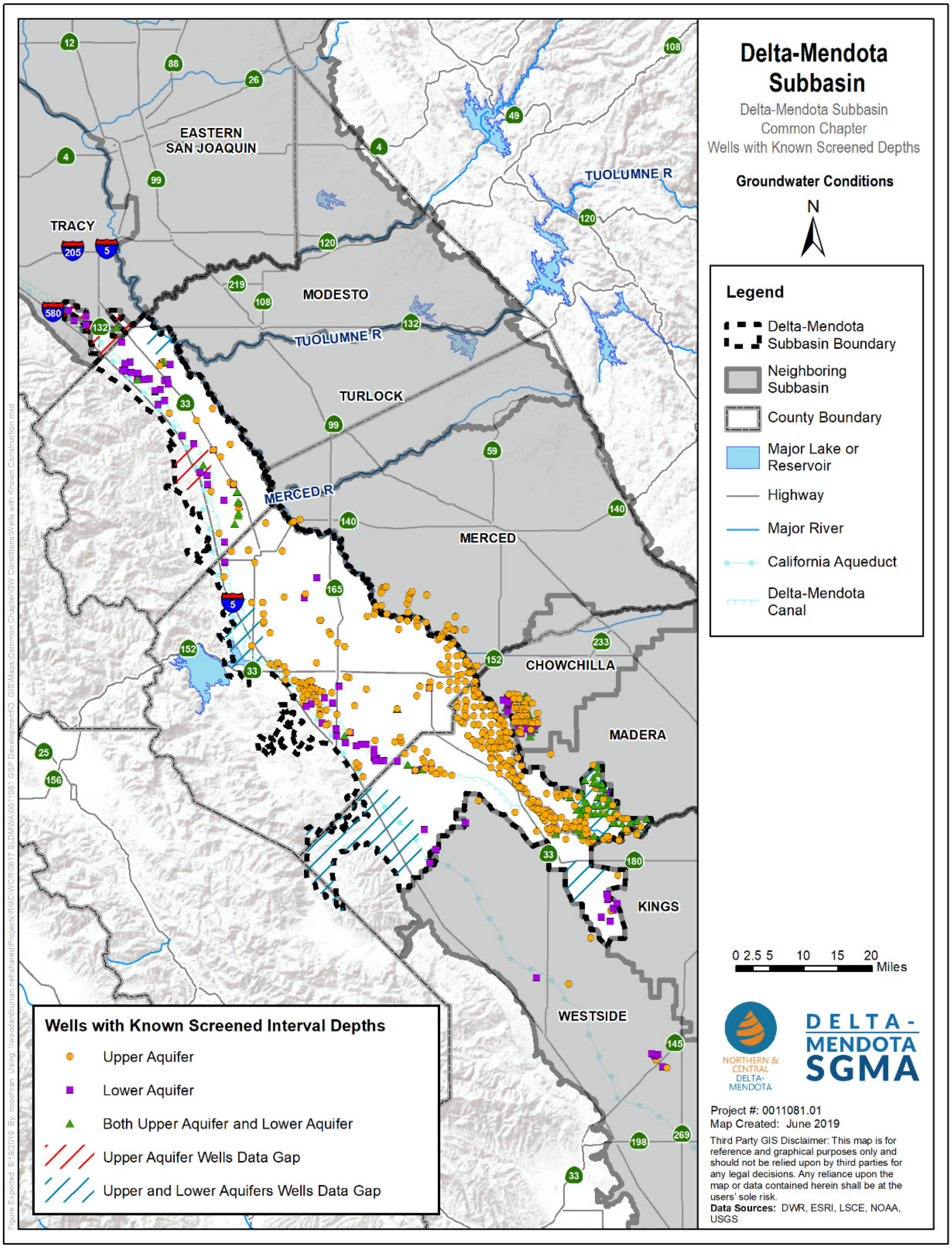
Groundwater Contours

The Subbasin-wide groundwater contours reflected in **Figure CC-45** and **Figure CC-46** evaluate the seasonal high (Spring 2013) and seasonal low (Fall 2013) conditions of the current year (defined as WY2013 for the GSP analyses) for the Upper Aquifer. Spring is defined as groundwater surface elevation measurements collected between January 1 and April 8; where Fall is defined as groundwater surface elevation measurements collected between September 1 and October 31. For wells where multiple Spring 2013 or Fall 2013 measurements were available, the highest elevation for each season was used for contouring. Gaps in data and contours can be attributed to a lack of wells present, level measurements, or requirements to report level readings groundwater level data. Consistent with traditional contouring efforts, the quality of outlier water level data was investigated. In instances of poor quality data, the associated data was eliminated for the groundwater contouring effort. Furthermore, implementation of the CASGEM program in 2014 has reduced temporal and spatial gaps in groundwater level datasets, and implementation of the Delta-Mendota Subbasin GSPs' monitoring programs will add to the improved data quantity and quality.

In the Upper Aquifer, during Spring 2013, the general flow of groundwater in the Delta-Mendota Subbasin was from the Coast Range along the western boundary of the Subbasin toward the San Joaquin River along the eastern boundary. Groundwater elevations tend to increase moving south throughout the Subbasin. Within Stanislaus County, groundwater elevations are the lowest, ranging between 40 and 80 feet above msl, becoming increasingly higher in Madera County, ranging between 80 and 100 feet above msl, and in Merced and Fresno counties, ranging between 80 and 140 feet above msl (**Figure CC-45**). Similar flow directions (west to east and northeast) are observed in the Fall 2013. Within Stanislaus County, groundwater elevations are the lowest ranging between 40 and 80 feet above msl, showing little difference compared to Spring 2013; become increasingly higher in Madera County ranging between 60 and 100 feet above msl; in Merced County ranging between 60 and 140 feet above msl; and in Fresno County ranging from 60 and 120 feet above msl (**Figure CC-46**). Both maps indicate a prevailing southwest to northeast flow gradient above the Corcoran Clay. In general, little variation is apparent in groundwater elevation between seasonal high and low periods in 2013.

Due to insufficient data, groundwater elevation contour maps for the Lower Aquifer for the seasonal high and low (Spring 2013 and Fall 2013, respectively) could not be accurately prepared. **Figure CC-47** and **Figure CC-48** show the available groundwater elevation measurements for Spring 2013 and Fall 2013. Available Spring 2013 measurements range from -127 to 12 feet above msl in Stanislaus County, -65 to

124 feet above msl in Merced County, and -5 to 88 feet above msl in Fresno County (**Figure CC-47**), where no measurements are available for this time period in Madera County. Available Fall 2013 measurements range from -138 to 156 feet above msl in Stanislaus County, -94 to 19 feet above msl in Merced County, and -72 to -4 feet above msl in Fresno County (**Figure CC-48**), where no measurements are available for this time period in Madera County. The Lower Aquifer exhibits less seasonal difference in groundwater elevations than the Upper Aquifer. Throughout most of the Subbasin, the Lower Aquifer shows lower piezometric heads than the Upper Aquifer suggesting that potential exists for downward vertical gradient.



Delta-Mendota Subbasin

Delta-Mendota Subbasin
Common Chapter
Wells with Known Screened Depths

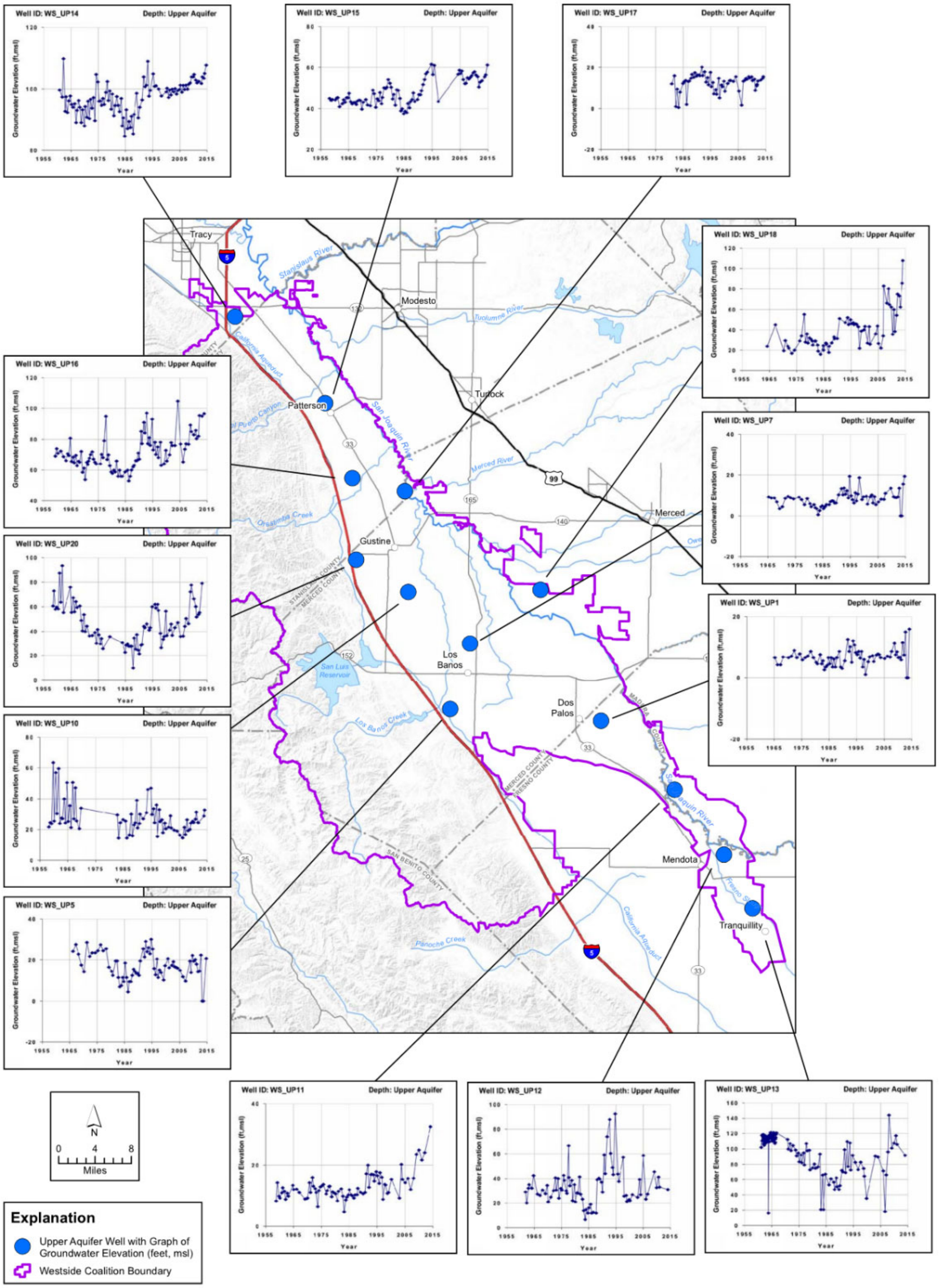
Groundwater Conditions

Project #: 0011081.01
Map Created: June 2019

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk.

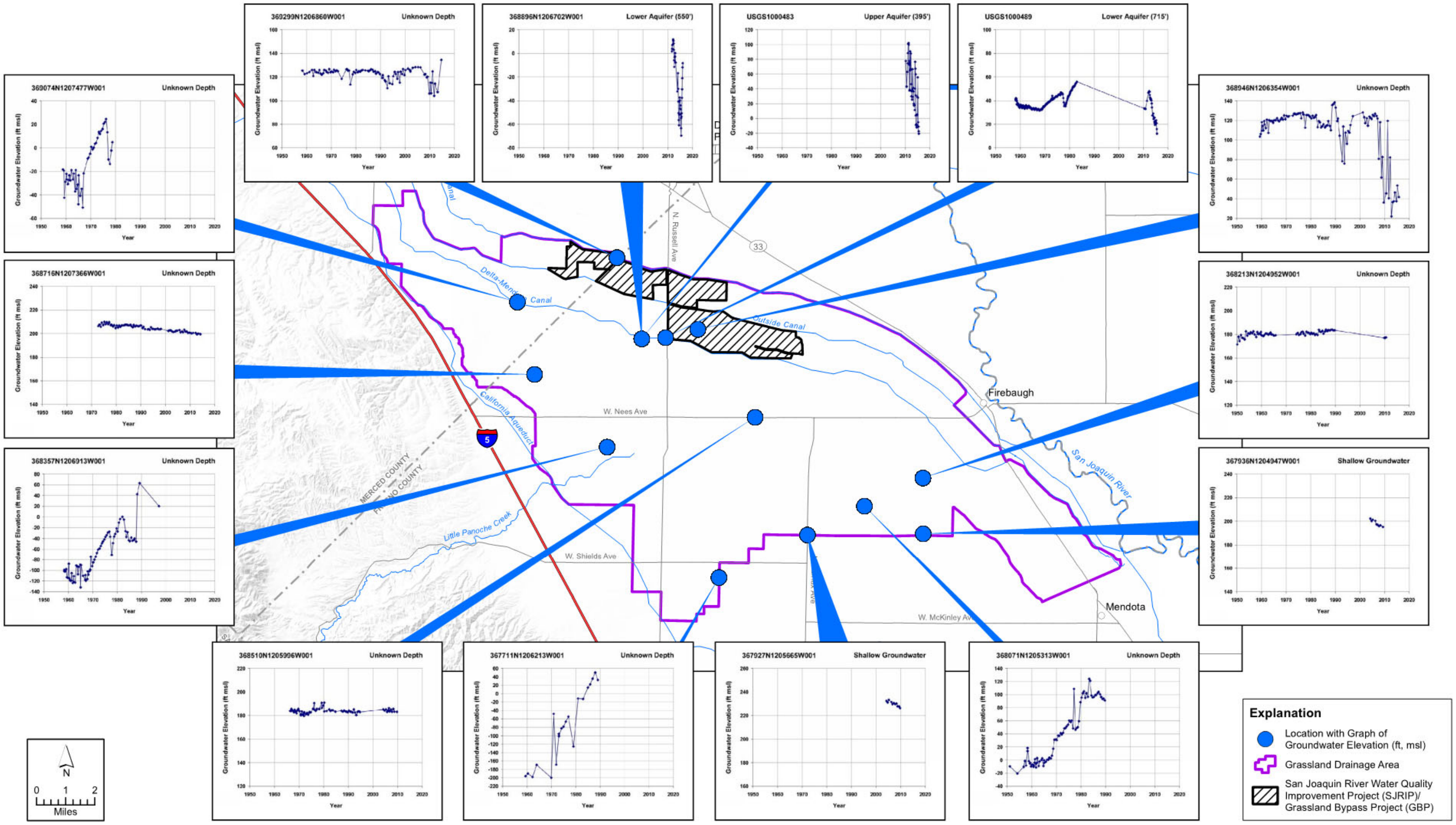
Data Sources: DWR, ESRI, LSCE, NOAA, USGS

Figure CC-41: Wells with Known Screened Interval Depths



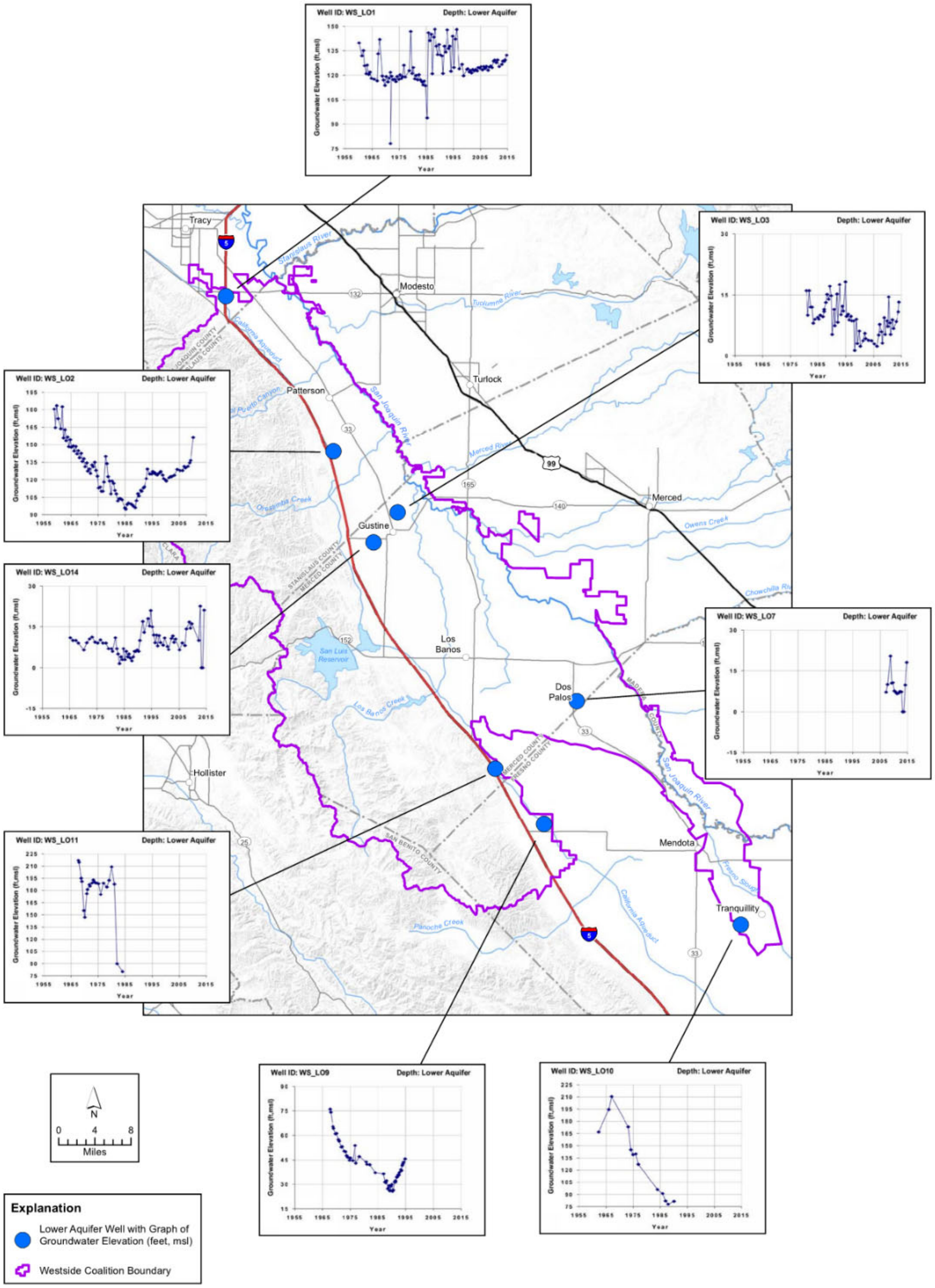
Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016

Figure CC-42: Select Graphs of Groundwater Elevations, Upper Aquifer



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-43: Select Graphs of Groundwater Elevations, Various Depths



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-44: Select Graphs of Groundwater Elevations, Lower Aquifer

