G. Other Water Use

There are no other water uses in the District.

Section IV: Description of Quantity and Quality of the Water Resources of the Agricultural Water Supplier

A. Water Supply Quantity

1. Surface Water Supply

Under its enabling legislation, KCWA was granted the primary power to acquire and contract water supplies, control storm water, reclaim water, reclaim land, and protect groundwater quality in Kern County. The Agency is a State Water Contractor and obtains water from the SWP for delivery to its 13 member agencies (a.k.a., Member Units). BMWD is a Member Unit of the KCWA. SWP deliveries for KCWA were initiated in 1968 with a "build up" schedule that allowed for increasing amounts of "firm water" each year, and decreasing amounts of "surplus water" until the maximum "firm water" Table A amount was achieved in 1990. BMWD's original 1967 Table A water supply contract with KCWA provided for an annual contract of 105,100 Acre-Feet (AF) of water. In 1970, BMWD purchased an additional perpetual annual Table A water supply contract of 50,000 AF raising the annual Table A water supply contract to 155,100 AF. Since then, BMWD has transferred a total of 62,500 AF of Table A contract water to other agencies. BMWD chose to transfer a portion of their Table A contract to reduce their SWP costs for a SWP contract supply that exceeded demand in BMWD. BMWD's annual Table A contract water presently stands at 92,600 AF of which only 18,520 was delivered in 2020 (water supply). The current water demands are approximately 99,885 AF per year.

BMWD also has the ability to purchase water through various State and locally operated pools several of which serve as important supplies for groundwater recharge. The availability of these supplies, however, has become scarcer over time.

Table 28. Surface Water Supplies (AF)						
Source	**Diversion Restriction**	**2016**	**2017**	**2018**	**2019**	**2020**
Pre-1914 water rights	NA	0	0	0	0	0
CVP class I water contract	NA	0	0	0	0	0
SWP water contract	ESA & Delta BIOps	55,560	78,710	32,410	69,450	18,520
Other Surface Water	ESA & Delta BIOps	-10,173*	60,595	52,090	6,437	26,673
Banked water recovery	NA	24,722	-73198**	13846	1,763	15,797
Upslope drain water	NA	0	0	0	0	0
Carryover		19797	32126	-5,932	14,459	31,647
Other		0	0	0	0	0
Total		**89906**	**98233**	**92414**	**92109**	**92637**
Notes:						
ESA = Endangered Species Act						
NA = Not Applicable						
BiOps = Smelt and Salmon Biological Opinions						
*Other Surface water is Imported Surface Waters – Future Year Carroyver, and may be negative in some instances						
**A Negative number indicates a recharge year						

Table 29. Restrictions on Water Sources			
Source	**Restrictions***	**Name of Agency Imposing Restrictions**	**Operational Constraints**
SWP	Delta Diversions	NMFS and SWRCB	ESA and Water Quality
Notes: *ESA = Endangered Species Act protection measures *NMFS = National Marine Fisheries Service *SWRCB = Sate Water Resources Control Board *Water Quality = restrictions relate to maintenance of Delta salinity standards.			

2. Groundwater Supply

A few private groundwater wells have historically supplied limited amounts of water for blending with SWP water, usually during shortage years. The District does participate in the Berrenda Mesa and Pioneer groundwater banking projects to supplement dry-year water supplies. Annually, the maximum amount BMWD can recover from both banking projects varies depending on demand downstream in the California Aqueduct. In very dry years, it can be as low as 35,000-40,000 AF. Currently, they have banked a total of 113,458 AF in these projects. Both banking projects are operated and maintained by KCWA.

Individual landowners participate in other groundwater banking projects which allows them to deliver a significant amount of banked groundwater for and on their behalf.

Deep percolation amounts are unknown in BMWD. Estimates of District wide deep percolation from water balance calculations included later show negative deep percolation (obviously in error due either to widespread deficit irrigation and/or inaccurate crop coefficient factors). Deep percolation estimates from USDA soil moisture monitoring demonstration projects in the District show very low percent of applied water.

3. Sustainable Groundwater Management Act (SGMA)

Berrenda Mesa Water District is located within the Kern Subbasin. Berrenda Mesa's SGMA compliance is handled through the Westside District Water Authority (WDWA), which is a member of the Kern Groundwater Authority (KGA), a Groundwater Sustainability Agency in the Kern Subbasin. An initial plan was submitted in early 2020, and the WDWA has been employing the management actions since then. The Management Area Plan (MAP) outlined three management actions to be completed over the course of SGMA implementation. All the management actions identified in the WDWA chapter GSP continue to progress. The three current management actions as stated in the WDWA chapter GSP are:

- Collection and analysis of representative hydrogeologic data to remedy a documented lack of groundwater data in the Westside.
- Water resource coordination – due to poor groundwater quality, Westside landowners rely primarily on surface water. As such to further reduce groundwater use and increase drought resiliency, WDWA Districts and their landowners will continue to work cooperatively in pursuing supplemental surface water opportunities, including trades and purchases both between themselves and with parties outside of the WDWA.
- Conjunctive reuse of brackish water as a new source of water supply is in the feasibility study and economic assessment phase. Sources of brackish water under study for treatment and beneficial reuse include groundwater with TDS above 2,000 mg/L and oilfield produced water.

For more information on Berrenda Mesa Water District's compliance with SGMA, please see the Kern Groundwater Authority Groundwater Sustainability Plan, and reference the WDWA Management Area Plan.

4. Delta Plan Consistency

To provide "the expected outcome for measurable reduction in Delta reliance", baseline historic Delta supplies delivered to DRWD were compared to supplies delivered over the past decade. Additionally, Delta supply reduction projections were made for comparison and future planning. For the purposes of comparison, the historic baseline period selected begins in 1996 and ends in 2010 because it is consistent with the typical historic water budget reporting period included in the recently completed Groundwater Sustainability Plans. This period provides a reasonable time frame for assessing average current conditions and to demonstrate consistency with reduced Delta reliance after enactment of the Delta Reform Act (2009). The table below shows projected water supplies from the Delta. The California Water Commission CALSIM 2030 and 2070 climate change scenarios were used to project future water supplies under 2030 and 2070 climate change scenarios. The table and figure below demonstrate reduced Delta reliance. Over the 2015 AWMP period, a 30% reduction in Delta water supplies was observed when compared to the baseline condition discussed above. Over the past decade (combined 2015 and 2020 AWMP period), a 22% reduction was observed. Due to increasing environmental commitments and restrictions on Delta Flows, landowners in the District will continue to experience reductions in Delta supply, likely exceeding the 2030 and 2070 projections.

Table 30. Comparison of Historic Average Annual Delta Supplies vs. Projected Average Annual Delta Supplies

Value	Baseline Delta Supplies (1995-2010)	2015 Conditions Delta Supplies	2020 Conditions Delta Supplies	2030 Climate Conditions Delta Supplies	2070 Climate Conditions Delta Supplies
Average Annual Supplies	94,000	66,000	73,000	72,000	67,000
Percent of Baseline Supply	n/a	70%	78%	77%	71%
Percent Reduction in Supplies		30%	22%	23%	29%