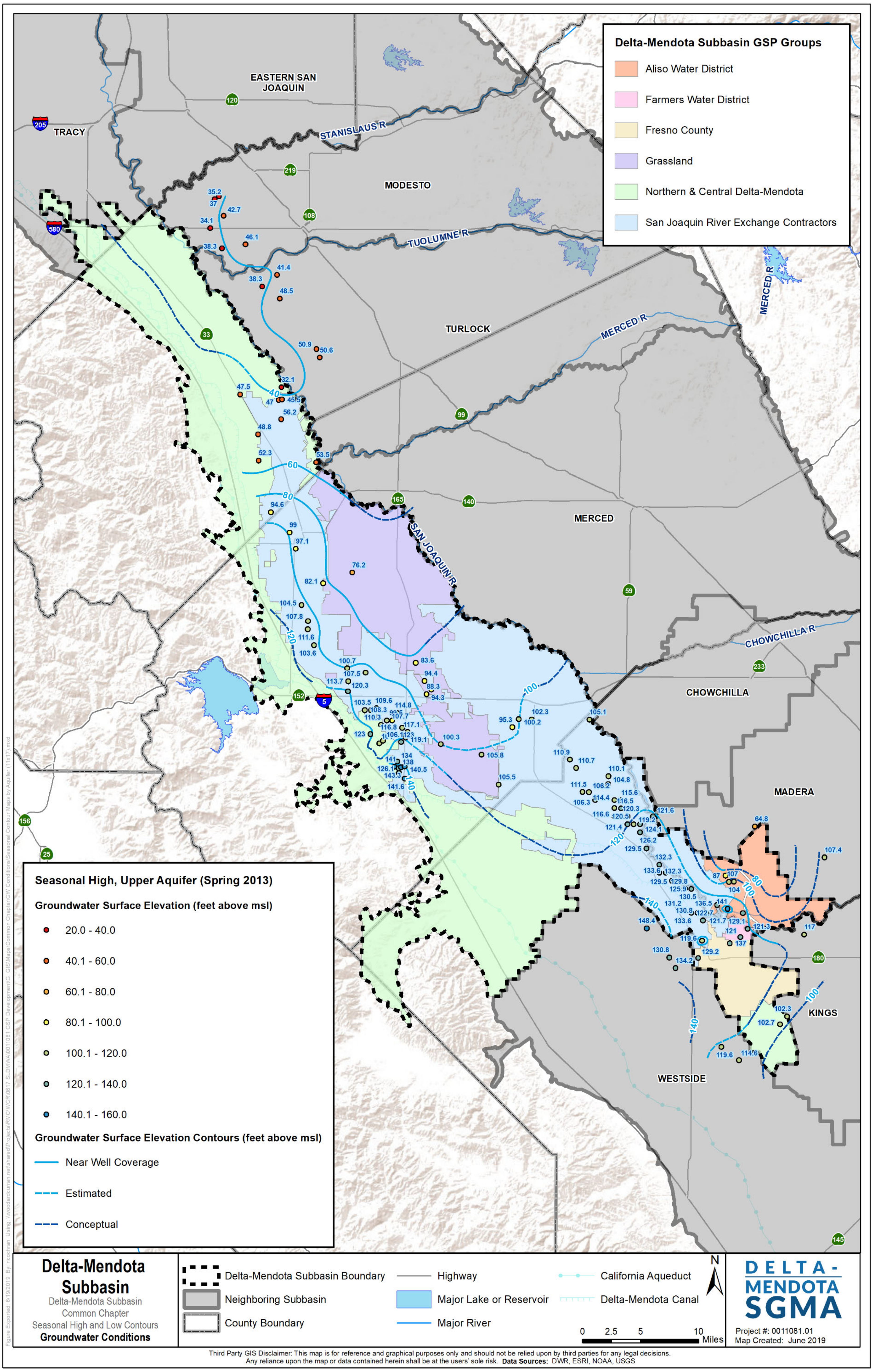


Figure CC-45: Spring 2013 Upper Aquifer Groundwater Contour Map

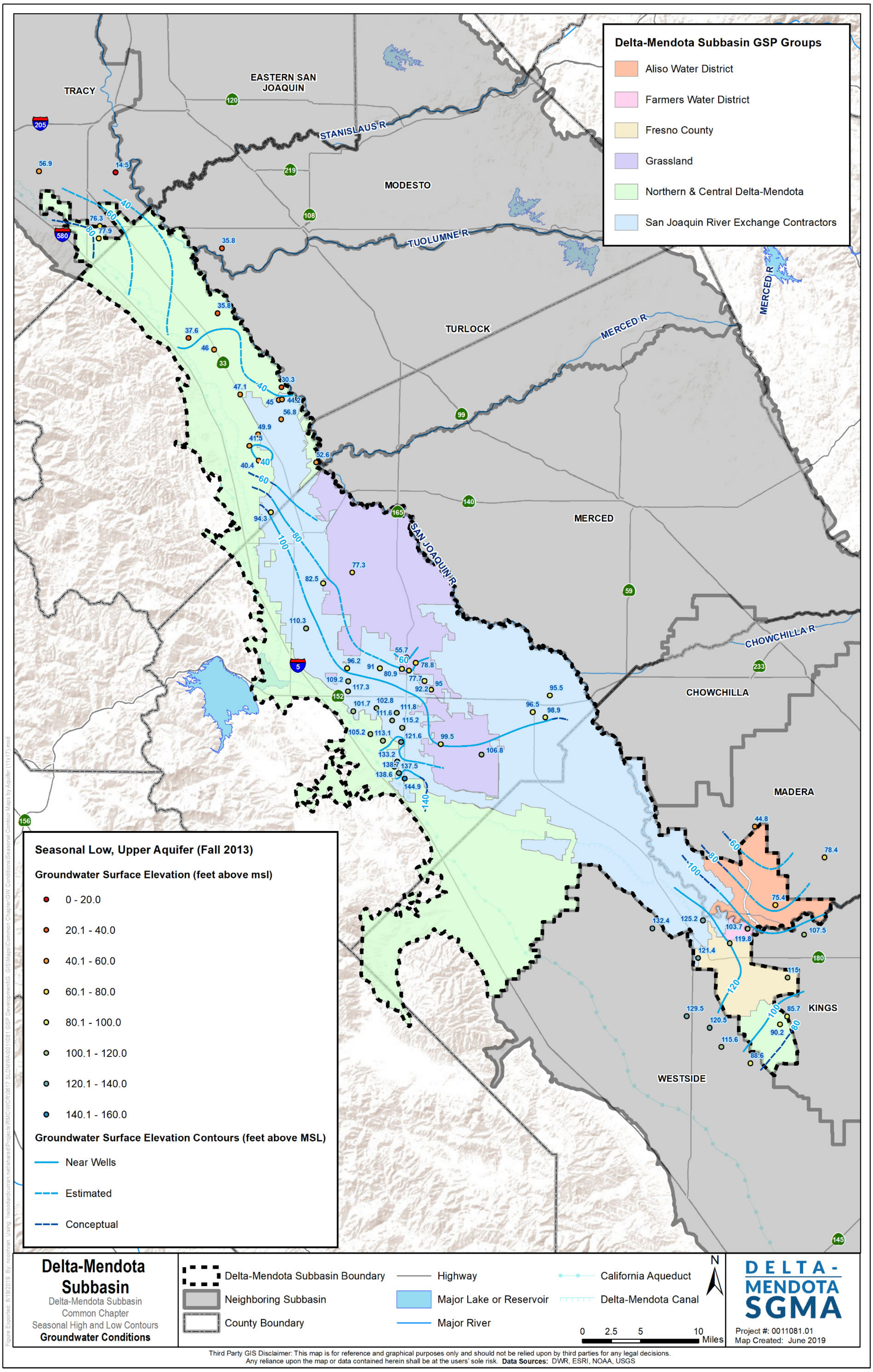


Figure CC-46: Fall 2013 Upper Aquifer Groundwater Contour Map

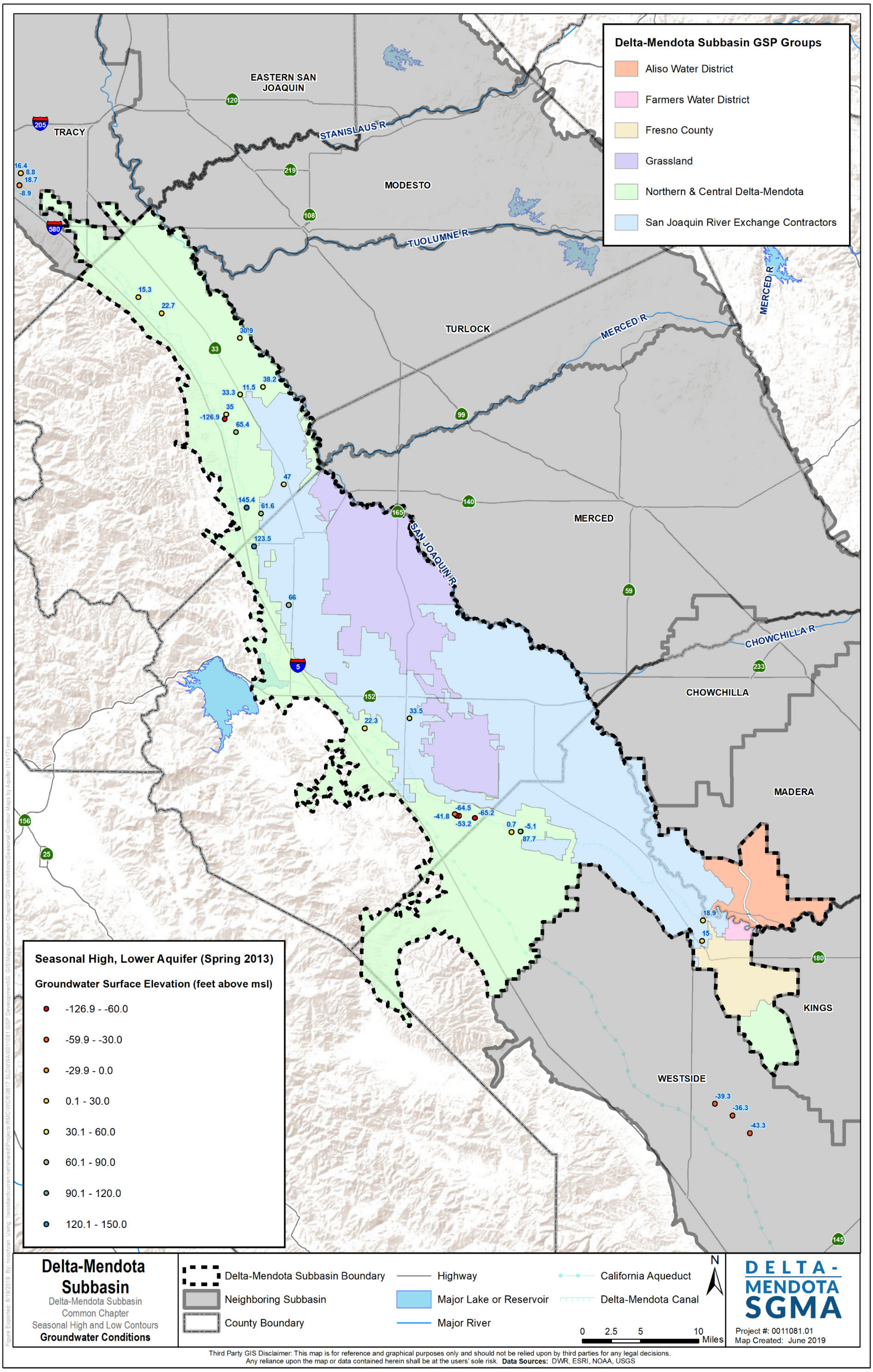


Figure CC-47: Spring 2013 Lower Aquifer Groundwater Elevation Measurements

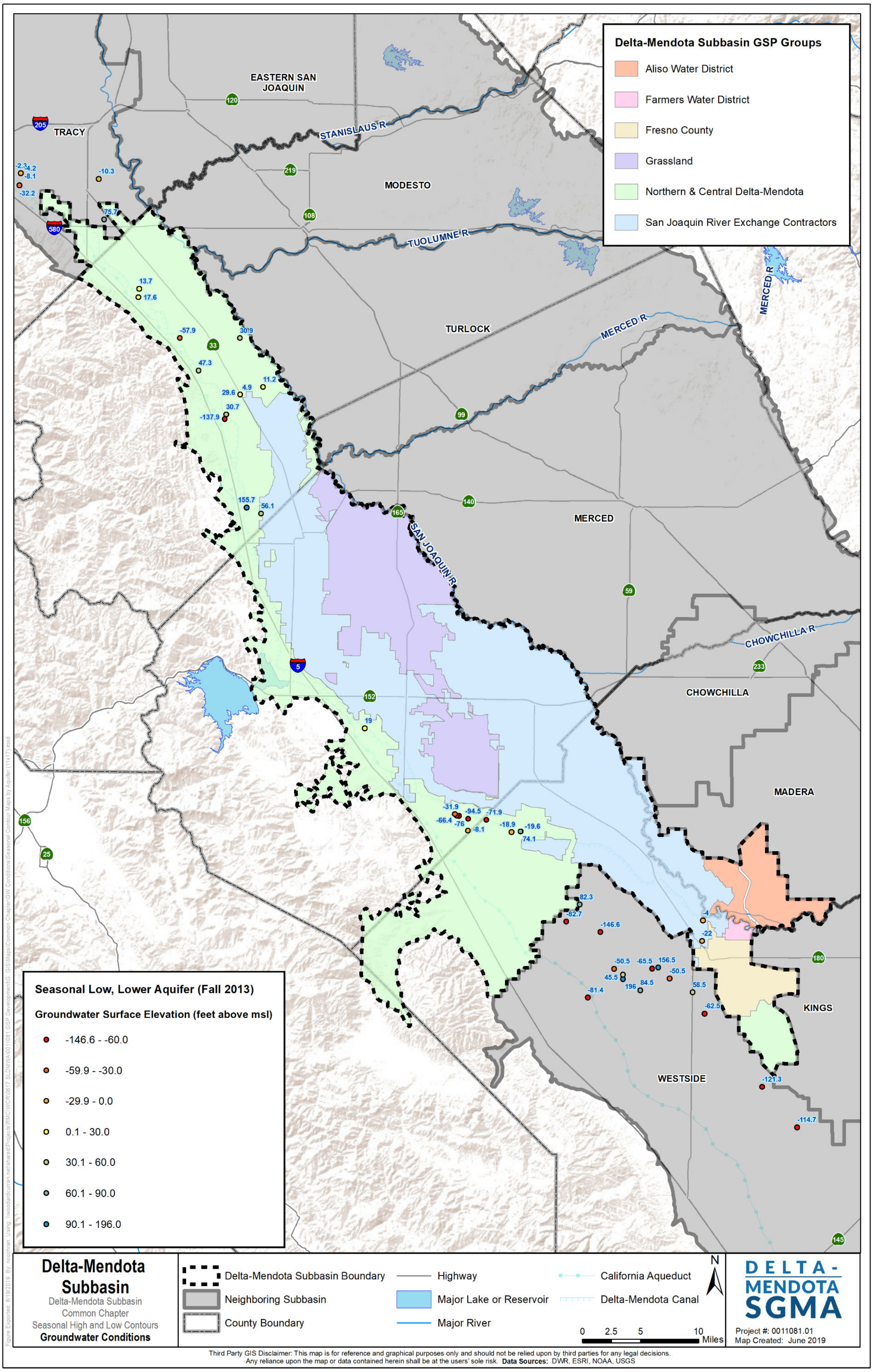


Figure CC-48: Fall 2013 Lower Aquifer Groundwater Elevation Measurements

4.2.3 Groundwater Storage

Annual changes in groundwater storage for both the Upper and Lower Aquifers in the Delta-Mendota Subbasin were estimated as part of the development of the Historic (WY2003-2012), Current (WY2013) and Projected Water Budgets (WY2014-2070). For information on how change in storage was calculated, refer to Section 4.3.2 – Water Budgets of this Common Chapter. **Figure CC-49** and **Figure CC-50** show annual change in storage, cumulative change in storage, and water year type for the Upper Aquifer and Lower Aquifer, respectively, from WY 2003 through 2013 for the Delta-Mendota Subbasin. For the purposes of the water budget four water year types were utilized, wet, average (corresponding to above and below normal water years), dry (corresponding to dry and critical water years) and Shasta critical.

Change in storage is negative for 6 out of the 11-year historic and current water budget period for the Upper Aquifer, and 9 out of 11 years for the Lower Aquifer. Despite periods of wet conditions with recharge outpacing extractions, an overall declining trend in groundwater storage can be observed in both the Upper Aquifer and Lower Aquifer. Cumulative change in storage declined more rapidly in the Upper Aquifer compared to the Lower Aquifer, declining by about 624,0000 AF in the Upper Aquifer and 375,000 AF in the Lower Aquifer between WY2003 to 2013.

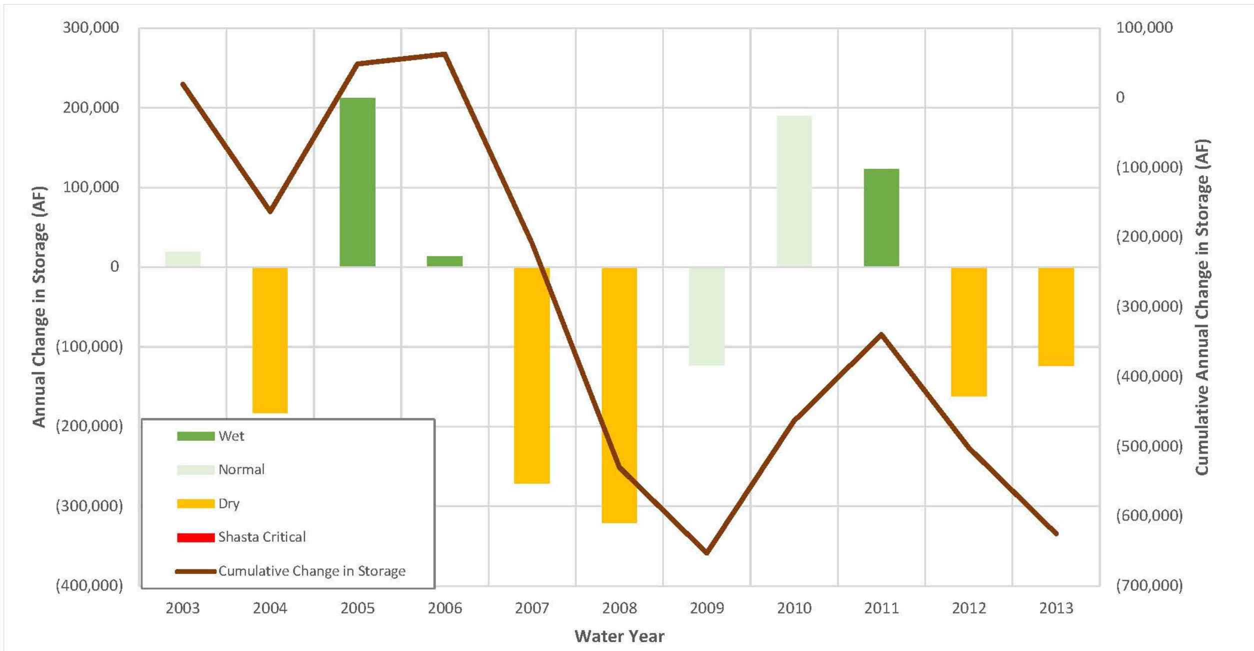


Figure CC-49: Calculated Upper Aquifer Change in Storage, Annual and Cumulative

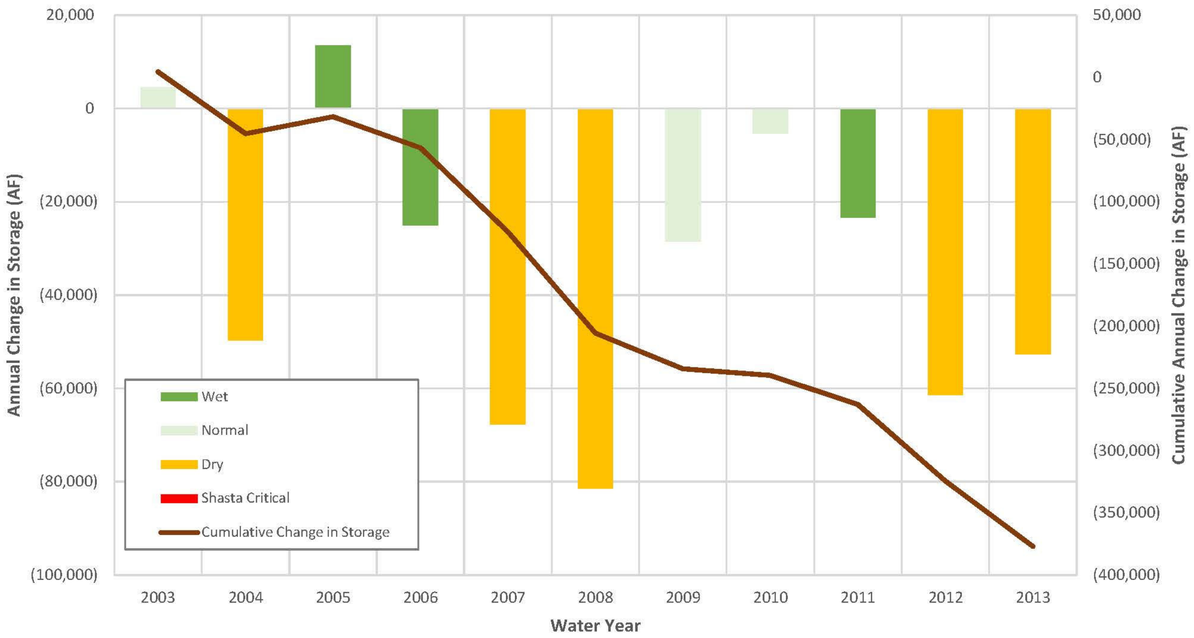


Figure CC-50: Calculated Lower Aquifer Change in Storage, Annual and Cumulative

4.2.4 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator for the Delta-Mendota Subbasin. The Subbasin is located inland from the Pacific Ocean; thus, groundwater conditions related to seawater intrusion are not applicable to the Delta-Mendota Subbasin.

4.2.5 Groundwater Quality

Groundwater quality varies considerably from west to east and north to south throughout the Delta-Mendota Subbasin. In general, Upper Aquifer water quality has historically been impacted by overlying land uses with some areas showing increasing concentrations of nitrate and TDS. Areas of elevated salt concentrations can be found in the Subbasin, generally along the southern portion of the San Joaquin River and in the southern portion of the Subbasin. Lower Aquifer groundwater has, and remains in most cases, to be of generally good quality. For more information about historic and current conditions relative to groundwater quality in each GSP Group area, refer to the individual GSPs.

4.2.6 Land Subsidence

Long-term groundwater level declines can result in a one-time release of “water of compaction” from compacting silt and clay layers (aquitards) resulting in inelastic land subsidence (Galloway et al., 1999). There are several other types of subsidence in the San Joaquin Valley, including subsidence related to hydrocompaction of moisture-deficient deposits above the water table, subsidence related to fluid withdrawal from oil and gas fields, subsidence caused by deep-seated tectonic movements, and subsidence caused by oxidation of peat soils that is a major factor in the Sacramento-San Joaquin Delta (Sneed et al., 2013). However, aquifer-system compaction caused by groundwater pumping causes the largest magnitude and areal extent of land subsidence in the San Joaquin Valley (Poland et al., 1975; Ireland et al., 1984; Farrar and Bertoldi, 1988; Bertoldi et al., 1991; Galloway and Riley, 1999).

Land subsidence is a prevalent issue in the Delta-Mendota Subbasin as it has impacted prominent infrastructure of statewide importance, namely the DMC and the California Aqueduct, as well as local canals, causing serious operational, maintenance, and construction-design issues (Sneed et al., 2013). Reduced freeboard and flow capacity for the DMC and California Aqueduct have rippling effects on imported water availability throughout the State. Even small amounts of subsidence in critical locations, especially where canal gradients are small, can impact canal operations (Sneed and Brandt, 2015). While some subsidence is reversible (referred to as elastic subsidence), inelastic or irreversible subsidence is caused mainly by pumping groundwater from below the Corcoran Clay, thus causing compaction and reducing storage in the fine-grained materials in the lower confined aquifer as well as damaging well infrastructure. As a result, important and extensive damages and repairs have resulted in the loss of conveyance capacity in canals that deliver water or remove floodwaters, the realignment of canals as their constant gradient becomes variable, the raising of infrastructure such as canal check stations, and the releveling of furrowed fields.

Available Data

There are six UNAVCO Continuous GPS (CGPS) locations that monitor subsidence within the Delta-Mendota Subbasin (**Figure CC-51**). Changes in land surface elevation have also been measured at DMC Check Structures. **Figure CC-52** through **Figure CC-57** show the vertical change in land surface elevation from a given time point (specified on charts) for the UNAVCO CGPS stations within the Delta-Mendota Subbasin, along with annual CVP allocations. **Table CC-5** summarizes the greatest monthly land subsidence rate and corresponding year(s) of that change at each UNAVCO CGPS station. Overall, the greatest monthly subsidence rates occurring after January 1, 2015 occurred during the Spring of 2016 to the Spring of 2017. Land subsidence rates (in feet per year), as measured by USBR from December 2011 to December 2014, are shown in **Figure CC-58**. Based on these data, within the majority of the Delta-Mendota Subbasin, annual subsidence rates were between -0.15 and -0.3 feet/year during this period (or between -0.45 and -0.9 feet of total subsidence over this three-year period).

Table CC-5: Subsidence Monitoring Trends
UNAVCO CGPS Stations

Station ID	Greatest Monthly Land Subsidence Rate as of January 1, 2015 (feet)	Year(s) of Greatest Monthly Subsidence Rate
P255	-0.0292	Spring 2016 to 2017
P259	-0.0183	Spring 2016 to 2017
P252	-0.033	Spring 2016 to 2017
P303	-0.2190	Spring 2016 to 2017
P301	-0.0029	Spring 2016 to 2017
P304	-0.0003	Spring 2013 to 2017

Historic Conditions

Along the DMC, in the northern portion of the San Joaquin Valley, extensive groundwater extraction from unconsolidated deposits caused subsidence exceeding 8.5 meters (or about 28 feet) between 1926 and 1970 (Poland et al., 1975), reaching 9 meters (or about 30 feet) in 1980 (Ireland, 1986). Land subsidence from groundwater pumping began in the San Joaquin Valley in the mid-1920s (Poland et al., 1975; Bertoldi et al., 1991; Galloway and Riley, 1999), and by 1970, about half of the San Joaquin Valley had land subsidence of more than 0.3 meters (or about 1 foot) (Poland et al., 1975). When groundwater pumping decreased in the Delta-Mendota Subbasin following imported water deliveries from the CVP via the DMC in the early 1950s, compaction rates were reduced in certain areas and water levels recovered. Notable droughts of 1976-1977 and 1987-1992 saw renewed compaction during these periods, with increased groundwater pumping as imported supplies were reduced or unavailable. However, following these droughts, compaction virtually ceased, and groundwater levels rose to near pre-drought levels quite rapidly (Swanson, 1998; Galloway et al., 1999).

Subsidence contours for 1926-1970 (Poland et al., 1975) show the area of maximum active subsidence was southwest of the community of Mendota. Historical subsidence rates in the Mendota area exceeded 500 millimeters/year (or about 20 inches/year) during the mid-1950s and early 1960s (Ireland et al., 1984). The area southwest of Mendota has experienced some of the highest levels of subsidence in California, where from 1925 to 1977, this area sustained over 29 feet of subsidence (USGS, 2017). Historical subsidence rates along Highway 152 calculated from leveling-survey data from 1972, 1988, and 2004 show that for the two 16-year periods (1972-1988 and 1988-2004), maximum subsidence rates of about 50 millimeters/year (or about 2 inches/year) were found just south of El Nido (Sneed et al., 2013). Geodetic surveys completed along the DMC in 1935, 1953, 1957, 1984, and annually from 1996-2001 indicated that subsidence rates were greatest between 1953 and 1957 surveys, and that the maximum subsidence along the DMC (about 3 meters, or about 10 feet) was just east of DMC Check Structure Number 18.

After 1974, land subsidence was demonstrated to have slowed or largely stopped (DWR, June 2017); however, land subsidence remained poised to resume under certain conditions. Such an example includes the severe droughts that occurred between 1976 and 1977 and between 1987 and 1991. Those droughts, along with other corroborating factors, led to diminished deliveries of imported water which prompted some water agencies and farmers (especially in the western Valley) to refurbish old pumps, drill new water wells, and begin pumping groundwater to make up for cutbacks in the imported water supply. The decisions to renew groundwater pumping were encouraged by the fact that groundwater levels had recovered to near-predevelopment levels. CGPS data collected between 2007 to 2014 show seasonally variable subsidence and compaction rates, including uplift as elastic rebound occurs during the fall and winter (Sneed and Brandt, 2015). Vertical displacement at P303, near Los Banos, indicates subsidence at fairly consistent rates during and between drought periods (Sneed and Brandt, 2015). Vertical displacement at P304, near Mendota, indicates that most subsidence occurred during drought periods with very little occurring between drought periods. Finally, data from extensometers 12S/12E-16H2, located on the DMC west of Los Banos, and 14S/13E-11D6, located between the DMC and California Aqueduct west of Mendota, showed subsidence rate increases during 2014, the third year of the most recent drought (Sneed and Brandt, 2015).

Subsidence impacts to the California Aqueduct, which runs parallel and in close proximity to the Delta-Mendota Canal across the Subbasin, is of statewide importance. During the construction of the California Aqueduct, it was thought that subsidence within the San Joaquin Valley would cease with the delivery of water from the Central Valley Project, though additional freeboard was incorporated into the design and construction of the Aqueduct in an attempt to mitigate for future subsidence (DWR, June 2017). After water deliveries from the Aqueduct began, subsidence rates decreased to an average of less than 0.1 inches/year during normal to wet hydrologic years. During dry to critical hydrologic years, subsidence increased to an average of 1.1 inches per year. The 2012-2015 drought produced subsidence similar to those seen before the Aqueduct began delivering water, with some areas experiencing nearly 1.25 inches of sinking per month (based on NASA UAVSAR flight measurements). Dry and critically dry water years since Aqueduct deliveries began have resulted in extensive groundwater withdrawals, causing some areas near the Aqueduct to subside nearly 6 feet.

Current Conditions

Based on subsidence rates observed over the last decade, it is anticipated that without mitigation, subsidence will continue to impact operations of the DMC and California Aqueduct. For example, recently, Reach 4A of the San Joaquin River near Dos Palos experienced between 0.38 and 0.42 feet/year in subsidence between 2008 and 2016. As a result of subsidence, freeboard in Reach 4A is projected to be reduced by 0.5 foot by 2026 as compared to 2016, resulting in a 50 percent reduction in designed flow capacity (DWR, May 2018). Reduced flow capacities in the California Aqueduct will impact deliveries and transfers throughout the State and result in the need to pump more groundwater, thus contributing to further subsidence.

More recent subsidence measuring indicates subsidence hot spots within the Subbasin include the area east of Los Banos and the Tranquillity Irrigation District (TRID) area. USGS began periodic measurements of the land surface in parts of the San Joaquin Valley over the last decade. Between December 2011 and December 2014, total subsidence in the area east of Los Banos, located within the Merced Subbasin (also referred to as the El Nido-Red Top area), over the three-year period ranged from 0.15 to 0.75 feet, or 1.8 to 9 inches respectively (KDSA, 2015). The Jet Propulsion Laboratory (JPL) at the California Institute of Technology has also been monitoring subsidence in California using interferometric synthetic aperture radar (or InSAR), and a recent progress report documenting data for the period from May of 2015 to September of 2016 indicates that the two previously-identified primary subsidence areas near the community of Corcoran and centered on El Nido was joined by a third area of significant subsidence near TRID. For the study period (as shown in **Figure CC-59**), maximum total subsidence of 22 inches was measured near Corcoran, while the El Nido area subsided 15 inches and the TRID area subsided around 20 inches. Analyses at two particular stations near El Nido show interesting trends. At Station P303, between 2007 and 2014, 50 mm (or nearly 2 inches) of subsidence occurred at this location. Vertical displacement at P303 (**Figure CC-55**) show subsidence at fairly consistent rates during and between drought periods, indicating that these areas continued to pump groundwater despite climatic variations (possibly due to a lack of surface water availability) (Sneed and Brandt, 2015). Residual compaction may also be a factor. Vertical displacement at Station P304 indicated that most subsidence in this particular area occurred during drought periods and very little occurred between drought periods (**Figure CC-57**). This suggests that this area received other sources of water (most likely surface water available between drought periods) and that residual compaction was not very important in this area. These two areas demonstrate a close link between the availability of surface water, groundwater pumping, and inelastic land subsidence.

Total land subsidence from April 2015 to April 2016 in the San Joaquin Valley is shown in

Figure CC-60: Vertical Displacement, April 2015 to April 2016 . Subsidence monitoring in the Delta-Mendota Subbasin, and in the San Joaquin Valley as a whole, demonstrated significant inelastic land subsidence as a result of the last drought, with effects continuing to the present time (as evidenced by continued subsidence between 2016 and 2018 through surveys of the DMC). While the impacts appeared to have slowed, the temporal and spatial impacts of continued subsidence have not yet been evaluated.