Figure 2. Historic, 2015 & 2020 AWMP and Projected Delta Supplies

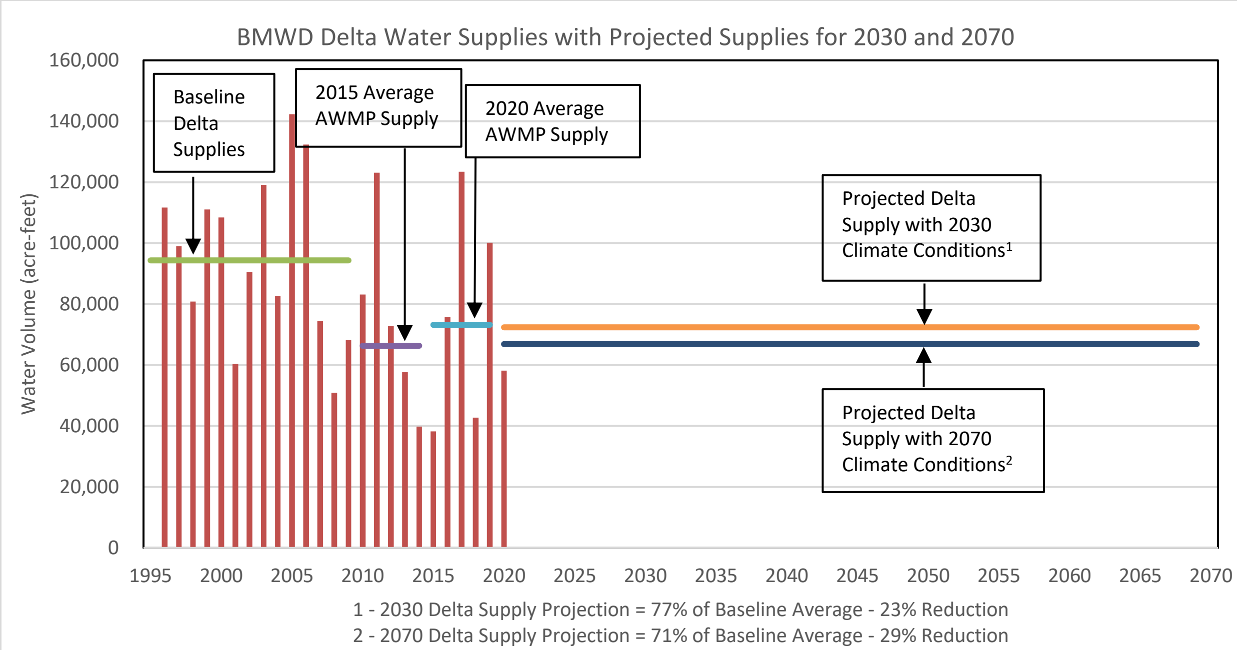

Table 31. Groundwater Basins			
Basin Name	**Size (Sq. Mi.)**	**Usable Capacity (AF)**	**Safe Yield (AF/Yr)**
BMWD portion of Kern sub-basin of Tulare Lake basin	87	Unknown and limited	Unknown and limited
Note: Area of main Tulare Lake Hydrologic Region: 5,149,000 acres = 8,045 sq. mi. Area of Kern County sub-basin: 1,950,000 acres = 3,047 sq. mi. (37.9% of Tulare Lake Hydrologic Region) Area of BMWD: 55,440 acres = 87 sq. mi. (2.8% of Kern County Sub-basin)			

Table 32. Groundwater Management Plan	
Written By	None in BMWD
Year	Not Applicable
Is Appendix Attached?	No

Table 33. Groundwater Supplies (AF)						
Groundwater Basin	**Diversion Restriction**	**2016**	**2017**	**2018**	**2019**	**2020**
Water Supplier Direct Pumping	None	N/A	N/A	N/A	N/A	0
Private Pumping	None	N/A	N/A	N/A	N/A	674
Transfers / Exchanges	None	N/A	N/A	N/A	N/A	0
TOTAL						**674**

5. Other Water Supplies

BMWD has no other water supplies besides those described before.

6. Drainage from the Water Supplier's Service Area

The land serviced by BMWD does not have a subsurface drainage water problem. There are no on-farm subsurface tile drains (Table 34).

On-farm tail water (surface) drainage within the District's service is also minimal due to the use of pressurized irrigation systems (Table 34). In the cases where on-farm tailwater is generated, the water users typically contain it within the property, as stated in the District's Operating Rules and Regulations.

Table 34. Drainage Discharge (AF)						
Surface/ Subsurface Drainage Path	**2020**	**2019**	**2018**	**2017**	**2016**	**Inside/ Outside Service Area**
Subsurface drainage into evaporation pond	0	0	0	0	0	Inside

B. Water Supply Quality

1. Surface Water Supply

There have been no water quality problems that limit the use of the SWP water within the District. The District does not monitor the surface water quality since all of the water delivered by the District is from the SWP and other agencies are already analyzing this water. The DWR has an on-going monitoring program where the quality of the SWP water is monitored on a monthly basis. The water is sampled at several locations along the Aqueduct and analyzed for electrical conductivity, standard minerals, selected trace elements and chemical residue. Table 3-3 presents historical water quality data for the months of January and June for the years 2010 through 2020. The water quality data shown in Table 35 was collected by DWR at Check 21 in the Aqueduct near Kettleman City, just upstream of the District.