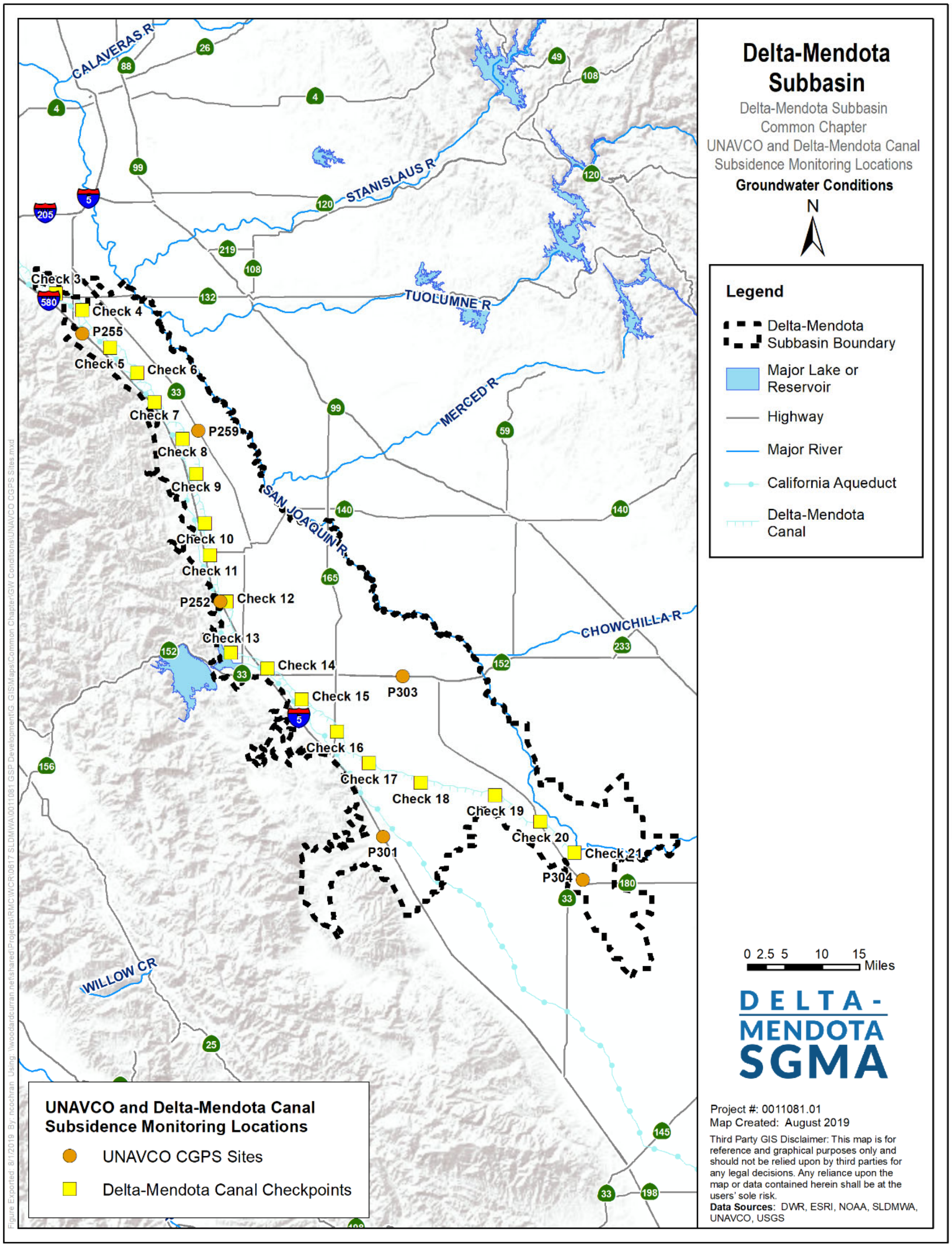


Figure CC-51: UNAVCO and Delta-Mendota Canal Subsidence Monitoring Locations

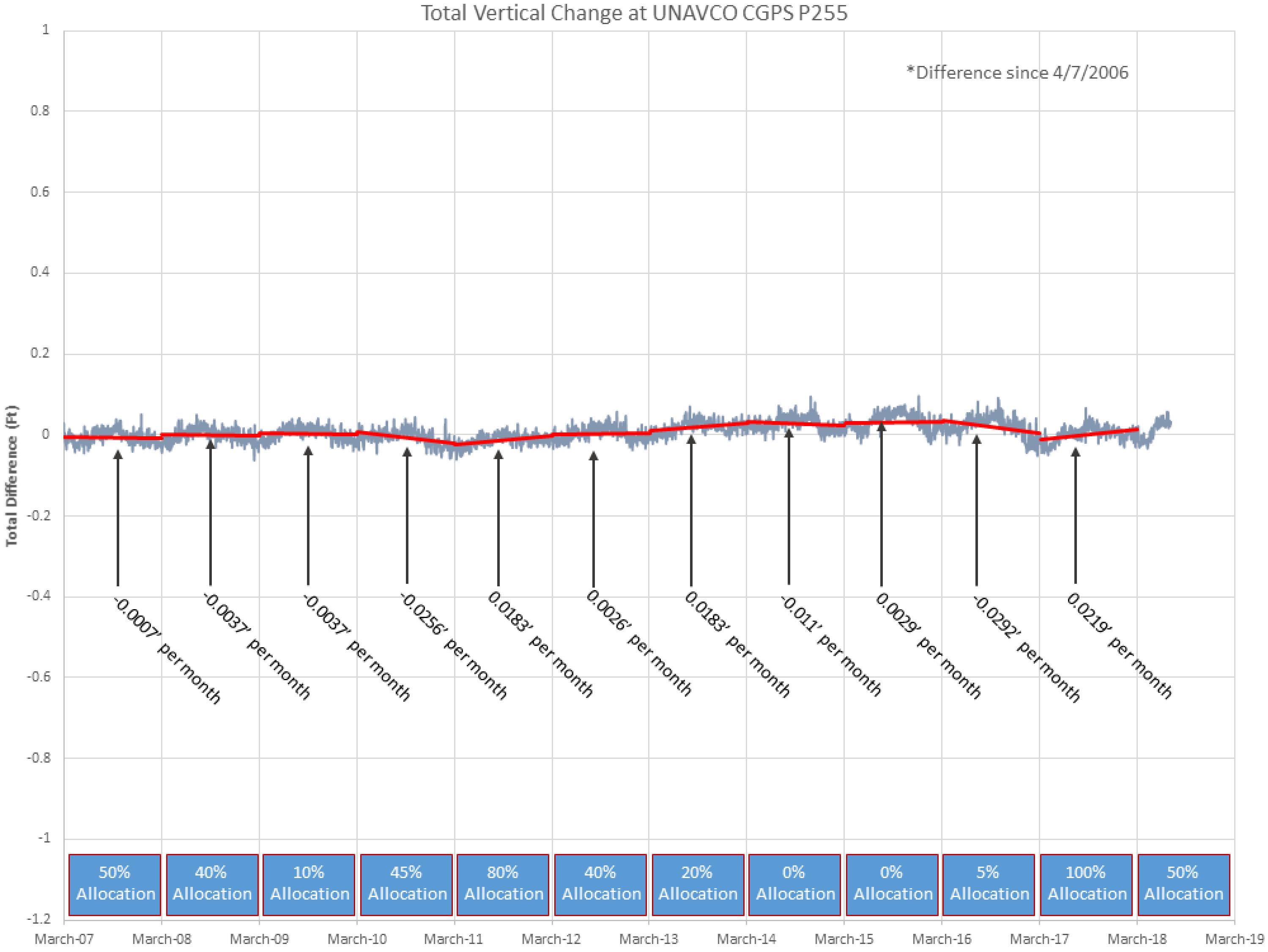


Figure CC-52: Vertical Elevation Change at UNAVCO CGPS P255, Spring 2007 to 2018

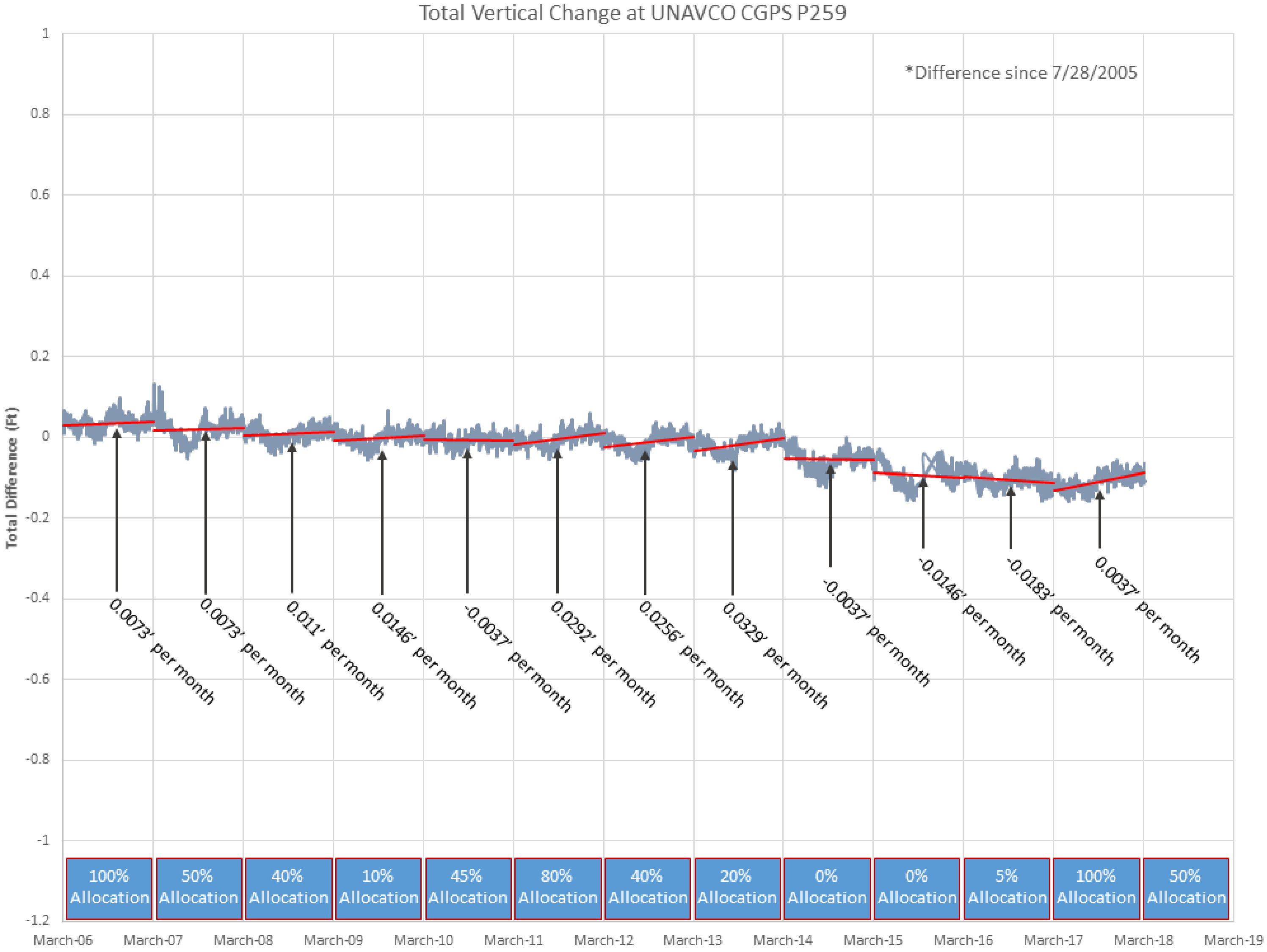


Figure CC-53: Vertical Elevation Change at UNAVCO CGPS P259, Spring 2006 to 2018

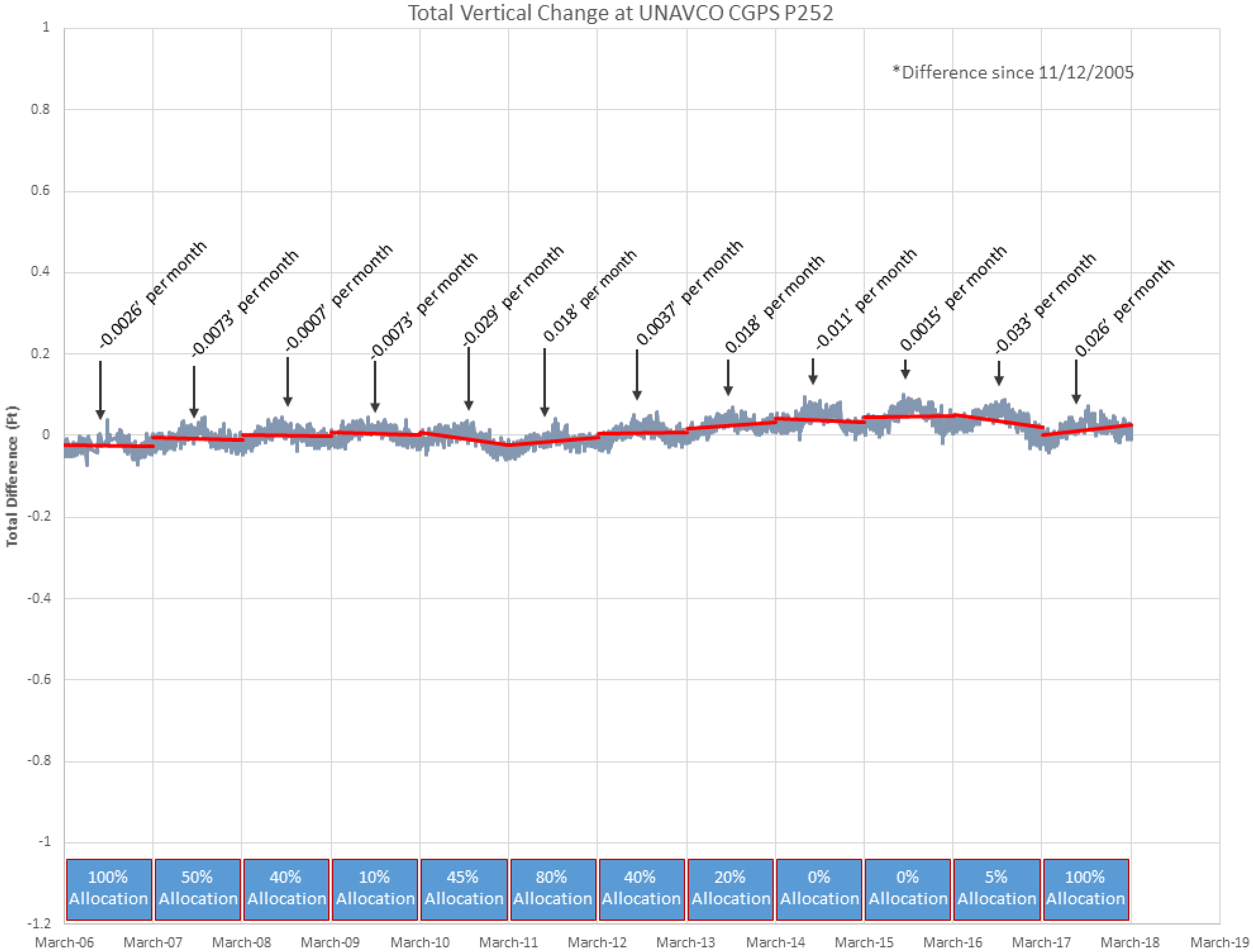


Figure CC-54: Vertical Elevation Change at UNAVCO CGPS P252, Spring 2006 to 2018

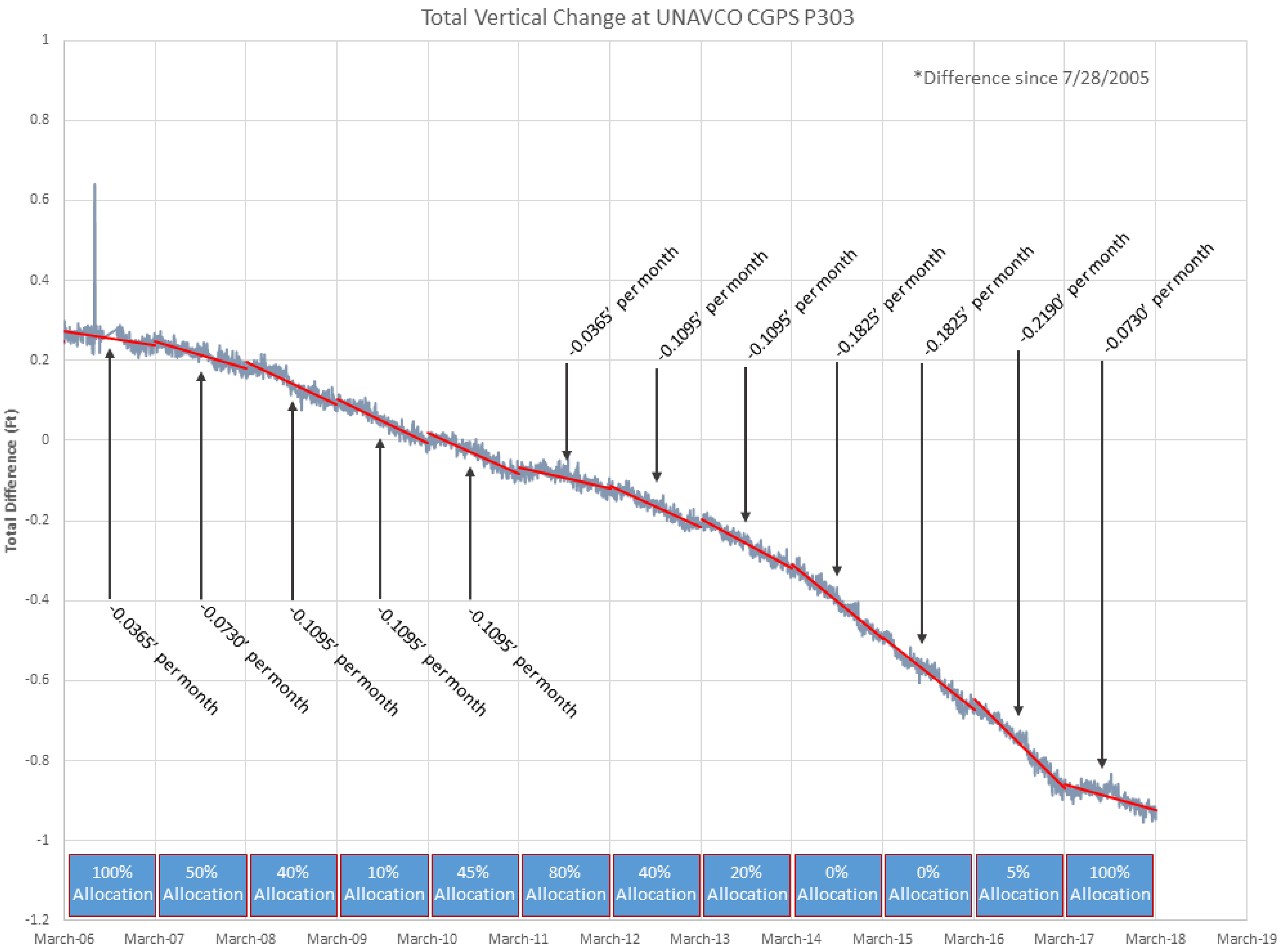


Figure CC-55: Vertical Elevation Change at UNAVCO CGPS P303, Spring 2006 to 2018

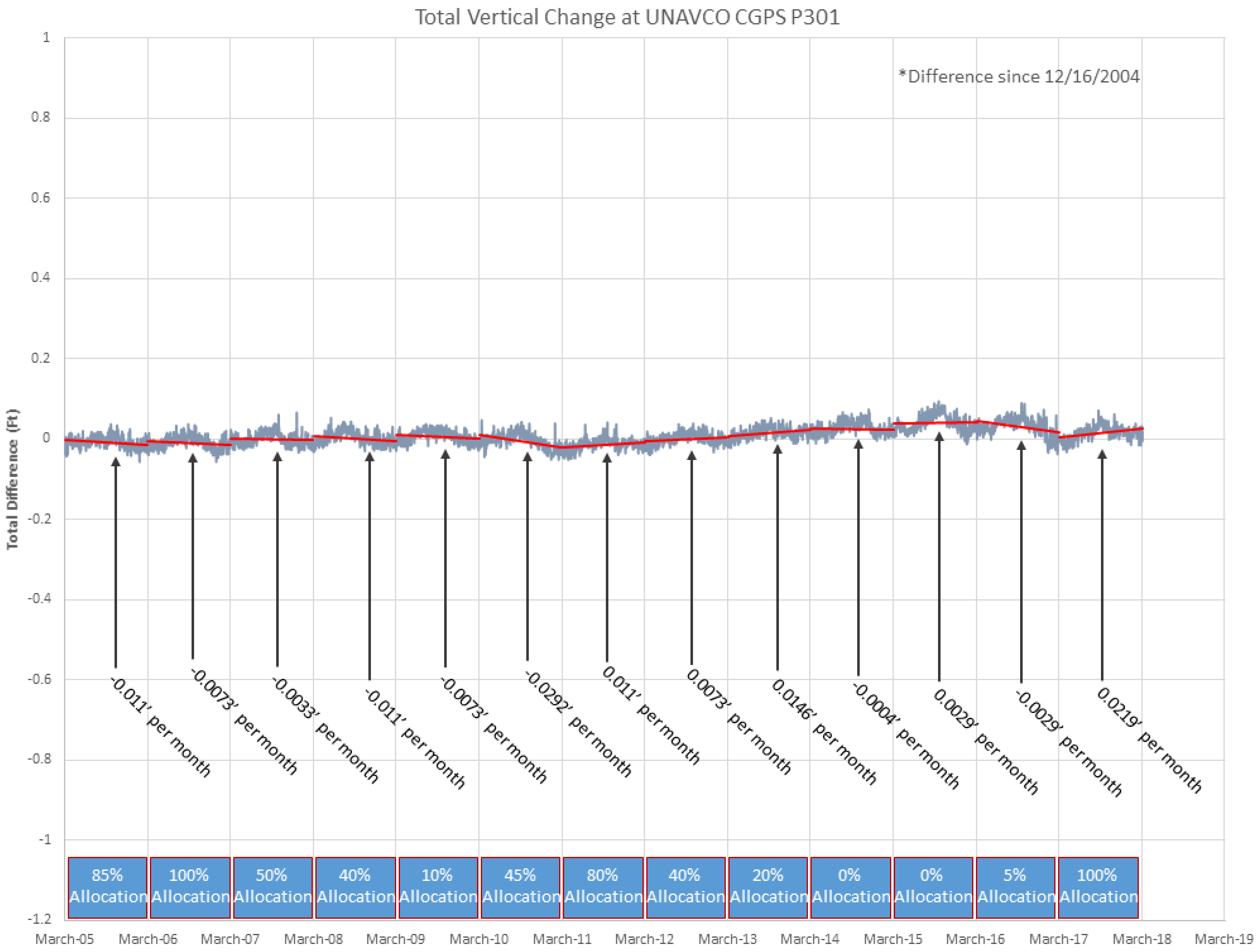


Figure CC-56: Vertical Elevation Change at UNAVCO CGPS P301, Spring 2005 to 2018

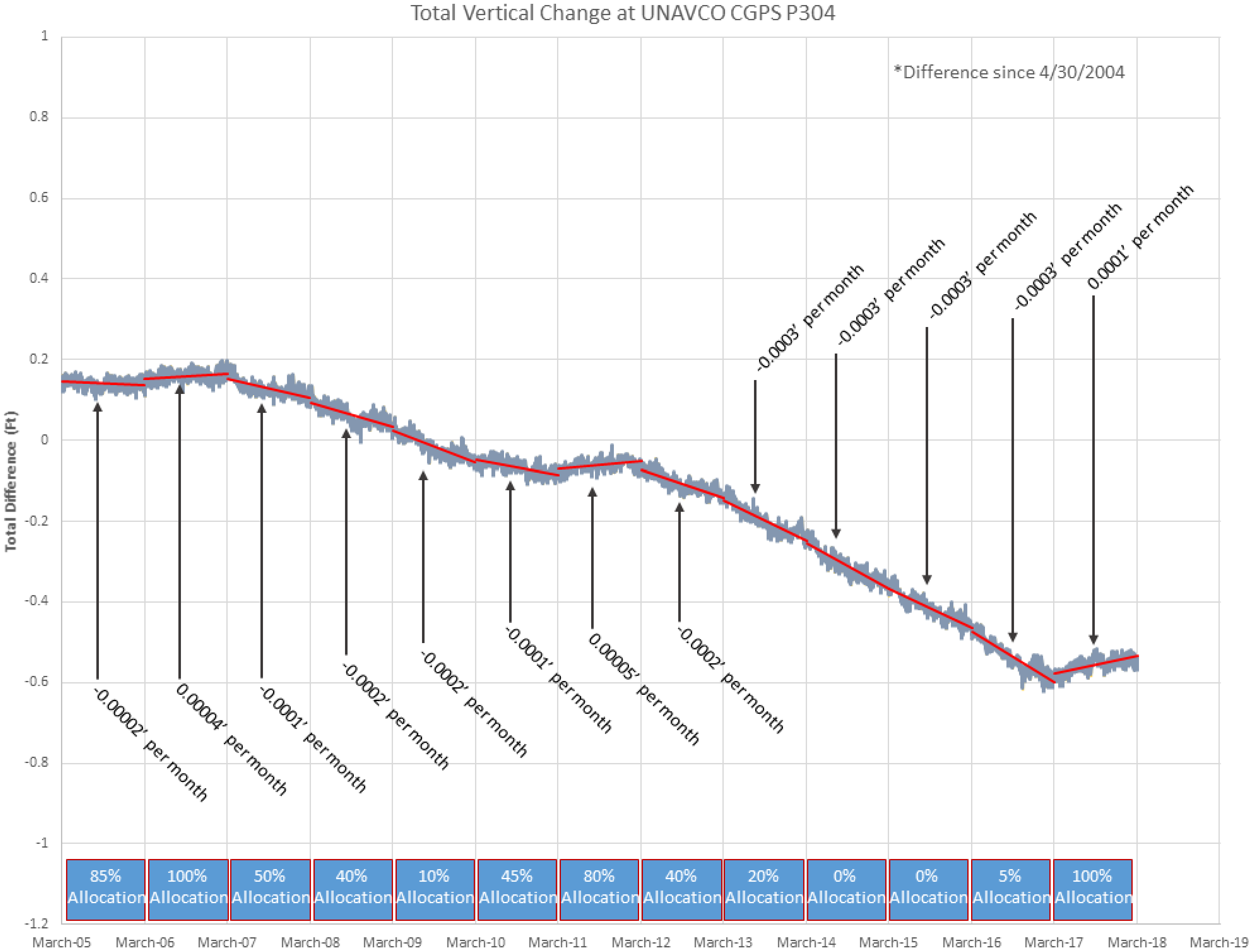


Figure CC-57: Vertical Elevation Change at UNAVCO CGPS P304, Spring 2005 to 2018

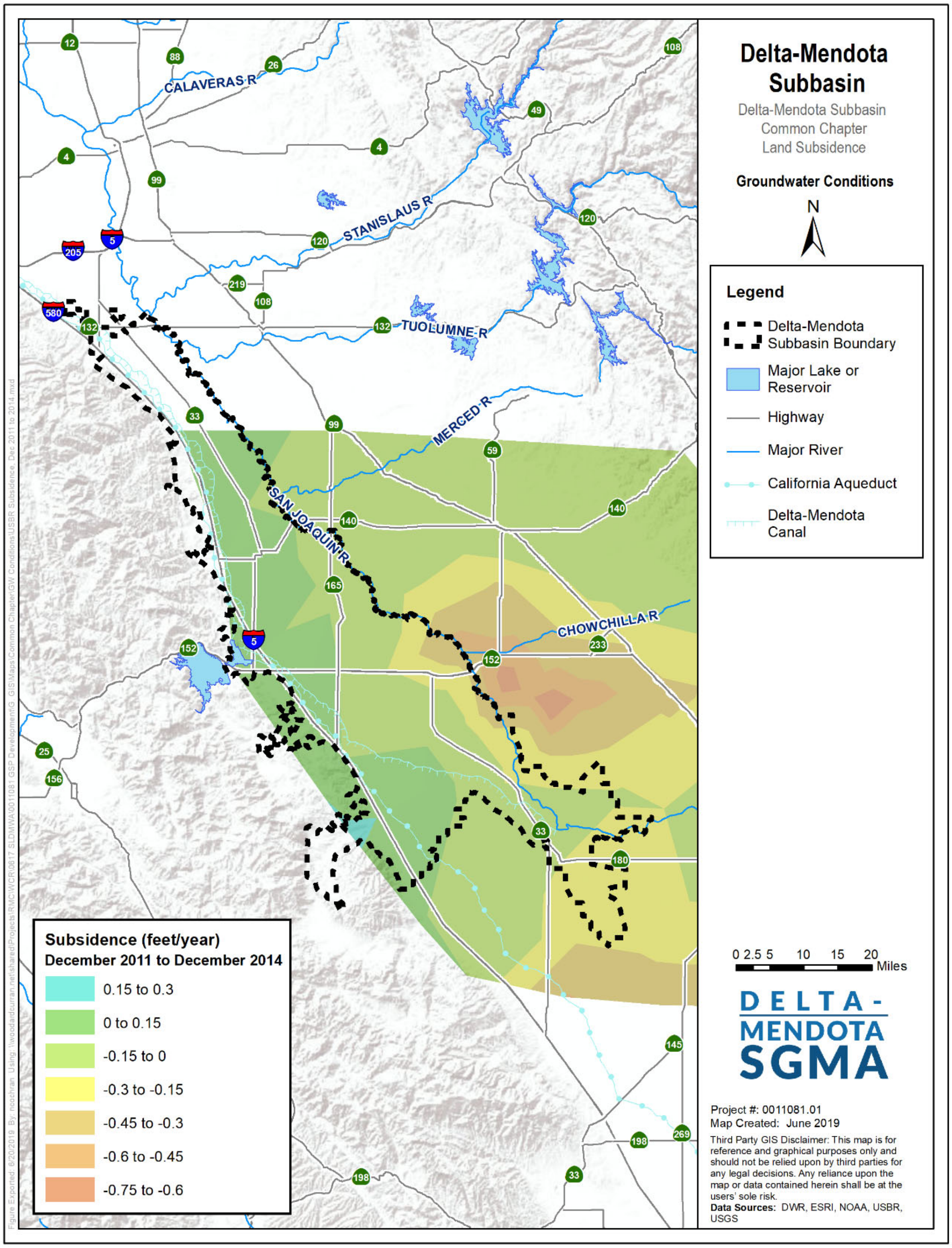


Figure CC-58: Land Subsidence, December 2011 to December 2014

Source: Progress Report: Subsidence in California, March 2015 – September 2016, Farr et. Al. JPL, 2017

Figure CC-59: Recent Land Subsidence at Key San Joaquin Valley Locations

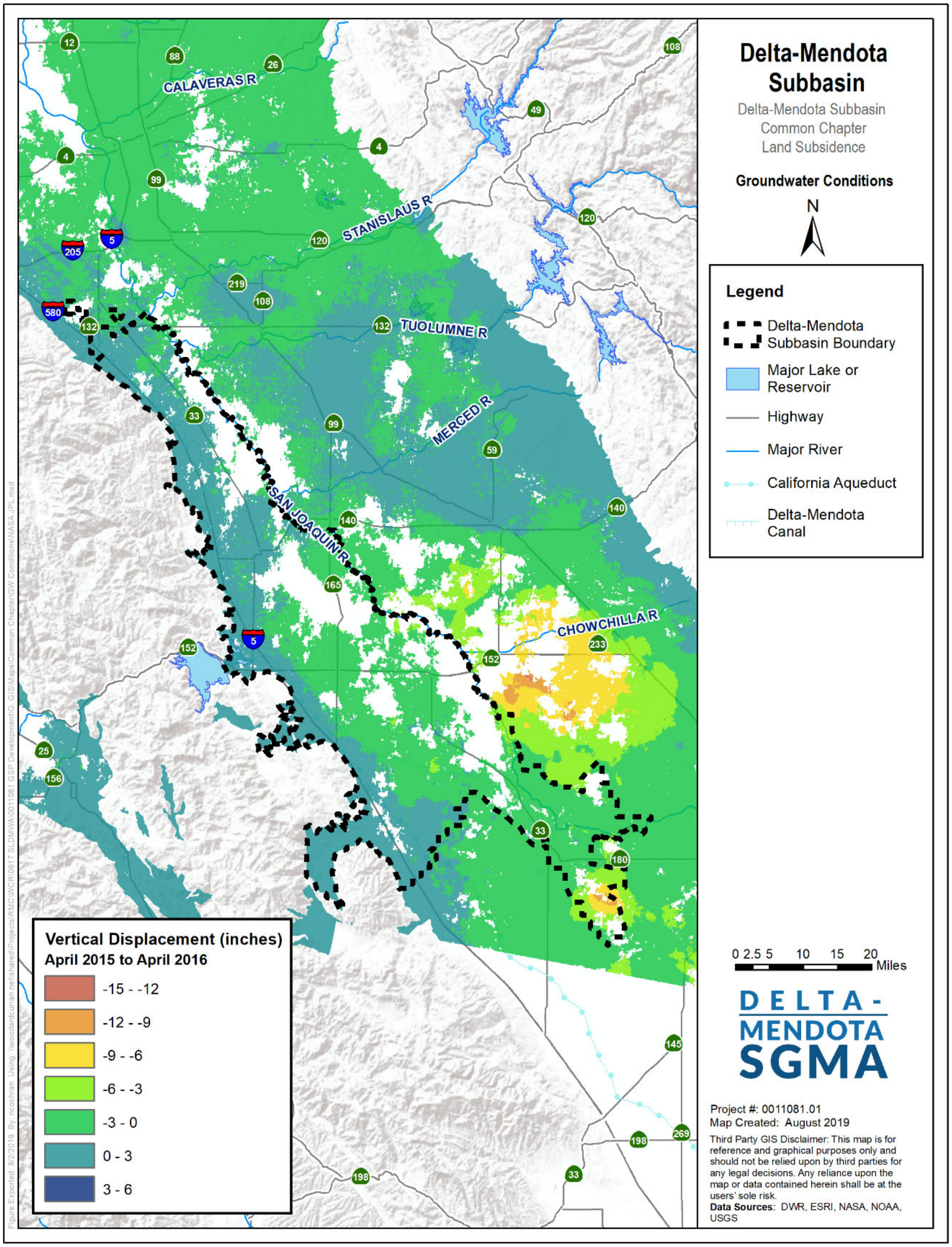


Figure CC-60: Vertical Displacement, April 2015 to April 2016

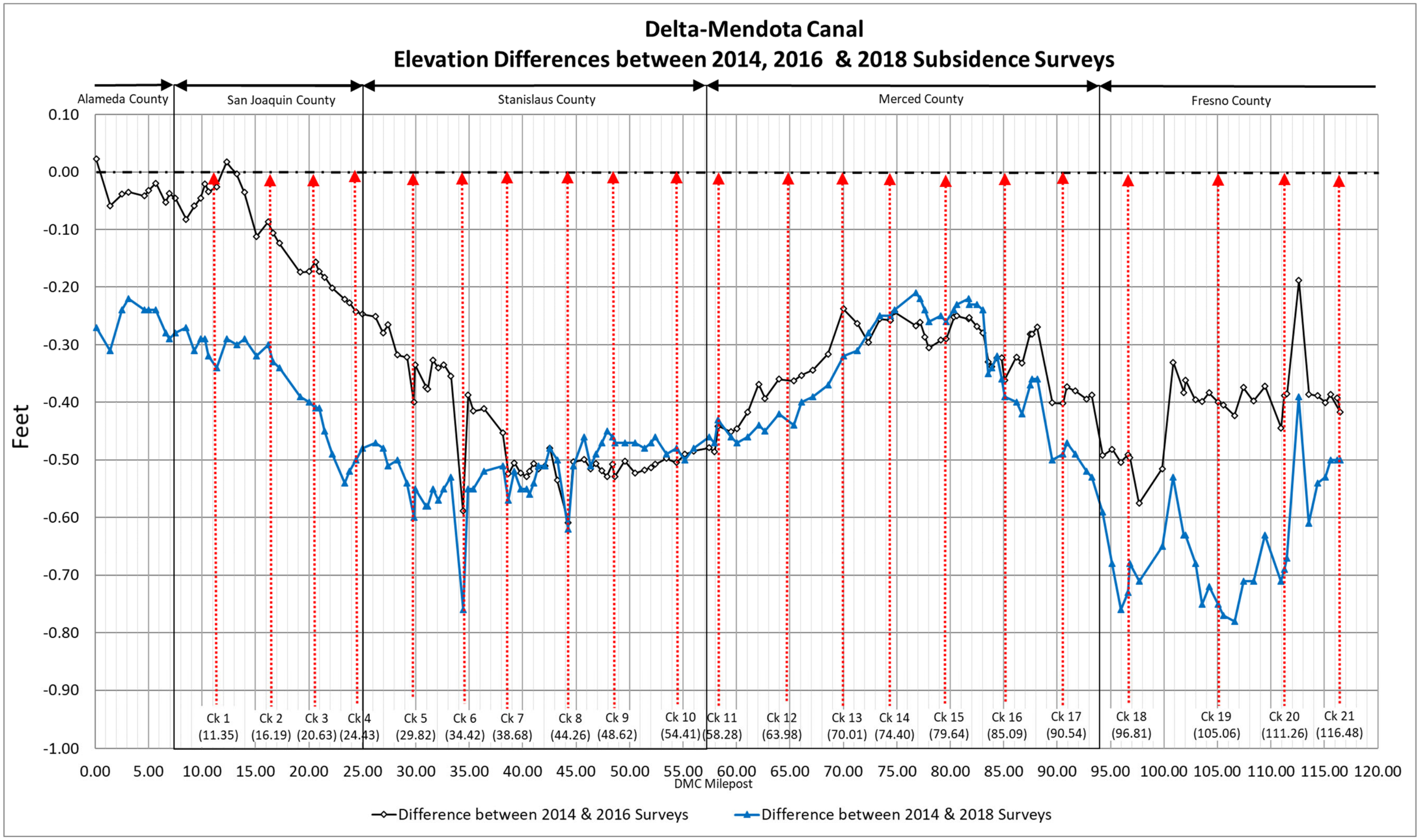


Figure CC-61: Elevation Change along the Delta-Mendota Canal, 2014 through 2018

4.2.7 Interconnected Surface Water Systems

Understanding the location, timing and magnitude of groundwater pumping impacts on interconnected surface water systems is important for the proper management of groundwater resources in order to minimize impacts on interconnected surface waters and the biological communities and permitted surface water diverters that rely on those resources. Historically, throughout the San Joaquin Valley, many interconnected stream reaches have transitioned from net-gaining to net-losing streams (TNC, 2014). Gaining streams occur when streamflows increase as a result of groundwater contribution and losing streams occur when streamflows decrease due to infiltration into the bed of the stream (McBain & Trush, Inc., 2002). Increased groundwater pumping has the ability to contribute to the depletion of interconnected waters with the nature, rate, and location of increased pumping being a function of distance to the river, as well as depth, timing, and rate of groundwater pumping.

Available Data

Two communities in the Delta-Mendota Subbasin are likely most vulnerable to the loss of interconnected surface water as a result of groundwater pumping: San Joaquin River surface water diverters and groundwater dependent ecosystems (GDEs). These communities represent the primary beneficial users of interconnected surface water and groundwater. Streams stemming from the west side of the Delta-Mendota Subbasin are ephemeral in nature, and only two of these creeks reach the San Joaquin River (Del Puerto Creek and Orestimba Creek). These creeks lose their flows to the underlying vadose zone (net-losing streams) and therefore do not represent areas of potential GDEs.

Groundwater dependent ecosystems are defined under Article 2 Definitions, § 351 Definitions of the GSP Emergency Regulations as “ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.” The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018) provided by DWR in conjunction with The Nature Conservancy (TNC) was initially used to identify GDEs within the Delta-Mendota Subbasin, following the associated guidance document provided by TNC (Rohde et al., 2018). Local verification efforts were conducted in the Delta-Mendota Subbasin by different GSA representatives to ground-truth GDEs based on local knowledge. Specifically, areas where natural communities have been urbanized or otherwise modified prior to 2015 were eliminated from the data set used to identify GDEs.

Identification of Interconnected Surface Water Systems

The San Joaquin River and Fresno Slough are the primary surface water bodies interconnected with Delta-Mendota Subbasin groundwater. For information about the sources used to determine the interconnected segments of the San Joaquin River and Fresno Slough within the Delta-Mendota Subbasin, refer to the individual GSPs.

Historic Conditions

The San Joaquin River and its tributaries drain approximately 13,500 mi^2 (measured at the USGS gaging station at Vernalis) along the western flank of the Sierra Nevada and eastern flank of the Coast Range, and flows northward into the Sacramento-San Joaquin Delta where it is joined by the Calaveras and Mokelumne Rivers before combining with the Sacramento River. Typical of Mediterranean climate catchments, river flows vary widely seasonally and from year to year. Three major tributaries join the San Joaquin from the east: the Merced, Tuolumne, and Stanislaus Rivers. Smaller tributaries include the Fresno River, Chowchilla River, Bear Creek, and Fresno Slough (from the Kings River). Precipitation is predominantly snow above about 5,500 to 6,000 feet in the Sierra Nevada, with rain in the middle and lower elevations of the Sierra foothills and in the Coast Range. As a result, the natural hydrology historically reflected a mixed runoff regime dominated by winter-spring rainfall runoff and spring-summer snowmelt runoff. Most flow is derived from snowmelt from the Sierra Nevada, with relatively little runoff contributed from the western side of the drainage basin in the rain shadow of the Coast Range. The unimpaired average annual water yield (WY1906-2002) of the San Joaquin River, as measured immediately above Millerton Reservoir, is 1,801,000 acre-feet (USBR, 2002); the post-Friant Dam average annual water yield (WY 1950-2000) to the lower San Joaquin River is 695,500 acre-feet (USGS, 2000). As average precipitation decreases from north to south, the San Joaquin River basin (including the Stanislaus, Tuolumne, and Merced Rivers) contributes about 22% of the total runoff to the Delta (DWR, 1998).

Current Conditions

Historically, most of the San Joaquin River, which forms the great majority of the Delta-Mendota Subbasin's eastern border, was a gaining reach. Snowmelt runoff during the spring and early summer resulted in these conditions through a good portion of the year. However, significant decreases in groundwater elevations due to a myriad of factors, including pumping, tile drains, the channelizing of flood flows, and upstream diversions on the river, have reversed this condition so most reaches are now losing reaches. Some localized gaining reaches still remain on the lower river, such as between the Stanislaus and Merced Rivers; however, many reaches along these rivers (and along localized streams) may transition from gaining to losing depending on hydrology.

Estimates of Timing and Quantity of Depletions

Using available data and where feasible, each Delta-Mendota Subbasin GSP Group quantified the gains and/or losses from the groundwater at each interconnected reach of the San Joaquin River adjoining the Delta-Mendota Subbasin. **Table CC-6** summarizes these estimates. For more information about the sources or methods used to estimate the timing and quantity of depletions, refer to the individual GSPs.

Table CC-6: Estimated Quantity of Gains/Depletions for Interconnected Stream Reaches, San Joaquin River

Landmark		River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
REACH 1		*267.5 to 229.0*	Located outside the Delta-Mendota Subbasin				
A	Friant Dam	267.5					
	North Fork Road Bridge	266.8					
	Cobb Island Bridge	259.0					
	State Route 41 (Lanes Bridge)	255.2					
	Scout Island Bend	250.0					
	ATSF Railroad Bridge	245.0					
B	State Route 99	243.2					
	Southern Pacific Railroad	243.2					
	State Route 145 Bridge (Skaggs Bridge)	234.1					
	Gravelly Ford	229.0					
REACH 2		*229.0 to 204.8*					
A	Gravelly Ford	229.0		Yes	Losing when flowing		
	Upstream Limit of Right Bank Levee	227.0					
	Upstream Limit of Left Bank Levee	225.0					
B	Chowchilla Bypass Control Structure	216.1	Farmers Water District	Yes	Losing when flowing	-4	2003 to 2013 average. High in 2010 (-8 cfs), low in 2004 and 2009 (-1 cfs)
	Mendota Dam	204.8					
	Mendota Pool			Yes	Losing	-40	-29,000 AFY
REACH 3		*204.8 to 182.0*		Yes	Losing	-25	-18.000 AFY
	Mendota Dam	204.8					
	Avenue 7.5 Bridge (Firebaugh)	195.2					
	Sack Dam	182.0					
REACH 4		*182.0 to 135.8*				-–0 - 0	Losses when wet; gaining in some areas (but unquantifiable)
A	Sack Dam	182.0		Y–s - first 2 miles –o - next 1.5 miles Y–s - remaining miles	Losing		
	State Route 152 Bridge	173.9		Yes	Gaining		
B	Sand Slough Control Structure	168.5					
	Mariposa Slough Control Structure	168.4					
	Turner Island Road Bridge	157.2					
	Mariposa Bypass confluence	147.2					

Landmark	River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
Bear Creek/Eastside Bypass confluence	135.8					
REACH 5	*135.8 to 118.0*		Yes	Gaining	unquantifiable	Likely gaining from ag/refuge draining but unquantifiable
Bear Creek/Eastside Bypass confluence	135.8					
State Route 165 Bridge (Lander Avenue)	132.9					
Salt Slough confluence	127.7					
State Route 140 Bridge (Fremont Ford)	125.1					
Mud Slough confluence	121.2					
Merced River confluence (Hills Ferry Bridge)	118.0					
Newman to Crows Landing		Northern & Central Delta-Mendota	Yes	Gaining	50	50
Crows Landing to Patterson		Northern & Central Delta-Mendota Region	Yes	Gaining	-50 to 200	-50 to 200
Patterson to Vernalis		Northern & Central Delta-Mendota Region	Yes	Gaining	190	6.1 cfs/mi for 30.8 miles. Based on Cooley, W. 2001. *Groundwater flow net analysis for lower San Joaquin River Basin.* Memo to CRWQCB, August 8, 2001

Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is defined under the GSP Emergency Regulations as referring “to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface” (§351(m)). Under §354.16(g) of the GSP Emergency Regulations, each Plan is required to identify GDEs within the subbasin utilizing data provided by DWR or the best available information. The following section describes the process for verifying GDEs within the Delta-Mendota Subbasin and the location of verified and potential GDEs.

The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018c) provided by DWR was used in conjunction with information provided by The Nature Conservancy (TNC) to identify GDEs within the Delta-Mendota Subbasin. To further screen available information regarding GDEs, each GSP Group developed individualized criteria. Additional details regarding the screening process implemented by each GSP can be found in the individual GSPs.

Based on the screening process implemented by each individual GSP Group, GDE polygons determined not to be GDEs were removed from the mapping. **Figure CC-62** and **Figure CC-63** summarize the results of the GDE analysis for the Subbasin. Results are compiled into two habitat classes: wetlands (**Figure CC-62**) and vegetation (**Figure CC-63**). Wetland features are commonly associated with surface expression of groundwater under natural, unmodified conditions. Vegetation feature types are commonly associated with the sub-surface presence of groundwater (phreatophytes – deep rooted plants). Confirmed GDEs have been grouped into larger polygons based on proximity and aquifer connection.

In general, identified Possible GDEs are primarily located along the San Joaquin River corridor, within the northern portion of the Northern & Central Delta-Mendota Region GSP, the SJREC GSP, the Grassland GSP, and the Fresno GSP Plan Areas, where some possible GDEs have been identified along ephemeral streams that originate from the Coast Range. Table CC-7 includes all freshwater species within the Delta-Mendota Subbasin as identified by TNC (2018). Per TNC data, these species (listed in Table CC-7) have either been observed or have the potential to exist within the Delta-Mendota Subbasin; however, the actual presence of these species have not been verified. As a result of the identification of Possible GDEs for the purpose of SGMA, no land use protections for GDEs are conveyed unless otherwise required. Additionally, the Delta Mendota Subbasin recognizes the opportunity to present further-refined GDE delineations in the subsequent GSP Updates.

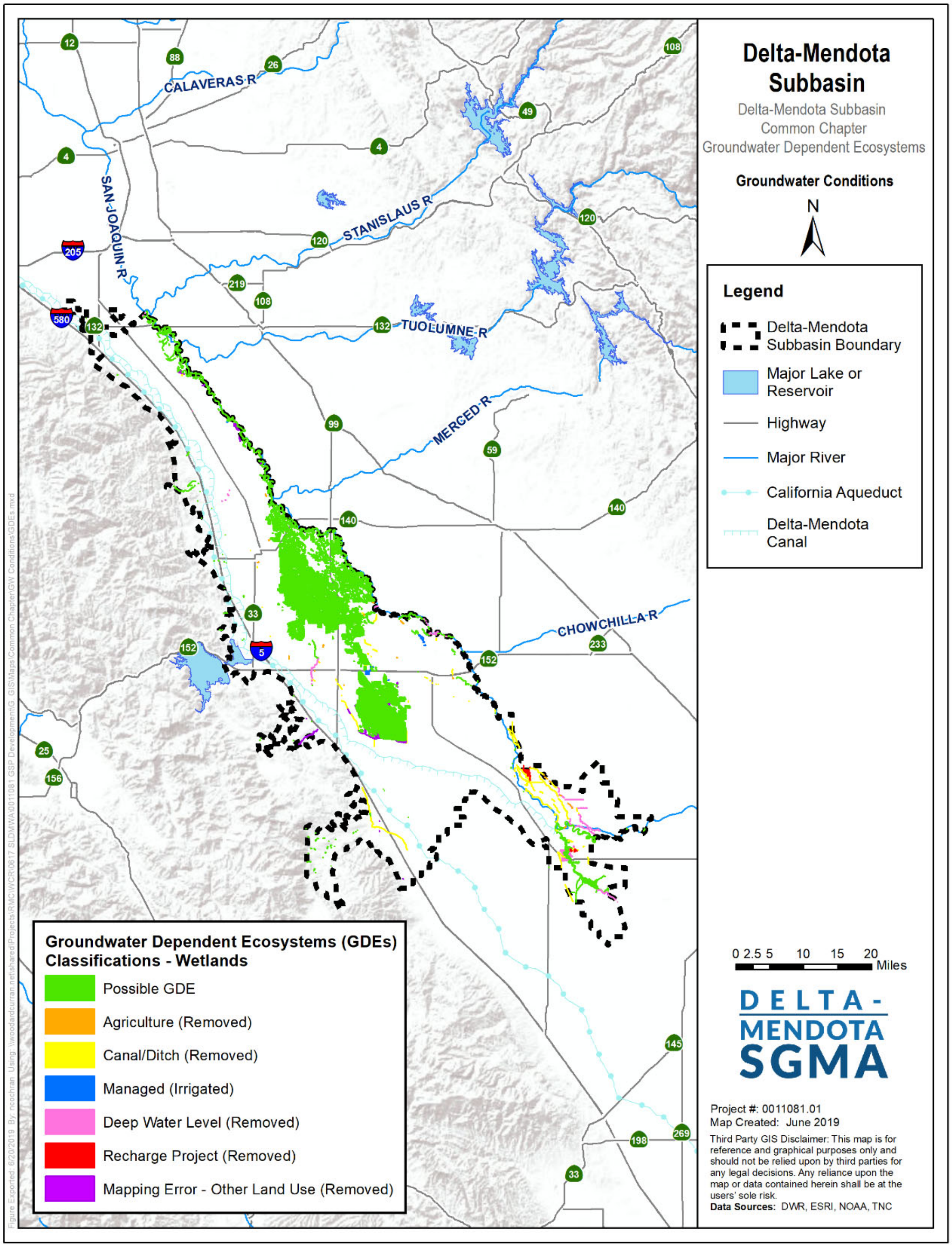
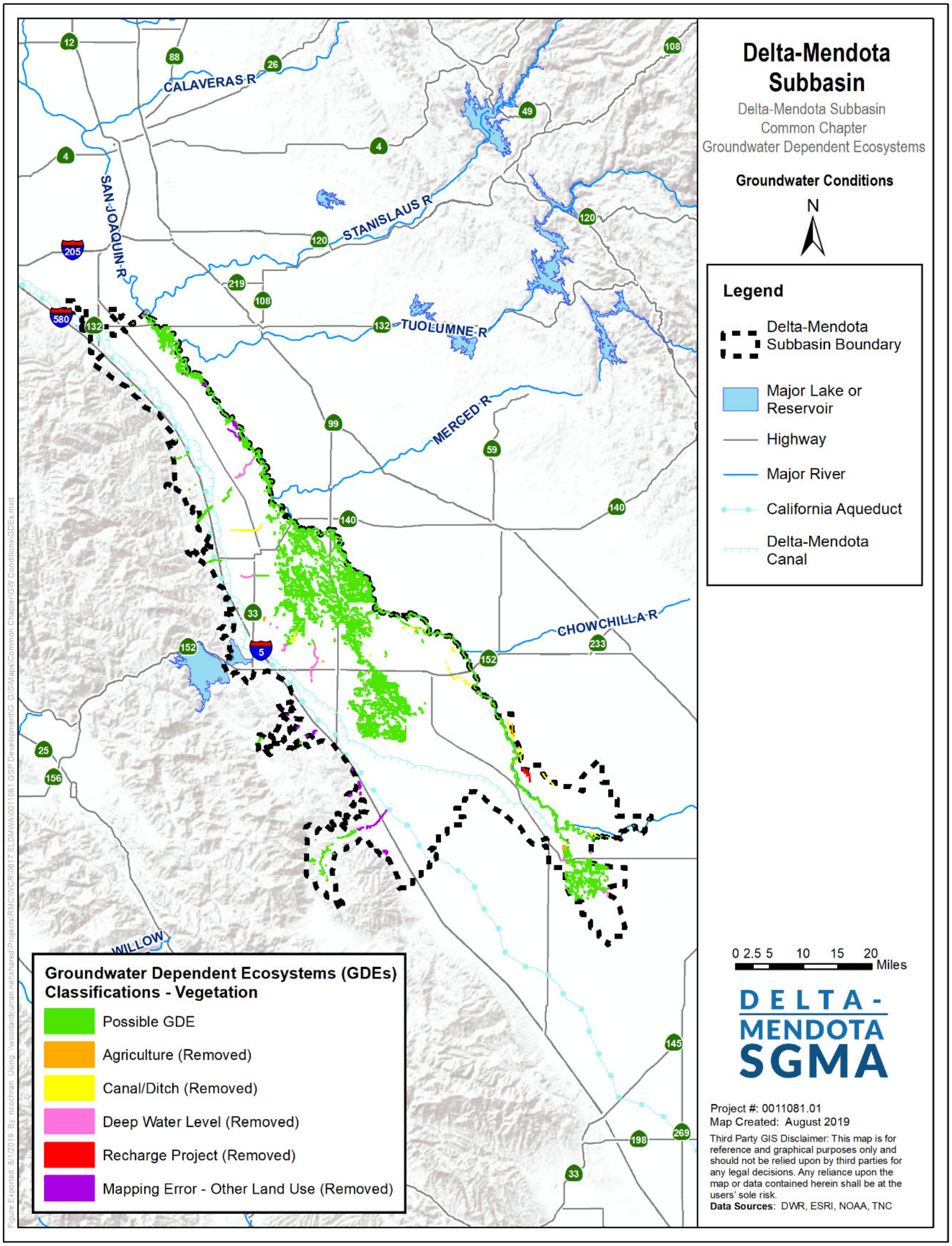


Figure CC-62: Groundwater Dependent Ecosystems, Wetlands



Project #: 0011081.01
Map Created: August 2019

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk.

Data Sources: DWR, ESRI, NOAA, TNC

Figure CC-63: Groundwater Dependent Ecosystems, Vegetation

Table CC-7: List of Potential Freshwater Species

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Actitis macularius	Spotted Sandpiper	Birds		
Aechmophorus clarkii	Clark's Grebe	Birds		
Aechmophorus occidentalis	Western Grebe	Birds		
Agelaius tricolor	Tricolored Blackbird	Birds	Bird of Conservation Concern	Special Concern
Aix sponsa	Wood Duck	Birds		
Anas acuta	Northern Pintail	Birds		
Anas americana	American Wigeon	Birds		
Anas clypeata	Northern Shoveler	Birds		
Anas crecca	Green-winged Teal	Birds		
Anas cyanoptera	Cinnamon Teal	Birds		
Anas discors	Blue-winged Teal	Birds		
Anas platyrhynchos	Mallard	Birds		
Ariescriser albifrons	Greater White-fronted Goose	Birds		
Ardea alba	Great Egret	Birds		
Ardea herodias	Great Blue Heron	Birds		
Aythya affinis	Lesser Scaup	Birds		
Aythya americana	Redhead	Birds		Special Concern
Aythya collaris	Ring-necked Duck	Birds		
Aythya marila	Greater Scaup	Birds		
Aythya valisineria	Canvasback	Birds		Special
Botaurus lentiginosus	American Bittern	Birds		
Bucephala albeola	Bufflehead	Birds		
Bucephala clangula	Common Goldeneye	Birds		
Butorides virescens	Green Heron	Birds		
Calidris alpina	Dunlin	Birds		
Calidris mauri	Western Sandpiper	Birds		
Calidris minutilla	Least Sandpiper	Birds		
Chen caerulescens	Snow Goose	Birds		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Chen rossii	Ross's Goose	Birds		
Chlidonias niger	Black Tern	Birds		Special Concern
Chroicocephalus philadelphia	Bonaparte's Gull	Birds		
Cistothorus palustris	Marsh Wren	Birds		
Cygnus columbianus	Tundra Swan	Birds		
Cypseloides niger	Black Swift	Birds	Bird of Conservation Concern	Special Concern
Dendrocygna bicolor	Fulvous Whistling-Duck	Birds		Special Concern
Egretta thula	Snowy Egret	Birds		
Empidonax traillii	Willow Flycatcher	Birds	Bird of Conservation Concern	Endangered
Fulica americana	American Coot	Birds		
Gallinago delicata	Wilson's Snipe	Birds		
Gallinula chloropus	Common Moorhen	Birds		
Geothlypis trichas	Common Yellowthroat	Birds		
Grus canadensis	Sandhill Crane	Birds		
Haliaeetus leucocephalus	Bald Eagle	Birds	Bird of Conservation Concern	Endangered
Himantopus mexicanus	Black-necked Stilt	Birds		
Icteria virens	Yellow-breasted Chat	Birds		Special Concern
Limnodromus scolopaceus	Long-billed Dowitcher	Birds		
Lophodytes cucullatus	Hooded Merganser	Birds		
Megaceryle alcyon	Belted Kingfisher	Birds		
Mergus merganser	Common Merganser	Birds		
Mergus serrator	Red-breasted Merganser	Birds		
Numenius americanus	Long-billed Curlew	Birds		
Numenius phaeopus	Whimbrel	Birds		
Nycticorax	Black-crowned Night-Heron	Birds		
Oxyura jamaicensis	Ruddy Duck	Birds		
Pandion haliaetus	Osprey	Birds		Watch list
Pelecanus erythrorhynchos	American White Pelican	Birds		Special Concern

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Phalacrocorax auritus	Double-crested Cormorant	Birds		
Phalaropus tricolor	Wilson’s Phalarope	Birds		
Plegadis chihi	White-faced Ibis	Birds		Watch list
Pluvialis squatarola	Black-bellied Plover	Birds		
Podiceps nigricollis	Eared Grebe	Birds		
Podilymbus podiceps	Pied-billed Grebe	Birds		
Porzana carolina	Sora	Birds		
Rallus limicola	Virginia Rail	Birds		
Recurvirostra americana	American Avocet	Birds		
Riparia	Bank Swallow	Birds		Threatened
Setophaga petechia	Yellow Warbler	Birds		
Tachycineta bicolor	Tree Swallow	Birds		
Tringa melanoleuca	Greater Yellowlegs	Birds		
Tringa semipalmata	Willet	Birds		
Tringa solitaria	Solitary Sandpiper	Birds		
Vireo bellii	Bell’s Vireo	Birds		
Vireo bellii pusillus	Least Bell’s Vireo	Birds	Endangered	Endangered
Xanthocephalus	Yellow-headed Blackbird	Birds		Special Concern
Artemia franciscana	San Francisco Brine Shrimp	Crustaceans		
Branchinecta conservatio	Conservancy Fairy Shrimp	Crustaceans	Endangered	Special
Branchinecta lindahli	Versatile Fairy Shrimp	Crustaceans		
Branchinecta longiantenna	Longhorn Fairy Shrimp	Crustaceans	Endangered	Special
Branchinecta lynchi	Vernal Pool Fairy Shrimp	Crustaceans	Threatened	Special
Lepidurus packardi	Vernal Pool Tadpole Shrimp	Crustaceans	Endangered	Special
Linderiella occidentalis	California Fairy Shrimp	Crustaceans		Special
Oncorhynchus myki–s - CV	Central Valley steelhead	Fishes	Threatened	Special
Oncorhynchus mykiss irideus	Coastal rainbow trout	Fishes		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Pogonichthys macrolepidotus	Sacramento splittail	Fishes		Special Concern
Actinemys marmorata	Western Pond Turtle	Herps		Special Concern
Ambystoma californiense	California Tiger Salamander	Herps	Threatened	Threatened
Anaxyrus boreas	Boreal Toad	Herps		
Pseudacris regilla	Northern Pacific Chorus Frog	Herps		
Rana boylii	Foothill Yellow-legged Frog	Herps	Under Review in the Candidate or Petition Process	Special Concern
Rana draytonii	California Red-legged Frog	Herps	Threatened	Special Concern
Spea hammondii	Western Spadefoot	Herps	Under Review in the Candidate or Petition Process	Special Concern
Thamnophis atratus	Santa Cruz Gartersnake	Herps		
Thamnophis elegans	Mountain Gartersnake	Herps		
Thamnophis gigas	Giant Gartersnake	Herps	Threatened	Threatened
Thamnophis hammondii	Two-striped Gartersnake	Herps		Special Concern
Thamnophis sirtalis	Common Gartersnake	Herps		
Aeshnidae fam.	Aeshnidae fam.	Insects & other inverts		
Anax junius	Common Green Darner	Insects & other inverts		
Brillia spp.	Brillia spp.	Insects & other inverts		
Callicorixa spp.	Callicorixa spp.	Insects & other inverts		
Capnia hitchcocki	Arroyo Snowfly	Insects & other inverts		
Chironomus spp.	Chironomus spp.	Insects & other inverts		
Coenagrionidae fam.	Coenagrionidae fam.	Insects & other inverts		
Corisella spp.	Corisella spp.	Insects & other inverts		
Cricotopus spp.	Cricotopus spp.	Insects & other inverts		
Ischnura cervula	Pacific Forktail	Insects & other inverts		
Ischnura denticollis	Black-fronted Forktail	Insects & other inverts		
Mesocapnia bulbosa	Bulbous Snowfly	Insects & other inverts		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Paraleptophlebia associata	A Mayfly	Insects & other inverts		
Paratanytarsus spp.	Paratanytarsus spp.	Insects & other inverts		
Phaenopsectra spp.	Phaenopsectra spp.	Insects & other inverts		
Procladius spp.	Procladius spp.	Insects & other inverts		
Psectrocladius spp.	Psectrocladius spp.	Insects & other inverts		
Tanypus spp.	Tanypus spp.	Insects & other inverts		
Tipulidae fam.	Tipulidae fam.	Insects & other inverts		
Trichocorixa spp.	Trichocorixa spp.	Insects & other inverts		
Castor canadensis	American Beaver	Mammals		
Lontra canadensis	North American River Otter	Mammals		
Neovison vison	American Mink	Mammals		
Ondatra zibethicus	Common Muskrat	Mammals		
Anodonta californiensis	California Floater	Mollusks		Special
Margaritifera falcata	Western Pearlshell	Mollusks		Special
Pyrgulopsis diablensis	Diablo Range Pyrg	Mollusks		Special
Alopecurus saccatus	Pacific Foxtail	Plants		
Ammannia coccinea	Scarlet Ammannia	Plants		
Anemopsis californica	Yerba Mansa	Plants		
Arundo donax	NA	Plants		
Azolla filiculoides	NA	Plants		
Azolla microphylla	Mexican mosquito fern	Plants		Special
Baccharis salicina		Plants		
Bacopa eisenii	Gila River Water-hyssop	Plants		
Bidens laevis	Smooth Bur-marigold	Plants		
Bolboschoenus glaucus	NA	Plants		
Bolboschoenus maritimus paludosus	NA	Plants		
Callitriche marginata	Winged Water-starwort	Plants		
Ceratophyllum demersum	Common Hornwort	Plants		
Chloropyronmoesclle hispidum		Plants		Special
Chloropyron palmatum	NA	Plants	Endangered	Special

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Cotula coronopifolia	NA	Plants		
Crassula aquatica	Water Pygmyweed	Plants		
Crypsis vaginiflora	NA	Plants		
Cyperus erythrorhizos	Red-root Flatsedge	Plants		
Cyperus squarrosus	Awned Cyperus	Plants		
Downingia bella	Hoover's Downingia	Plants		
Downingia pulchella	Flat-face Downingia	Plants		
Echinodorus berteroi	Upright Burhead	Plants		
Elatine brachysperma	Shortseed Waterwort	Plants		
Elatine californica	California Waterwort	Plants		
Eleocharis acicularis	Least Spikerush	Plants		
Eleocharis atropurpurea	Purple Spikerush	Plants		
Eleocharis coloradoensis		Plants		
Eleocharis macrostachya	Creeping Spikerush	Plants		
Eleocharis montevidensis	Sand Spikerush	Plants		
Eleocharis quadrangulata	NA	Plants		
Elodea canadensis	Broad Waterweed	Plants		
Epilobium cleistogamum	Cleistogamous Spike-primrose	Plants		
Eragrostis hypnoides	Teal Lovegrass	Plants		
Eryngium castrense	Great Valley Eryngo	Plants		
Eryngium racemosum	Delta Coyote-thistle	Plants		Endangered
Eryngium spinosepalum	Spiny Sepaled Coyote-thistle	Plants		Special
Eryngium vaseyi vallicola		Plants		
Eryngium vaseyi	Vasey's Coyote-thistle	Plants		
Euthamia occidentalis	Western Fragrant Goldenrod	Plants		
Hydrocotyle verticillata	Whorled Marsh-pennywort	Plants		
Juncus acuminatus	Sharp-fruit Rush	Plants		
Juncus xiphioides	Iris-leaf Rush	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Lasthenia ferrisiae	Ferris' Goldfields	Plants		Special
Lasthenia fremontii	Fremont’s Goldfields	Plants		
Lemna aequinoctialis	Lesser Duckweed	Plants		
Lemna gibba	Inflated Duckweed	Plants		
Lemna minor	Lesser Duckweed	Plants		
Lepidium jaredii	Jared’s Peppergrass	Plants		Special
Lepidium oxycarpum	Sharp-pod Peppergrass	Plants		
Limnanthes douglasii	Douglas' Meadowfoam	Plants		
Limosella acaulis	Southern Mudwort	Plants		
Lipocarpha micrantha	Dwarf Bulrush	Plants		
Ludwigia peploides	NA	Plants		
Ludwigia repens	Creeping Seedbox	Plants		
Lythrum californicum	California Loosestrife	Plants		
Marsilea vestita	NA	Plants		
Mimulus cardinalis	Scarlet Monkeyflower	Plants		
Mimulus guttatus	Common Large Monkeyflower	Plants		
Montia fontana	Fountain Miner’s-lettuce	Plants		
Myosurus minimus	NA	Plants		
Myosurus sessilis	Sessile Mousetail	Plants		
Myriophyllum aquaticum	NA	Plants		
Najas guadalupensis	Southern Naiad	Plants		
Navarretia heterandra	Tehama Navarretia	Plants		
Navarretia leucocephala	White-flower Navarretia	Plants		
Navarretia prostrata	Prostrate Navarretia	Plants		Special
Neostapfia colusana	Colusa Grass	Plants	Threatened	Endangered
Panicum dichotomiflorum	NA	Plants		
Paspalum distichum	Joint Paspalum	Plants		
Persicaria hydropiperoides		Plants		
Persicaria lapathifolia		Plants		
Persicaria maculosa	NA	Plants		
Persicaria pensylvanica	NA	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Phacelia distans	NA	Plants		
Phyla lanceolata	Fog-fruit	Plants		
Phyla nodiflora	Common Frog-fruit	Plants		
Pilularia americana	NA	Plants		
Plagiobothrys acanthocarpus	Adobe Popcorn-flower	Plants		
Plagiobothrys greenei	Greene’s Popcorn-flower	Plants		
Plagiobothrys humistratus	Dwarf Popcorn-flower	Plants		
Plagiobothrys leptocladus	Alkali Popcorn-flower	Plants		
Plantago elongata	Slender Plantain	Plants		
Pluchea odorata	Scented Conyza	Plants		
Pogogyne douglasii	NA	Plants		
Pogogyne zizyphoroides		Plants		
Potamogeton diversifolius	Water-thread Pondweed	Plants		
Potamogeton foliosus	Leafy Pondweed	Plants		
Potamogeton nodosus	Longleaf Pondweed	Plants		
Potamogeton pusillus	Slender Pondweed	Plants		
Psilocarphus brevissimus	Dwarf Woolly-heads	Plants		
Psilocarphus oregonus	Oregon Woolly-heads	Plants		
Psilocarphus tenellus	NA	Plants		
Puccinellia simplex	Little Alkali Grass	Plants		
Ranunculus sceleratus	NA	Plants		
Rorippa curvisiliqua	Curve-pod Yellowcress	Plants		
Rorippa palustris	Bog Yellowcress	Plants		
Rotala ramosior	Toothcup	Plants		
Ruppia cirrhosa	Widgeon-grass	Plants		
Ruppia maritima	Ditch-grass	Plants		
Sagittaria longiloba	Longbarb Arrowhead	Plants		
Sagittaria montevidensis calycina		Plants		
Salix exigua	Narrowleaf Willow	Plants		
Salix gooddingii	Goodding’s Willow	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Schoenoplectus acutus occidentalis	Hardstem Bulrush	Plants		
Schoenoplectus americanus	Three-square Bulrush	Plants		
Sinapis alba	NA	Plants		
Sparganium eurycarpum		Plants		
Stuckenia pectinata		Plants		
Typha domingensis	Southern Cattail	Plants		
Typha latifolia	Broadleaf Cattail	Plants		
Veronica americana	American Speedwell	Plants		
Wolffiella lingulata	Tongue Bogmat	Plants		
Zannichellia palustris	Horned Pondweed	Plants		

Source: The Nature Conservancy (TNC). 2018. Identifying Environmental Surface Water Use–s - Freshwater Species List for Each Groundwater Basin dataset. https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

4.2.8 Data Gaps

The Delta-Mendota Subbasin is an extensive subbasin covering a large area extending along the northwestern end of the San Joaquin Valley. While there is a significant amount of data available regarding various groundwater-related aspects of the Subbasin, much is still not known in multiple locations around the Subbasin. To this end, the following data gaps have been identified and will be addressed as part of the interim period between adoption of this GSP and its first 5-year update.

- Information regarding subsidence varies in extent around the region. While there is a large amount of land elevation survey data available in association with the DMC and the San Joaquin River Restoration Program, other areas in the Delta-Mendota Subbasin require additional data collection to both further establish and monitor future land subsidence rates.
- Only three shallow groundwater wells exist proximate to the northern end of the San Joaquin River (outside of the area being addressed by the San Joaquin River Restoration Program). Additional nested or clustered monitoring wells are required adjacent to the river on the northern end of the Subbasin to evaluate horizontal and vertical groundwater gradients, and in connection with river stage monitoring, to assess the interconnection between the San Joaquin River and the northeastern end of the Delta-Mendota Subbasin.
- There are a large number of wells in the Delta-Mendota Subbasin where no well construction information exists or is readily available. Video surveys and other surveys should be conducted on selected wells that may potentially be added to the Subbasin monitoring network to (1) identify where the wells are screened, and (2) determine if the well(s) are appropriate as additions to the GSP Groups' groundwater monitoring programs.
- Mapping of GDEs in the Delta-Mendota Subbasin, as contained in this Common Chapter, is an initial assessment of their location. This mapping may be refined using most recent groundwater elevation/depth to water contour mapping.
- Monitoring networks contained herein are preliminary and were formulated based on existing well information. As additional wells are installed in the Subbasin and additional well construction information is obtained for existing wells, these networks may need to be refined to improve on the spatial (areal and vertical) distribution of monitoring points and the data collected for evaluation of conditions of the groundwater basin.
- The sustainable yield estimates and water budgets contained in this Common Chapter for both the Upper and Lower Aquifers were developed using limited data. As additional data are collected over the first five years, improved sustainable yield estimates and estimates of water in storage in both principal aquifers should be prepared utilizing the new data.

In addition to these Subbasin-level data gaps, additional data gaps have been identified for each GSP Plan Area. Please see the individual GSPs for additional identified data gaps.

4.3 Delta-Mendota Subbasin Water Budgets

This section describes the common coordinated assumptions agreed upon and utilized by each GSP Group in the Delta-Mendota Subbasin in developing the historical, current, and projected water budgets for their respective GSP Plan Areas. These coordinated historical, current, and projected water budgets were then compiled to prepare the subbasin-level water budgets required under the GSP Regulations §

357.4(b)(3)(B), presented below. The sustainable yield for the Upper Aquifer and Lower Aquifer developed at the Subbasin-level and agreed upon by all GSP Groups in the Delta-Mendota Subbasin is also presented along with a description as to how the sustainable yield for each primary aquifer was calculated.

4.3.1 Coordinated Assumptions

All common coordinated assumptions agreed upon and utilized by each GSP Group in preparing their respective historical, current, and projected water budgets are presented in Technical Memoranda 3 (*Assumptions for the Historical, Current, and Projected Water Budgets of the Delta-Mendota Subbasin*), which is included in **Appendix B** of this Common Chapter.

The data and methodologies used to develop the water budgets in the six individual GSPs (and compiled herein as the Subbasin Water Budgets) were coordinated with the express objective to "rely on the best available information and best available science to quantify the water budget for the basin" (Title 23 of the California Code of Regulations [23 CCR] § 354.18(e)). Given the complex nature of the Subbasin, different data sets and methodologies were appropriate for and/or available in different portions of the Subbasin. As such, a significant effort was made by the Subbasin GSAs to: (1) identify the different sources and accuracy of the available data; (2) consolidate these data and associated methodologies into a general hierarchy for use by the GSAs to honor the local conditions, while maintaining consistency with the intent of 23 CCR § 354.18(e); and (3) standardize the terminology for purposes of the Common Chapter presentation of the Subbasin Water Budget. These standardized water budget components and data sources are presented in Error! Reference source not found. and **Table CC-9** for the historic and current, and projected water budgets, respectively, and are further described below, while acknowledging that significant additional detail is presented in the six underlying GSPs. In some cases, data were not available or applicable, as acknowledged below and in the tables. Additionally, in some cases the specific terminology and/or the details of the calculations included in each underlying GSP remains unique relative to the standardized terminology and descriptions presented below; a full reconciliation of water budget nomenclature will be conducted as part of the 2025 GSP updates, as well as updates to the datasets and methodologies employed. Water use in the Subbasin is largely for agricultural purposes, with local municipal and industrial (M&I) uses. As appropriate, these M&I uses were quantified and incorporated in the individual GSP water budgets.

LAND SURFACE WATER BUDGET

The data sources/methodologies used to estimate the six major components of the Historical and Current Land Surface Water Budgets are summarized in **Table CC-8** and for the Projected Land Surface Water Budgets in **Table CC-9**. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. For purposes of the Subbasin GSPs, the Historical and Current Water Budgets represent Water Year (WY) 2003-2013, where the historical period is WY 2003-2012 and the current year is WY 2013. The Projected Water Budgets reflect projected conditions through 2070[1] and consider the impacts

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[1] The Subbasin GSAs agreed to use actual data from WYs 2014-2017 and assume a repeat of the historical hydrology for the years WY 2018-2070. The selected period for the projected water budgets meets SGMA requirements by establishing a 50-year period, where the timeframe is continuous between the historic, current, and projected water budgets. The historic hydrologic period for simulating the projected water budget hydrologic

of climate change and projects and management actions (PMAs). To the extent possible the data sources and methodology used were consistent with those identified by the California Department of Water Resources (DWR) in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the Best Management Practices (BMP) –4 - Water Budget.[1] As applicable and available, models and tools (e.g., the Central Valley Hydrologic Model 2 [CVHM2]) were used to support the local sources and assumptions incorporated into the development of the Subbasin Groundwater Water Budget.

(1) **Precipitation (Inflow).** For the Historical and Current Land Surface Water Budgets, total precipitation across the Subbasin was estimated using either: (1) PRISM: the Precipitation-Elevation Regressions on Independent Slopes Model (PRISM); (2) CIMIS: area-weighted data from the California Irrigation Management Information System (CIMIS) stations located in the Subbasin; California Data Exchange Center (CDEC) and/or (3) data from the National Water Service Station located in Los Banos, CA. Total precipitation was further parsed into effective and non-effective precipitation, as applicable to each GSP area, based on assumptions regarding deep percolation percentages and other losses.

For the Projected Land Surface Water Budgets, for WY 2014-2017, actual data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected WY 2018-2070 period, the 2030 Central Tendency and 2070 Central Tendency climate change factors and guidance provided by DWR were applied to the historical precipitation record to project the impact of climate change on precipitation across the Subbasin. For example, either (1) the Gridded Statewide Precipitation and Change Factors developed for the Water Storage Investment Program (WSIP) using the Variable Infiltration Capacity (VIC) Macroscale Hydrology Model (DWR, 2018) were applied to the available precipitation data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR Climate Change Technical Advisory Group (CCTAG) were incorporated (DWR CCTAG, 2015).

(2) **Applied Water – Groundwater (Inflow).** To estimate the volume of applied groundwater for the Historical and Current Land Surface Water Budgets (including both agricultural and M&I pumping, as applicable to each GSP area), the total pumping within the Subbasin was estimated using the following hierarchy of sources, depending upon existing records: (1) Flow meters: volumetric flow meter records from pumping wells; (2) Power bills: electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency); and/or (3) Consumptive use: reported crop acreages and consumptive use data based on either Irrigation Training and Research Center (ITRC)[2] Mapping of Evapotranspiration with Internal Calibration (METRIC) procedure or crop coefficient methodologies (e.g., those provided in the Food and Agricultural Organization of the United States (FAO) Irrigation and Drainage Paper No. 56

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schema was chosen as WY 1979-2017, then wrapping around to include WY 1965-1978 hydrology. Actual data and hydrology were used for WY 2014- 2017 with the representative water years simulating WY 2018 and beyond (e.g., WY2018 is represented by the hydrology from WY1979; WY2019 is represented by the hydrology from WY1980, and so forth, with the caveat that 1979 would represent the fifth year of the projection and following sequentially the historical water year 1965 would represent the forty-fourth year of the projection).

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

[2] California Polytechnic State University, San Luis Obispo

(FAO-56) (Snyder *et. al*., 2000, Snyder and Bali, 2008) or the ITRC Crop Coefficient data for Zone 14), corrected as applicable, for applied local and imported surface water. This volume of applied groundwater is consistent with the volume estimated under Water Budget Component (9) Extraction of the Groundwater Water Budget (see below).

For the Projected Land Surface Water Budgets, for WY 2014-2017, actual data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of applied groundwater was estimated using various, complementary methods, including: (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production rates would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record). Climate change impacts and the effects of the planned projects and management actions (PMAs) are implicitly, rather than explicitly, accounted for (i.e., to the extent that climate change and PMAs increase or decrease the amount of water otherwise available to meet applied water demands, the volume of applied groundwater will be adjusted accordingly). Total inflow to Shasta Lake dictates the amount of imported surface water available for use in the Subbasin. The WSIP model was used to analyze the impacts of climate change on the Subbasin and anticipate projected inflow to Shasta Lake, and as to whether or not the water year would be classified as Shasta Critical under the Exchange Contract, the Refuge Contract, and by municipal users.

(3) **Surface Water Inflow (Inflow).** Surface water serves as an inflow to Subbasin water budget as both applied surface water and as seepage from streams and rivers. To estimate the volume of applied surface water for the Historical and Current Land Surface Water Budgets, the total diversions within the Subbasin over the historical and current water budget time periods were reported using the best available data for each source. Deliveries from the Central Valley Project (CVP), State Water Project (SWP), the San Joaquin River, and other local streams and rivers were compiled from records from the following sources, including, but not limited to: State Water Resources Control Board (SWRCB) diversion reports; United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records; CVP refuge water supply delivery data; and GSA member agency records.

To account for seepage of surface water into the Subbasin from streams and rivers for the Historical and Current Water Budgets, California Data Exchange Center (CDEC) data were used (i.e., by comparing the reductions in measured flow at successive gauging stations after accounting for other diversions) and/or from estimates of seepage losses from certain water bodies from prior water infiltration studies or modeling efforts, as described in the individual GSPs. Seepage from streams and rivers is counted either towards the Groundwater Water Budget directly or towards the Land Surface Water Budget and then, because of the lack of storage capacity in the land surface system and by way of mass balance principles, some or all of this water adds to the Groundwater Water Budget through Water Budget Component (6) Deep Percolation (see below).

For the Projected Land Surface Water Budgets, the volume of applied surface water was estimated as (1) the records of actual delivery data as available for the respective service areas for WY 2014-2017; and (2) estimates of anticipated future deliveries by WY type for WY 2018-2070, inclusive of climate change considerations to the extent they could be reasonably estimated (i.e., directly modeled based on data provided by DWR and the USBR), or using water year types as a proxy (i.e., future dry year deliveries would reflect historical average dry year deliveries over the historical record). The impacts of planned PMAs on the availability of applied surface water volumes were also incorporated, as applicable.

For the Projected Land Surface Water Budgets, the volume of surface water seepage was adjusted, as applicable and available, based on climate change factors provided by DWR. Changes to surface water seepage were directly estimated as a result of PMAs or other program implementation (e.g., the impact on seepage resulting from the San Joaquin River Restoration Program [SJRRP] implemented by the USBR).

(4) **Surface Water Outflow (Outflow).** As described above, total precipitation was parsed into effective and non-effective precipitation (i.e., the latter being that portion of the total precipitation that cannot be used by the plants because it either runs off or percolates beyond the root zone). Similarly, a portion of the applied water can run off or deep percolate (typically termed "irrigation inefficiency"). Other surface water outflows (losses) from the Subbasin Land Surface Water Budget include agency-measured or estimated "spills" (i.e., outflow from tile drained fields, canal spills, field runoff, and precipitation runoff) and stream gauge readings, flow meter readings, and transfer pumping data. These collective data sets, sources, and methodologies were used to estimate the historical and current outflows from this component of the Subbasin Land Surface Water Budget.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of surface water outflows was estimated based on estimates provided by the GSA member agencies (using water year types as a proxy), while those components that may be impacted by climate change (e.g., runoff) were adjusted to reflect changes to precipitation and reference evapotranspiration (ETo). Changes to surface water outflows were directly estimated as a result of PMAs or other program implementation (e.g., water conservation programs to reduce spills) as information was available.

(5) **Evapotranspiration (Outflow).** The largest outflow for the Historical and Current Land Surface Water Budget is evapotranspiration (consumptive use) by crops. As such, a combination of CIMIs ETo data, crop acreage, and crop coefficient data and methodologies (e.g., ITRC data and methodologies) were utilized to estimate the consumptive use, including municipal uses, of water in the Subbasin. In addition, direct evaporation from surface water bodies and phreatophytes (i.e., groundwater dependent ecosystems [GDEs]) was estimated based on the surface area and time period it was wetted.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the actual data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the 2030 Central Tendency and 2070 Central Tendency climate change factors or guidance provided by DWR were applied to the historical ETo record to project the impact of climate change on ETo across the Subbasin. For example, either the Gridded Statewide Precipitation and Change Factors developed for the WSIP using the VIC Macroscale Hydrology Model (DWR, 2018) were applied to the available ETo data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR CCTAG (2015) were incorporated.

(6) **Deep Percolation (Outflow).** For the Historical, Current, and Projected Land Surface Water Budgets, this water budget component is estimated as the sum of the other Outflow components (Water Budget Components 4 and 5) of the Land Surface Water Budget subtracted from the sum of the Inflow components (Water Budget Components 1 through 3) and represents the total

volume of water that seeps past the root zone and into the Subbasin aquifer(s). This includes applied water seepage, as well as stream seepage (from the San Joaquin River, Delta-Mendota Canal, and California Aqueduct, and other canals), and delivery losses. To the extent that climate change and PMA implementation affects the volumes of Water Budget Components 1 through 5, these impacts are reflected in the resultant Outflow component, Water Budget Component (6) Deep Percolation, which serves as the inflow component, and Water Budget Component (7) Deep Percolation to the Groundwater Water Budget (see below).

GROUNDWATER WATER BUDGET

The data sources/methodologies used to estimate the Historical and Current Groundwater Water Budgets are summarized in **Table CC-8** and for the Projected Groundwater Water Budgets in **Table CC-9**. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. The time periods for the Groundwater Water Budgets are consistent with those used for the Land Surface Water Budgets, and likewise, to the extent possible, the data sources and methodology used were consistent with those identified by DWR in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the BMP –4 - Water Budget.[1] As identified in **Table CC-8** and **Table CC-9**, significant data gaps were identified in several of the GSPs on key aspects of the Groundwater Water Budget; additional efforts are on-going to address those data gaps and refine the water budgets as part of the 2025 GSP update. As applicable and available, models and tools (e.g., CVHM2, Westside Subbasin Groundwater Model, and a numerical flow model for the Farmers Water District and Fresno County areas) were used to validate the local sources and support assumptions used to develop the Subbasin Groundwater Water Budget.

(7) **Deep Percolation (Inflow).** In all instances, this component of the Groundwater Water Budget is directly linked to the Water Budget Component (6) Deep Percolation of the Land Surface Water Budget. To the extent that climate change is factored into the Historical, Current, and Projected Land Surface Water Budgets, those impacts are reflected in the varying volumes of deep percolation that are assumed to recharge the aquifer system(s) via infiltration.

(8) **Lateral Subsurface Flow (Inflow).** For the Historical and Current Groundwater Water Budgets, this component is estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

8A. Upper Aquifer. For the Upper Aquifer, lateral inflows were generally estimated using Darcy's equation[2] and estimated aquifer characteristics, or a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries. Mountain front recharge

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[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

[2] Darcy's equation in which groundwater flow velocity is identified as a function of the aquifer hydraulic conductivity and hydraulic gradient based upon measured water levels and aquifer properties. Freeze, R.A. and Cherry, J.A. 1979. Groundwater. Prentice Hall, Inc. Englewood Cliffs, NJ. p 16.

from the Coastal Range was also assumed to provide an additional source of inflow to the Upper Aquifer.

8B. Lower Aquifer. To the extent possible, lateral inflows to the Lower Aquifer were estimated, primarily using Darcy's equation and estimated aquifer characteristics, and coarse assumptions regarding contributions of other sources of inflow, or via a groundwater flow model, as available. However, this portion of the Groundwater Budget was acknowledged as a significant data gap, which the GSAs are working to address through the collection of additional data, etc.

In instances where there was significant downward flow between the Upper and Lower Aquifers, vertical flow was estimated using Darcy's equation, estimated aquifer characteristics, and groundwater gradients. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while water level maps for wet, normal, and dry water year types were prepared to determine the elevation and groundwater gradient. Furthermore, flow to the Lower Aquifer from the Upper Aquifer is acknowledged as a data gap.

Projected Groundwater Water Budget. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, this component is generally estimated using historical inflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in inflows as a result of PMAs (including projected groundwater banking activities) are directly incorporated to the extent the information was provided by the GSAs. As additional data are obtained during implementation of the GSPs, the inputs will be updated and improved to revise the Projected Groundwater Water Budget.

(9) **Extraction (Outflow).** Consistent with the methodology used to estimate Water Budget Component (2), Applied Groundwater, of the Historical and Current Land Surface Water Budgets, the total pumping from the Subbasin aquifers was estimated using the following hierarchy of sources depending upon available records: (1) Flow meters: Volumetric flow meter records from pumping wells; (2) Power bills: Electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency and duration of operation); and/or (3) Consumptive use: crop acreages and consumptive use data based on either ITRC-METRIC or crop coefficient methodologies. While the exact distribution of pumping from the Upper and Lower Aquifers is acknowledged as a data gap, total extractions were assumed to be partitioned between the aquifers, with the majority of extractions (80-90%) occurring in the Upper Aquifer. Information regarding well construction obtained and compiled from the local and Subbasin Well Census and Inventory projects completed by the GSAs in 2022 will be used to further improve the estimated allocation of groundwater extraction between the aquifers in the 2025 GSP update.

For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of pumped groundwater was estimated using various, complimentary methods, including (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record, with the exception of M&I pumping which was projected based on information provided in various source documents such as Urban

Water Management Plans). Climate change impacts and the effect of the planned PMAs are implicitly, rather than explicitly, accounted for.

(10) **Lateral Subsurface Flow (Outflow).** For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin, but similarly to Water Budget Component (8) of the Groundwater Water Budget.

10A. Upper Aquifer. Lateral outflows were generally estimated using Darcy's equation and estimated aquifer characteristics, and validated by a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries.

10B. Lower Aquifer. To the extent possible, lateral outflows from the Lower Aquifer were estimated, primarily using Darcy's equation and estimated aquifer characteristics, and validated by a groundwater flow model, as available. However, this portion of the Groundwater Water Budget was acknowledged as a significant data gap which the GSAs are working to address through the collection and evaluation of additional data, etc.

Projected Groundwater Water Budget. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, this component is generally estimated using historical outflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in outflows as a result of PMAs (including projected groundwater banking activities) are directly incorporated to the extent the information was provided by the GSAs.

(11) **Change in Storage.** For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

11A. Upper Aquifer. A sum of the Outflow components (Water Budget Components 9 through 10) of the Groundwater Water Budget was subtracted from the Inflow components (Water Budget Components 7 and 8) to assess the change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

11B. Lower Aquifer. Approaches varied among the GSPs given the limited available data, which the GSAs are working to address through the collection of additional data, etc. Change in storage was estimated using measured subsidence as a proxy (i.e., due to compaction caused by inelastic land subsidence), as the difference between inflows and outflows based on modeled results, or as an assumed proportion of overall groundwater change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

Projected Groundwater Water Budgets. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the change in storage volumes used in the Historical and Current Water Budgets were averaged by water year type and used throughout the projected water budget period, or were calculated as the difference between inflows and outflows.

Table CC-8: Historical and Current Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) and California Irrigation Management Information System (CIMIS)	PRISM		PRISM and CIMIS	PRISM and CIMIS	CIMIS and National Weather Service (NWS)
Land Surface	Inflow	Applied Wat–r - Groundwater	Consumptive use	Flow meters	Flow meters, power bills, and consumptive use	Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports; landowner records	San Joaquin River inflows	United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records	Central Valley Project (CVP) refuge water supply delivery data	USBR CVO and SWRCB diversion reports	USBR CVO; California Data Exchange Center (CDEC) where available, water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation	Transfer pumping and San Joaquin River outflows	Transfer pumping that exceeds applied groundwater	Non-effective precipitation and agency measured spills	Evapotranspiration and non-effective precipitation)	Non-effective precipitation and flow meter readings
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS					
Land Surface	Outflow	Deep Percolation	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)					
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities)			Data G–p - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities)
Groundwater	Outflow	Extraction - Upper Aquifer	Consumptive use and irrigation efficiency	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use		Flow meters
Groundwater	Outflow	Extraction - Lower Aquifer	Unused - Data Gap	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use		Assumed 10% of total pumping
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)					
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities)				
Groundwater	Change in Storage	Upper Aquifer	Inflow - Outflow					
Groundwater	Change in Storage	Lower Aquifer	Land subsidence as proxy	Inflow - Outflow		Land subsidence as proxy		

Table CC-9: Projected Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM), applying climate change factors (CCF)			PRISM and California Irrigation Management Information System (CIMIS), applying CCF		CIMIS and National Weather Service (NWS), applying CCF
Land Surface	Inflow	Applied Wat–r - Groundwater	Consumptive use			Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports, using water year (WY) types as a proxy	San Joaquin River inflows (CDEC and United States Geological Survey [USGS])	Mendota Pool inflows - USBR CVO	USBR CVO and SWRCB diversion reports, using WY types as a proxy		USBR CVO; California Data Exchange Center (CDEC) where available, using WY types as a proxy; Water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	San Joaquin River outflows (CDEC and USGS)	Mendota Pool outflows (USBR CVO)	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS (calculated with CCFs and WY types as a proxy)					
Land Surface	Outflow	Deep Percolation	Land Surface Inflow - Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy					
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy			Data Gap - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy
Groundwater	Outflow	Extraction - Upper Aquifer	Consumptive use and irrigation efficiency using WY type as a proxy with CCFs and PMAs	Adjusted historic metered data using WY type as a proxy with CCFs and PMAs		Adjusted historic metered data and consumptive use using WY type as a proxy with CCFs and PMAs		
Groundwater	Outflow	Extraction - Lower Aquifer	Unused - Data Gap	Not Applicable		Unused - Data Gap	Adjusted historic metered data and consumptive use using WY type as a proxy with CCFs and PMAs	
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with CCFs					
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused – Data Gap	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with CCFs			Data Gap - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities) with CCFs
Groundwater	Change in Storage	Upper Aquifer	Inflow - Outflow					
Groundwater	Change in Storage	Lower Aquifer	Unused – Data Gap	Inflow - Outflow		Projected land subsidence and WY types used as a proxy with CCFs and PMAs	Inflow - Outflow	Projected land subsidence and WY types used as proxy with CCFs and PMAs

4.3.2 GSP-Level Water Budgets

Individual historical, current, and projected water budgets were developed by each GSP Group for their respective Plan Area. For more information on the development of those water budgets, as well as tabular and graphical representation of the results, refer to the respective sections of the individual GSPs.

All historical, current, and projected water budgets developed within the Delta-Mendota Subbasin are consistent with GSP Regulations §354.18 Water Budget, and DWR's *Best Management Practices for the Sustainable Management of Groundwater Water Budget BMP* (2016c) document was used when and where applicable at the discretion of each GSP Group.

4.3.3 Coordinated Water Budgets

The land surface budget, groundwater budget, and annual change in storage for the historical water budget, current water budget, and projected water budget with climate change factors (CCFs) and projects and management actions for the Delta-Mendota Subbasin were developed by compiling the water budgets prepared by each of GSP Group. The land surface budget is an accounting of water flows into and out of the land surface above an aquifer within with Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins, the atmosphere, and the groundwater aquifer below. The groundwater budget is an accounting of groundwater flows into and out of the two principal groundwater aquifers (Upper Aquifer and Lower Aquifer) within the Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins as well as the above land surface.

Subsequent to the submittal of the Delta-Mendota GSP in January 2022, and in response to the Consultation Initiation Letter (CIL) received from DWR on January 21, 2022 in which DWR stated that, while the same data may have been used in developing the water budgets, the terminology used to describe those data sets were not consistent across the basin, the Delta-Mendota Subbasin GSAs acknowledge additional detail was needed to demonstrate that all water budget components across the six Subbasin GSPs utilize the same data and methodologies. As such, subsequent to receipt of the CIL, the Technical Working Group and Coordination Committee met to identify the specific data used and to develop a consistent terminology for the various water budget components. Additionally, the Technical Working Group attempted to simplify the presentation of the Subbasin water budgets through a reduction in the number of water budget components. The mapping of the original GSP water budget components into the revised simplified coordinated water budget component terminology is discussed in the prior section (Section 4.3.1 of this revised Common Chapter).

After agreeing to the set of common simplified definitions for water budget components, the six Delta-Mendota GSP groups mapped their prior water budget components to the new common definitions. The revised land surface budget and groundwater budget are presented respectively for the historical water budget in **Table CC-10** and **Table CC-11,** for the current water budget in **Table CC-12** and **Table CC-13**, and for the projected water budget with climate change factors and projects and management actions in **Table CC-14** and **Table CC-15**. All categories presented in the land surface budget and groundwater budget tables were agreed upon by all Delta-Mendota GSP Groups, with representatives from each GSP group tasked with filling out these budget tables as appropriate to account for the unique hydrology, land use, and water use within their respective GSP regions. The tables below are simply compilations of the individual GSP water budget data as provided by their respective plan preparers, and no water budget data were modified during the mapping process.

Individual GSAs and agencies in the Delta-Mendota Subbasin understand that the historical, current, and projected water budgets were completed using best available science and data, and efforts were made to use the same data sources throughout the Subbasin where available, though due to variability in data availability throughout the Subbasin, the best available data were used and characterized appropriately. Where data gaps exist, the individual GSAs and agencies intend to conduct the work necessary to substantiate or improve the estimates and assumptions developed for determining their water budgets. Nothing in this part, or in any groundwater sustainability plan adopted pursuant to this part, determines, or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.

Figure CC-64 shows the revised average annual and cumulative change in storage in both principal aquifers under the Subbasin projected water budget (including application of climate change factors and the addition of projects and management actions).

Table CC-10: Delta-Mendota Subbasin Historical Water Budget, Land Surface Budget

Land Surface Budget									
Water Year	Water Year Type	Inflows				Outflows			
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflows	**Total Inflows**	Surface Water Outflows	Evapotranspiration	Deep Percolation	**Total Outflows**
2003	N	450,000	395,000	2,501,000	**3,346,000**	1,306,000	1,772,000	293,000	**3,371,000**
2004	D	412,000	417,000	2,433,000	**3,262,000**	1,206,000	1,760,000	315,000	**3,281,000**
2005	W	739,000	303,000	2,764,000	**3,806,000**	1,614,000	1,810,000	352,000	**3,776,000**
2006	W	571,000	293,000	3,311,000	**4,175,000**	2,111,000	1,804,000	296,000	**4,211,000**
2007	D	258,000	474,000	2,485,000	**3,217,000**	1,230,000	1,701,000	310,000	**3,241,000**
2008	D	328,000	527,000	2,295,000	**3,150,000**	1,140,000	1,769,000	331,000	**3,240,000**
2009	N	304,000	511,000	2,191,000	**3,006,000**	1,017,000	1,813,000	327,000	**3,157,000**
2010	N	539,000	380,000	2,637,000	**3,556,000**	1,515,000	1,655,000	406,000	**3,576,000**
2011	W	626,000	279,000	3,283,000	**4,188,000**	2,013,000	1,799,000	414,000	**4,226,000**
2012	D	275,000	470,000	2,582,000	**3,327,000**	1,301,000	1,679,000	355,000	**3,335,000**

Table CC-11: Delta-Mendota Subbasin Historical Water Budget, Groundwater Budget

Groundwater Budget													
Water Year	Water Year Type	Inflows				Outflows					Change in Storage		
		Infiltration	Lateral Subsurface Flow		**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		**Total Outflows**	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Total*
2003	N	324,000	196,000	117,000	**637,000**	357,000	39,000	260,000	106,000	**762,000**	17,000	5,000	22,000
2004	D	345,000	180,000	114,000	**639,000**	376,000	42,000	286,000	132,000	**836,000**	(180,000)	(48,000)	(228,000)
2005	W	424,000	223,000	128,000	**775,000**	268,000	36,000	269,000	78,000	**651,000**	223,000	14,000	237,000
2006	W	394,000	203,000	120,000	**717,000**	260,000	34,000	264,000	75,000	**633,000**	18,000	(23,000)	(5,000)
2007	D	358,000	161,000	99,000	**618,000**	431,000	48,000	280,000	130,000	**889,000**	(282,000)	(67,000)	(349,000)
2008	D	371,000	169,000	106,000	**646,000**	481,000	55,000	293,000	141,000	**970,000**	(341,000)	(80,000)	(421,000)
2009	N	361,000	195,000	112,000	**668,000**	466,000	53,000	273,000	117,000	**909,000**	(134,000)	(28,000)	(162,000)
2010	N	470,000	211,000	124,000	**805,000**	350,000	39,000	264,000	116,000	**769,000**	180,000	(4,000)	176,000
2011	W	515,000	205,000	124,000	**844,000**	248,000	32,000	277,000	83,000	**640,000**	125,000	(23,000)	102,000
2012	D	417,000	168,000	107,000	**692,000**	432,000	45,000	288,000	141,000	**906,000**	(171,000)	(62,000)	(233,000)

Table CC-12: Delta-Mendota Subbasin Current Water Budget, Land Surface Budget

Land Surface Budget									
Water Year	**Water Year Type**	**Inflows**				**Outflows**			
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflows	**Total Inflows**	Surface Water Outflows	Evapotranspiration	Deep Percolation	**Total Outflows**
2013	D	318,000	521,000	2,597,000	**3,436,000**	1,386,000	1,671,000	402,000	**3,459,000**

Table CC-13: Delta-Mendota Subbasin Current Water Budget, Groundwater System

Groundwater Budget													
Water Year	**Water Year Type**	**Inflows**				**Outflows**					**Change in Storage**		
		Infiltration	Lateral Subsurface Flow		**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		**Total Outflows**	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Total*
2013	D	467,000	173,000	112,000	**752,000**	477,000	51,000	278,000	136,000	**942,000**	(128,000)	(55,000)	(183,000)

Table CC-14: Delta-Mendota Subbasin Projected Water Budget, Land Surface Budget (containing climate change factors and projects and management actions)

		Land Surface Budget													
		Inflows							Outflows						
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflow	Applied Wat–r - Groundwater (Project Effect–) - NCDM Only	Applied Wat–r - Imported Surface Water (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Inflows**	Surface Water Outflow	Evapotranspiration	Crop Evapotranspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Outflows**
2014	SC	283,000	601,000	1,725,000	0	0	1,000	**2,610,000**	852,000	1,616,000	0	0	230,000	0	0	**2,698,000**
2015	SC	363,000	650,000	1,247,000	0	0	0	**2,260,000**	479,000	1,528,000	0	0	287,000	0	0	**2,294,000**
2016	D	712,000	392,000	1,605,000	0	0	0	**2,709,000**	631,000	1,618,000	0	0	403,000	0	0	**2,652,000**
2017	W	686,000	303,000	3,651,000	0	0	6,000	**4,646,000**	2,423,000	1,773,000	0	0	445,000	0	0	**4,641,000**
2018	N	527,000	389,000	2,628,000	(6,000)	0	7,000	**3,545,000**	1,506,000	1,660,000	0	0	403,000	0	0	**3,569,000**
2019	W	712,000	266,000	3,162,000	(7,000)	2,000	6,000	**4,141,000**	1,975,000	1,810,000	0	0	368,000	0	0	**4,153,000**
2020	D	434,000	394,000	2,187,000	(6,000)	9,000	7,000	**3,025,000**	939,000	1,726,000	0	0	343,000	0	0	**3,008,000**
2021	W	808,000	261,000	3,261,000	(7,000)	7,000	6,000	**4,336,000**	2,025,000	1,821,000	0	0	403,000	0	0	**4,249,000**
2022	W	1,021,000	249,000	3,266,000	(7,000)	7,000	6,000	**4,542,000**	2,190,000	1,834,000	0	0	449,000	0	0	**4,473,000**
2023	N	580,000	389,000	2,658,000	(8,000)	6,000	7,000	**3,632,000**	1,470,000	1,711,000	0	0	403,000	0	0	**3,584,000**
2024	D	573,000	387,000	2,176,000	(3,000)	6,000	6,000	**3,145,000**	963,000	1,726,000	0	0	374,000	0	0	**3,063,000**
2025	W	884,000	261,000	3,256,000	(7,000)	7,000	6,000	**4,407,000**	1,993,000	1,847,000	0	0	424,000	0	0	**4,264,000**
2026	D	575,000	483,000	2,098,000	(43,000)	52,000	9,000	**3,174,000**	914,000	1,785,000	0	0	412,000	0	0	**3,111,000**
2027	D	653,000	481,000	2,078,000	(41,000)	49,000	9,000	**3,229,000**	914,000	1,766,000	0	0	419,000	0	0	**3,099,000**
2028	D	534,000	484,000	2,115,000	(42,000)	50,000	9,000	**3,150,000**	934,000	1,789,000	0	0	353,000	0	0	**3,076,000**
2029	D	462,000	484,000	2,099,000	(46,000)	55,000	9,000	**3,063,000**	910,000	1,744,000	0	0	356,000	0	0	**3,010,000**
2030	SC	417,000	575,000	1,800,000	(47,000)	49,000	3,000	**2,797,000**	833,000	1,624,000	0	0	363,000	0	0	**2,820,000**
2031	SC	492,000	573,000	1,780,000	(48,000)	51,000	2,000	**2,850,000**	815,000	1,633,000	0	0	406,000	0	0	**2,854,000**
2032	W	832,000	269,000	3,250,000	(31,000)	46,000	6,000	**4,372,000**	1,963,000	1,830,000	0	0	490,000	1,000	0	**4,284,000**
2033	D	466,000	490,000	2,001,000	(46,000)	60,000	10,000	**2,981,000**	869,000	1,741,000	0	0	364,000	1,000	0	**2,975,000**
2034	W	851,000	252,000	3,258,000	(29,000)	47,000	7,000	**4,386,000**	2,003,000	1,791,000	0	0	465,000	1,000	0	**4,260,000**
2035	W	731,000	280,000	3,163,000	(32,000)	48,000	7,000	**4,197,000**	1,969,000	1,849,000	0	0	422,000	1,000	0	**4,241,000**
2036	W	774,000	316,000	3,268,000	(31,000)	50,000	7,000	**4,384,000**	2,052,000	1,867,000	0	0	494,000	1,000	0	**4,414,000**
2037	W	1,194,000	252,000	3,274,000	(28,000)	49,000	7,000	**4,748,000**	2,254,000	1,780,000	0	0	607,000	1,000	0	**4,642,000**
2038	N	448,000	431,000	2,689,000	(47,000)	53,000	10,000	**3,584,000**	1,529,000	1,660,000	0	0	381,000	0	0	**3,570,000**
2039	N	488,000	446,000	2,655,000	(46,000)	52,000	10,000	**3,605,000**	1,487,000	1,698,000	0	0	411,000	0	0	**3,596,000**
2040	D	534,000	423,000	2,200,000	(46,000)	66,000	9,000	**3,186,000**	1,001,000	1,712,000	0	0	411,000	1,000	0	**3,125,000**
2041	D	384,000	437,000	2,139,000	(52,000)	62,000	9,000	**2,979,000**	879,000	1,704,000	0	0	374,000	1,000	0	**2,958,000**
2042	N	530,000	469,000	2,730,000	(46,000)	51,000	10,000	**3,744,000**	1,532,000	1,795,000	0	0	400,000	0	0	**3,727,000**

		Land Surface Budget														
		Inflows							Outflows							
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflow	Applied Wat–r - Groundwater (Project Effect–) - NCDM Only	Applied Wat–r - Imported Surface Water (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Inflows**	Surface Water Outflow	Evapotranspiration	Crop Evapotranspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Outflows**
2043	D	488,000	437,000	2,101,000	(48,000)	68,000	11,000	**3,057,000**	884,000	1,797,000	0	0	331,000	1,000	0	**3,013,000**
2044	W	875,000	286,000	3,231,000	(37,000)	53,000	11,000	**4,419,000**	2,141,000	1,831,000	0	0	419,000	1,000	0	**4,392,000**
2045	W	622,000	313,000	3,263,000	(45,000)	53,000	12,000	**4,218,000**	1,971,000	1,847,000	0	0	355,000	1,000	0	**4,174,000**
2046	D	268,000	571,000	2,149,000	(57,000)	68,000	12,000	**3,011,000**	893,000	1,794,000	0	0	346,000	1,000	0	**3,034,000**
2047	D	402,000	575,000	2,067,000	(55,000)	64,000	12,000	**3,065,000**	834,000	1,820,000	0	0	383,000	0	0	**3,037,000**
2048	N	331,000	593,000	2,696,000	(49,000)	49,000	12,000	**3,632,000**	1,457,000	1,893,000	0	0	358,000	0	0	**3,708,000**
2049	N	658,000	407,000	2,683,000	(29,000)	62,000	12,000	**3,793,000**	1,525,000	1,706,000	0	0	474,000	2,000	0	**3,707,000**
2050	W	708,000	316,000	3,145,000	(40,000)	54,000	13,000	**4,196,000**	1,974,000	1,878,000	0	0	376,000	1,000	0	**4,229,000**
2051	D	350,000	447,000	2,110,000	(51,000)	69,000	13,000	**2,938,000**	858,000	1,738,000	0	0	302,000	1,000	0	**2,899,000**
2052	D	390,000	553,000	2,103,000	(46,000)	67,000	14,000	**3,081,000**	873,000	1,727,000	0	0	416,000	1,000	0	**3,017,000**
2053	SC	306,000	634,000	1,765,000	(44,000)	47,000	8,000	**2,716,000**	801,000	1,699,000	0	0	304,000	0	0	**2,804,000**
2054	SC	340,000	632,000	1,678,000	(29,000)	34,000	7,000	**2,662,000**	750,000	1,657,000	0	0	354,000	0	0	**2,761,000**
2055	D	630,000	453,000	1,831,000	(39,000)	49,000	14,000	**2,938,000**	855,000	1,742,000	0	0	385,000	1,000	0	**2,983,000**
2056	W	745,000	351,000	3,073,000	(44,000)	46,000	12,000	**4,183,000**	1,935,000	1,894,000	0	0	450,000	0	0	**4,279,000**
2057	W	693,000	313,000	3,150,000	(34,000)	55,000	12,000	**4,189,000**	1,932,000	1,893,000	0	0	401,000	1,000	0	**4,227,000**
2058	N	478,000	547,000	2,688,000	(49,000)	54,000	15,000	**3,733,000**	1,417,000	1,871,000	0	0	446,000	0	0	**3,734,000**
2059	W	739,000	309,000	3,154,000	(33,000)	55,000	13,000	**4,237,000**	1,941,000	1,888,000	0	0	425,000	1,000	0	**4,255,000**
2060	D	405,000	441,000	2,111,000	(52,000)	69,000	15,000	**2,989,000**	847,000	1,786,000	0	0	360,000	1,000	0	**2,994,000**
2061	W	910,000	300,000	3,276,000	(33,000)	55,000	13,000	**4,521,000**	2,106,000	1,896,000	0	0	512,000	1,000	0	**4,515,000**
2062	N	466,000	459,000	2,687,000	(50,000)	58,000	16,000	**3,636,000**	1,482,000	1,757,000	0	0	420,000	0	0	**3,659,000**
2063	N	477,000	544,000	2,674,000	(49,000)	54,000	16,000	**3,716,000**	1,454,000	1,861,000	0	0	397,000	0	0	**3,712,000**
2064	D	338,000	447,000	2,123,000	(49,000)	70,000	16,000	**2,945,000**	818,000	1,780,000	0	0	341,000	1,000	0	**2,940,000**
2065	N	725,000	443,000	2,688,000	(47,000)	58,000	17,000	**3,884,000**	1,502,000	1,739,000	0	0	573,000	1,000	0	**3,815,000**
2066	W	668,000	323,000	3,153,000	(34,000)	55,000	15,000	**4,180,000**	1,929,000	1,897,000	0	0	383,000	1,000	0	**4,210,000**
2067	W	690,000	321,000	3,262,000	(33,000)	55,000	15,000	**4,310,000**	1,942,000	1,898,000	0	0	394,000	1,000	0	**4,235,000**
2068	D	448,000	558,000	1,859,000	(52,000)	69,000	12,000	**2,894,000**	872,000	1,695,000	0	0	327,000	1,000	0	**2,895,000**
2069	D	382,000	561,000	1,824,000	(50,000)	66,000	12,000	**2,795,000**	788,000	1,688,000	0	0	328,000	1,000	0	**2,805,000**
2070	W	962,000	302,000	3,388,000	(34,000)	55,000	16,000	**4,689,000**	2,130,000	1,887,000	0	0	557,000	1,000	0	**4,575,000**

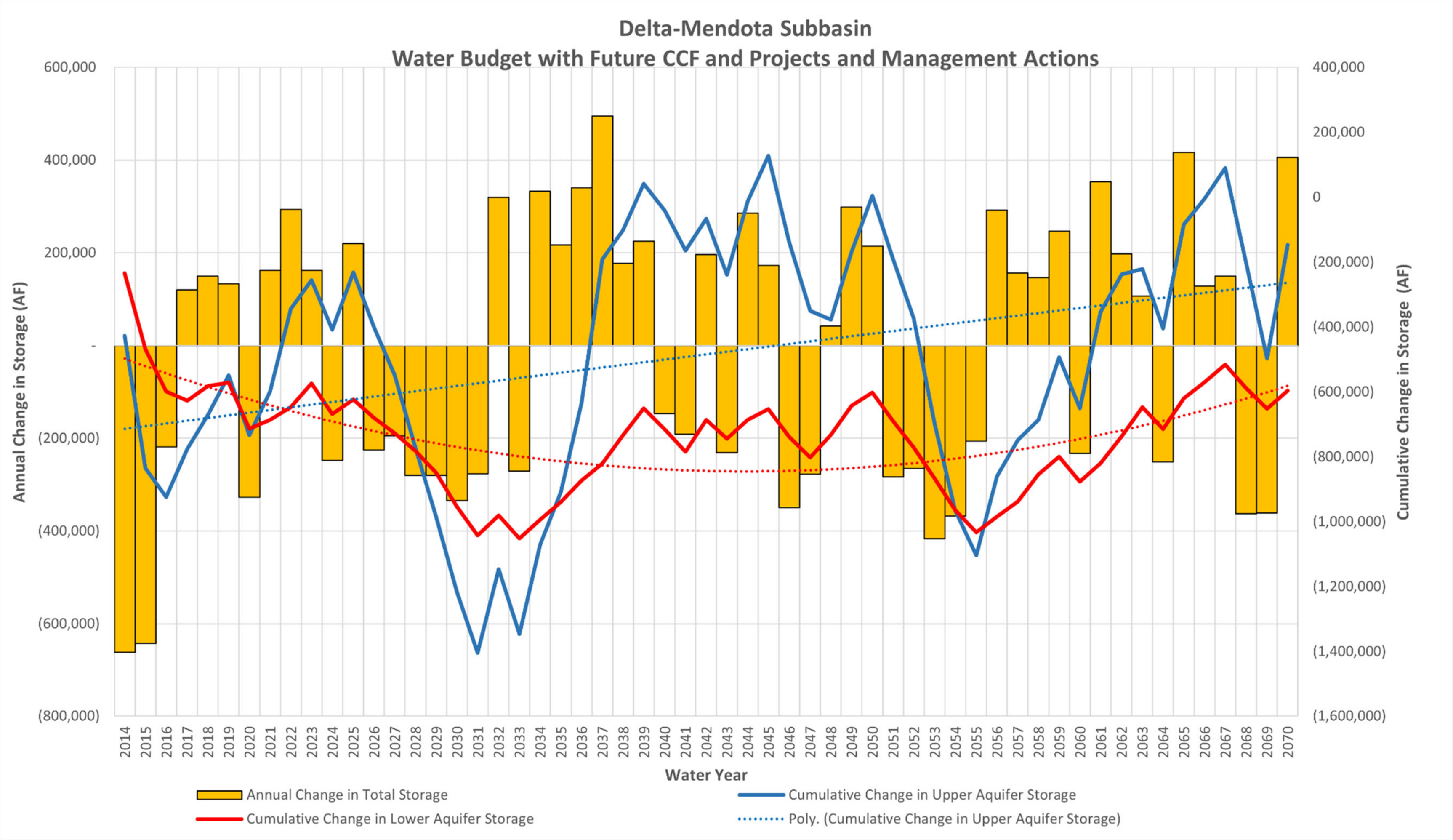
Table CC-15: Delta-Mendota Subbasin Projected Water Budget, Groundwater Budget (containing climate change factors and projects and management actions)

Groundwater Budget																			
		Inflows								Outflows							Change in Storage		
		Infiltration	Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effects) - NCDM Only	Deep Percolation (Project Effects) - NCDM Only	Project Effects	**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer - Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only	**Total Outflows**	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*				*Upper Aquifer*	*Lower Aquifer*	*Total*
2014	SC	275,000	162,000	115,000	0	0	0	0	**552,000**	513,000	101,000	321,000	191,000	0	0	**1,126,000**	(428,000)	(234,000)	(662,000)
2015	SC	333,000	154,000	113,000	0	0	0	0	**600,000**	558,000	101,000	325,000	202,000	0	0	**1,186,000**	(408,000)	(234,000)	(642,000)
2016	D	487,000	152,000	112,000	0	0	0	0	**751,000**	354,000	60,000	313,000	156,000	0	0	**883,000**	(89,000)	(130,000)	(219,000)
2017	W	525,000	198,000	128,000	0	0	0	10,000	**861,000**	254,000	50,000	307,000	91,000	0	0	**702,000**	148,000	(28,000)	120,000
2018	N	465,000	190,000	115,000	0	0	0	0	**770,000**	347,000	59,000	264,000	101,000	0	0	**771,000**	105,000	44,000	149,000
2019	W	461,000	216,000	124,000	0	0	0	10,000	**811,000**	231,000	38,000	279,000	74,000	0	0	**622,000**	122,000	11,000	133,000
2020	D	385,000	153,000	106,000	0	0	3,000	0	**647,000**	354,000	57,000	298,000	136,000	0	0	**845,000**	(185,000)	(142,000)	(327,000)
2021	W	464,000	218,000	125,000	0	0	10,000	0	**817,000**	224,000	39,000	280,000	72,000	0	0	**615,000**	135,000	27,000	162,000
2022	W	553,000	218,000	125,000	0	0	10,000	10,000	**916,000**	214,000	37,000	276,000	77,000	0	0	**604,000**	254,000	40,000	294,000
2023	N	449,000	186,000	117,000	0	0	3,000	0	**755,000**	348,000	55,000	264,000	111,000	0	0	**778,000**	89,000	74,000	163,000
2024	D	417,000	151,000	108,000	0	0	3,000	0	**679,000**	349,000	58,000	301,000	134,000	0	0	**842,000**	(153,000)	(94,000)	(247,000)
2025	W	493,000	214,000	125,000	0	0	10,000	10,000	**852,000**	227,000	38,000	278,000	73,000	0	0	**616,000**	176,000	44,000	220,000
2026	D	451,000	152,000	107,000	0	0	6,000	0	**716,000**	413,000	51,000	302,000	137,000	0	0	**903,000**	(169,000)	(56,000)	(225,000)
2027	D	470,000	152,000	106,000	0	0	9,000	0	**737,000**	411,000	52,000	303,000	131,000	0	0	**897,000**	(148,000)	(47,000)	(195,000)
2028	D	390,000	153,000	104,000	0	0	9,000	0	**656,000**	414,000	51,000	304,000	130,000	0	0	**899,000**	(225,000)	(55,000)	(280,000)
2029	D	395,000	154,000	103,000	0	0	10,000	0	**662,000**	410,000	51,000	303,000	129,000	0	0	**893,000**	(213,000)	(67,000)	(280,000)
2030	SC	400,000	159,000	97,000	0	0	9,000	0	**665,000**	454,000	84,000	312,000	127,000	0	0	**977,000**	(230,000)	(104,000)	(334,000)
2031	SC	442,000	158,000	97,000	0	0	9,000	0	**706,000**	453,000	82,000	313,000	118,000	0	0	**966,000**	(188,000)	(89,000)	(277,000)
2032	W	545,000	220,000	115,000	0	0	22,000	0	**902,000**	213,000	35,000	279,000	68,000	0	0	**595,000**	258,000	61,000	319,000
2033	D	400,000	157,000	98,000	0	0	10,000	0	**665,000**	402,000	50,000	308,000	133,000	0	0	**893,000**	(201,000)	(70,000)	(271,000)
2034	W	547,000	220,000	118,000	0	0	22,000	10,000	**917,000**	203,000	29,000	273,000	70,000	0	0	**575,000**	275,000	57,000	332,000
2035	W	459,000	220,000	119,000	0	0	22,000	0	**820,000**	225,000	34,000	276,000	76,000	0	0	**611,000**	162,000	55,000	217,000
2036	W	552,000	221,000	119,000	0	0	22,000	10,000	**924,000**	243,000	51,000	275,000	76,000	0	0	**645,000**	275,000	65,000	340,000
2037	W	719,000	217,000	122,000	0	0	23,000	10,000	**1,091,000**	202,000	31,000	269,000	80,000	0	0	**582,000**	442,000	53,000	495,000
2038	N	415,000	185,000	114,000	0	0	15,000	0	**729,000**	350,000	58,000	258,000	111,000	0	0	**777,000**	90,000	87,000	177,000
2039	N	455,000	197,000	117,000	0	0	15,000	0	**784,000**	360,000	63,000	262,000	108,000	0	0	**793,000**	142,000	82,000	224,000
2040	D	457,000	151,000	104,000	0	0	10,000	0	**722,000**	348,000	53,000	299,000	136,000	0	0	**836,000**	(82,000)	(65,000)	(147,000)
2041	D	410,000	150,000	101,000	0	0	10,000	0	**671,000**	352,000	56,000	299,000	130,000	0	0	**837,000**	(123,000)	(68,000)	(191,000)
2042	N	448,000	197,000	111,000	0	0	15,000	0	**771,000**	385,000	62,000	264,000	100,000	0	0	**811,000**	98,000	98,000	196,000
2043	D	368,000	151,000	100,000	0	0	10,000	0	**629,000**	357,000	55,000	298,000	109,000	0	0	**819,000**	(173,000)	(58,000)	(231,000)

Groundwater Budget

		Inflows								Outflows							Change in Storage		
		Infiltration	Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effects) - NCDM Only	Deep Percolation (Project Effects) - NCDM Only	Project Effects	**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer - Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only	**Total Outflows**	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*				*Upper Aquifer*	*Lower Aquifer*	*Total*
2044	W	502,000	209,000	119,000	0	0	23,000	28,000	**881,000**	220,000	38,000	282,000	71,000	0	0	**611,000**	227,000	59,000	286,000
2045	W	413,000	215,000	121,000	0	0	22,000	28,000	**799,000**	235,000	43,000	271,000	77,000	0	0	**626,000**	141,000	32,000	173,000
2046	D	382,000	151,000	101,000	0	0	10,000	0	**644,000**	469,000	68,000	296,000	112,000	0	0	**945,000**	(264,000)	(85,000)	(349,000)
2047	D	422,000	150,000	99,000	0	0	10,000	0	**681,000**	471,000	71,000	298,000	105,000	0	0	**945,000**	(214,000)	(64,000)	(278,000)
2048	N	393,000	187,000	109,000	0	0	14,000	0	**703,000**	475,000	92,000	263,000	100,000	0	0	**930,000**	(27,000)	69,000	42,000
2049	N	545,000	188,000	110,000	0	0	16,000	0	**859,000**	345,000	56,000	262,000	103,000	0	0	**766,000**	209,000	90,000	299,000
2050	W	436,000	217,000	120,000	0	0	23,000	28,000	**824,000**	239,000	46,000	274,000	73,000	0	0	**632,000**	173,000	41,000	214,000
2051	D	343,000	152,000	101,000	0	0	10,000	0	**606,000**	361,000	58,000	296,000	136,000	0	0	**851,000**	(195,000)	(88,000)	(283,000)
2052	D	466,000	150,000	98,000	0	0	10,000	0	**724,000**	463,000	66,000	296,000	105,000	0	0	**930,000**	(183,000)	(82,000)	(265,000)
2053	SC	341,000	156,000	97,000	0	0	9,000	0	**603,000**	499,000	99,000	312,000	104,000	0	0	**1,014,000**	(322,000)	(95,000)	(417,000)
2054	SC	392,000	156,000	96,000	0	0	8,000	0	**652,000**	514,000	98,000	312,000	102,000	0	0	**1,026,000**	(270,000)	(98,000)	(368,000)
2055	D	422,000	152,000	96,000	0	0	9,000	0	**679,000**	376,000	62,000	296,000	101,000	0	0	**835,000**	(138,000)	(69,000)	(207,000)
2056	W	511,000	222,000	115,000	0	0	22,000	28,000	**898,000**	258,000	58,000	278,000	67,000	0	0	**661,000**	244,000	48,000	292,000
2057	W	437,000	222,000	116,000	0	0	23,000	0	**798,000**	249,000	41,000	279,000	73,000	0	0	**642,000**	110,000	46,000	156,000
2058	N	479,000	205,000	108,000	0	0	15,000	0	**807,000**	453,000	69,000	266,000	105,000	0	0	**893,000**	63,000	83,000	146,000
2059	W	482,000	221,000	120,000	0	0	23,000	28,000	**874,000**	245,000	40,000	275,000	74,000	0	0	**634,000**	192,000	55,000	247,000
2060	D	395,000	150,000	101,000	0	0	10,000	0	**656,000**	361,000	51,000	293,000	136,000	0	0	**841,000**	(157,000)	(76,000)	(233,000)
2061	W	581,000	218,000	120,000	0	0	23,000	28,000	**970,000**	238,000	40,000	274,000	72,000	0	0	**624,000**	297,000	56,000	353,000
2062	N	454,000	198,000	113,000	0	0	15,000	0	**780,000**	372,000	60,000	262,000	109,000	0	0	**803,000**	115,000	83,000	198,000
2063	N	431,000	200,000	113,000	0	0	15,000	0	**759,000**	448,000	71,000	264,000	107,000	0	0	**890,000**	17,000	90,000	107,000
2064	D	376,000	152,000	101,000	0	0	11,000	0	**640,000**	368,000	52,000	299,000	134,000	0	0	**853,000**	(183,000)	(68,000)	(251,000)
2065	N	657,000	186,000	111,000	0	0	15,000	0	**969,000**	360,000	60,000	263,000	103,000	0	0	**786,000**	321,000	95,000	416,000
2066	W	419,000	218,000	120,000	0	0	23,000	0	**780,000**	258,000	42,000	280,000	74,000	0	0	**654,000**	78,000	50,000	128,000
2067	W	430,000	217,000	121,000	0	0	23,000	0	**791,000**	257,000	42,000	277,000	77,000	0	0	**653,000**	96,000	54,000	150,000
2068	D	362,000	155,000	102,000	0	0	10,000	0	**629,000**	451,000	64,000	311,000	113,000	0	0	**939,000**	(291,000)	(72,000)	(363,000)
2069	D	364,000	154,000	98,000	0	0	10,000	0	**626,000**	457,000	62,000	312,000	105,000	0	0	**936,000**	(297,000)	(64,000)	(361,000)
2070	W	638,000	211,000	118,000	0	0	23,000	28,000	**1,018,000**	237,000	42,000	270,000	70,000	0	0	**619,000**	350,000	55,000	405,000

Figure CC-64: Change in Storage, Delta-Mendota Subbasin Projected Water Budget



4.3.4 Sustainable Yield

Under SGMA, sustainable yield is defined as “the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result.” (CWC 10721(w)). Sustainable yield estimates for the Upper Aquifer and Lower Aquifer have been developed in a coordinated fashion for the Delta-Mendota Subbasin by the Delta-Mendota Technical Working Group and approved by the Delta-Mendota Coordination Committee.

Upper Aquifer Sustainable Yield Estimate

Methodologies for calculating Upper Aquifer sustainable yield were discussed by both the Delta-Mendota Coordination Committee and an ad-hoc Technical Working Group of the Coordination Committee. During a workshop dedicated to this effort, several basic concepts and principles were discussed to calculate the Upper Aquifer sustainable yield estimate. Consideration was given to several potential options with increasing detail, including a combination of the following: total Subbasin Upper Aquifer pumping volumes, total Subbasin Upper Aquifer change in storage, and Subbasin Upper Aquifer subsurface inflows and outflows. Inflow from certain neighboring subbasins, based on groundwater flow direction, as well as subsurface inflow from the Coast Range at existing gradients (as part of the inflow to the Northern & Central Delta-Mendota Region GSP area) was considered. Outflow to neighboring subbasins at existing gradients was also considered in certain applicable areas along the Delta-Mendota Subbasin boundary based on groundwater flow characteristics.

An overarching goal of this Subbasin is to maintain a balanced water budget by managing groundwater extractions (pumping). Therefore, the Upper Aquifer sustainable yield was estimated using the change in storage from the historic water budget (WY2003-2012). Based on these considerations, the following formula was selected for estimating Upper Aquifer sustainable yield utilizing the consolidated historic water budget components:

> Upper Aquifer Sustainable Yield = (Pumping + Change in Storage) + (Subsurface Outflow – Subsurface Inflow)

The formula for determining Upper Aquifer sustainable yield was applied to the following compiled Delta-Mendota Subbasin projected water budgets (WY2014-2070):

- Projected Baseline values with Climate Change Factors
- Projected Baseline values with Climate Change Factors and Projects and Management Actions

This analysis resulted in an Upper Aquifer Sustainable Yield estimate of 403,000 acre-feet.

The Upper Aquifer sustainable yield value, derived from calculations using the best available but limited data, is considered to be a preliminary estimation only and will be updated to an anticipated higher level of accuracy in future GSP updates. The intention of the Delta-Mendota Subbasin GSAs, following GSP submission in 2020, is to increase subbasin-wide data collection efforts. Improved data, modeling results, and understanding of subsurface flows will allow the GSAs and each GSP Group to improve estimated sustainable yield values for future GSP updates. The GSP Groups are in the process of developing GSP implementation guidelines that will address future data collection efforts and other GSP implementation activities.

The Upper Aquifer sustainable yield calculated range reflects the principle that the GSAs within the Delta-Mendota Subbasin reserve the right to claim or retain some portion of subbasin outflow generated by the lowering of groundwater levels from neighboring subbasins and the equitable portion of sources of recharge shared between two subbasins, by physical or non-physical means, in the future if the Delta-Mendota Subbasin GSAs determine that doing so will improve Subbasin sustainability or will prevent undesirable results due to the chronic lowering of groundwater levels. Furthermore, intra-basin coordination during GSP development, followed by continuing inter-basin coordination discussions and data collection after GSP adoption, will allow the GSAs to further refine these determinations.

Lower Aquifer Sustainable Yield Estimate

Currently, within the Delta-Mendota Subbasin, the distribution of known Lower Aquifer water level data and extraction volume data are not sufficient to allow for an accurate calculation of Lower Aquifer sustainable yield utilizing the same methodology as for the Upper Aquifer. Following discussions by both the Coordination Committee and the Technical Working Group of the Coordination Committee, a consensus was reached to establish a Lower Aquifer sustainable yield estimate for the Subbasin based on a projection of existing subsidence rates as measured along the DMC with the minimum threshold established for inelastic land subsidence. In the original 2020 submittal, the calculation for the Lower Aquifer sustainable yield was based on the following. The Westlands Water District GSA recently conducted a study using groundwater modeling, in conjunction with the Westside GSP development, to estimate sustainable yield for the Westside Subbasin. Based on an analysis of available data and an initial assumption of Lower Aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, Groundwater Management Strategy Concepts presentation to the WWD Board on October 16, 2018), the GSA estimates a sustainable yield of 230,000 to 250,000 acre-feet, with historic conditions suggesting a range from 250,000 to 300,000 acre-feet (Westlands Water District GSA, Westside Subbasin's Groundwater Model Forecast and Augmentation Strategies presentation to the WWD Board on April 3, 2019). Using Westlands Water District GSA's analysis, the Delta-Mendota Coordination Committee recommended a slightly more conservative sustainable yield value of one-third (0.33) an acre-foot per acre for the Delta-Mendota Subbasin. Using this more conservative value, the estimated Lower Aquifer sustainable yield is approximately 250,000 acre-feet per year over the approximately 750,000-acre subbasin. It should be noted that sustainable management of the Lower Aquifer is governed by significant and unreasonable subsidence rather than sustainable yield. The distribution of sustainable yield is not uniform throughout the Subbasin, and it will be the responsibility of each GSA in the Subbasin to manage Lower Aquifer pumping to prevent significant and unreasonable subsidence.

Acknowledging that land subsidence is occurring at localized areas in the Subbasin, the DMCC refined the Lower Aquifer sustainable yield calculation, adjusting the value from 250,000 AF to 101,000 AF, based on observed extractions from the Lower Aquifer during WY2015. This refinement is consistent with the common definitions established across the Subbasin for all SMCs. It is important to note that subsidence will be the primary factor influencing the allowable volume of groundwater that can be extracted from the Lower Aquifer without incurring significant and unreasonable impacts on beneficial uses and users. As such, this number will be updated as data gaps are filled, particularly using the Proposition (Prop) 68 grant-funded well inventory and subsidence study and the results of the Airborne Electromagnetic (AEM) survey recently completed by DWR. Furthermore, the Subbasin will investigate the feasibility to recharge the Lower Aquifer as a means of reducing subsidence and managing future Lower Aquifer sustainable yield.

The Lower Aquifer sustainable yield estimate will be refined in the future based on data collected and compiled for the Subbasin. This current sustainable yield approximation highlights the importance of an accepted Subbasin-level subsidence monitoring program concurrent with improved estimates of sub-Corcoran Clay groundwater extractions.