Table 35. Surface Water Supply Quality

Station Name/NR	: KETTLEMAN CK-21 (KA017226)														
		Sample Date													
Parameter	Units	1/12/2010	6/15/2010	1/18/2011	6/14/2011	1/17/2012	6/19/2012	1/15/2013	6/18/2013	1/14/2014	6/17/2014	1/20/2015	6/16/2015	1/14/2020	6/16/2020
Alkalinity as CaCO3	mg/L	78	76	47	40	77	73	72	72	89	93	95	92	71	76
Aluminum	mg/L	N/A	N/A	N/A	0.173,0.175**	0.077	0.092	0.124	0.048	r	r	0.015	r	0.0441	0.063
Dissolved Ammonia	mg/L	0.04	0.01	0.05	<0.01	0.02	0.01	0.05	r	0.002	0.02	0.08	0.04	<0.05	<0.05
Dissolved Arsenic	mg/L	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.002	0.001	0.003	0.004	0.002	<0.001	0.002
Arsenic	mg/L	N/A	N/A	N/A	0.001	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.003	0.0023	0.002
Barium	mg/L	N/A	N/A	N/A	<0.05	0.039	0.033	0.033	0.037	0.031	0.026	0.045	0.039	0.037	0.032
Dissolved Beryllium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	r	r	r	r	r	r	<0.001	<0.001
Beryllium	mg/L	N/A	N/A	N/A	<0.001	<0.001	<0.001	r	r	r	r	r	r	<0.001	<0.001
Dissolved Boron	mg/L	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.151
Dissolved Bromide	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.18	0.193
Dissolved Cadmium	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<0.001	<0.001
Cadmium	mg/L	N/A	N/A	N/A	<0.001	<0.001	<0.001	r	r	r	r	r	r	<0.001	<0.001
Dissolved Calcium	mg/L	22	21	15	12	22	20	22	22	25	25	26	25	18	19
Dissolved Chloride	mg/L	75	70	28	24	109	62	74	76	107	110	116	109	59.5	68
Dissolved Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	r	r	r	r	r	r	<0.001	<0.001
Chromium	mg/L	N/A	N/A	N/A	0.001	0.003	0.001	r	r	r	r	r	r	<0.001	<0.001
Conductance (EC) µS/cm	µS/cm	496	449	259	223	630	426	474	469	624	648	671	645	415	450
Dissolved Copper	mg/L	0.002	0.002	0.008	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	<0.001	0.001
Copper	mg/L	N/A	N/A	N/A	0.002	0.002	0.001	0.002	0.002	0.001	0.002	0.002	0.002	0.003	<0.001
Dissolved Hardness as CaCO3	mg/L	112	105	68	53	114	98	113	111	132	135	137	136	93	95
Dissolved Iron	mg/L	<0.005	<0.005	0.017	0.016	0.019	<0.005	0.034	r	0.005	r	r	r	<0.005	0.0132
Iron	mg/L	N/A	N/A	N/A	0.389,0.395**	0.131	0.12	0.14	0.08	0.017	0.017	0.017	0.023	0.099	0.076
Kjeldahl Nitrogen as N	mg/L	0.4	0.4	0.6	0.4	0.4	0.3	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.3
Dissolved Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	r	r	r	r	r	r	<0.001	<0.001
Lead	mg/L	N/A	N/A	N/A	<0.001	<0.001	<0.001	r	r	r	r	r	r	<0.001	<0.001
Dissolved Lithium	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dissolved Magnesium	mg/L	14	13	8	6	15	12	14	14	17	18	18	18	11	11.6
Dissolved Manganese	mg/L	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	r	0.005	r	0.005	0.01	r	<0.005	<0.005
Manganese	mg/L	N/A	N/A	N/A	0.049,0.05**	0.014	0.021	0.007	0.015	0.008	0.015	0.023	0.017	0.013	0.018
Dissolved Mercury	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<0.0002	<0.0002
Dissolved Molybdenum	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dissolved Nickel	mg/L	0.001	0.001	0.002	<0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	<0.001	0.002
Nickel	mg/L	N/A	N/A	N/A	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Dissolved Nitrate	mg/L	3.7	2.5	2.9	2.4	3.8	1.8	4.6	1.6	2.4	0.4	0.2	2	4.6	0.7
Dissolved Nitrate + Nitrite as N	mg/L	0.69	0.54	0.65	0.41	0.87	0.4	1	0.32	0.57	0.09	r	0.49	1.06	0.156
Dissolved Ortho-phosphate as I	mg/L	0.05	0.08	0.08	0.05	0.06	0.06	0.07	0.05	0.05	0.05	0.08	0.08	0.085	0.054
Dissolved Organic Carbon	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.5	3.3
Total Organic Carbon	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.7	3.2
Phosphorus	mg/L	0.09	0.1	0.12	0.11	0.08	0.08	0.09	0.08	0.07	0.08	0.09	0.1	0.08	0.07
Dissolved Selenium	mg/L	0.001	0.001	0.001	<0.001	<0.001	0.001	r	r	0.001	0.001	0.001	0.001	<0.001	0.001
Selenium	mg/L	N/A	N/A	N/A	<0.001	<0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	<0.001	0.001
Silver	mg/L	N/A	N/A	N/A	<0.001	<0.001	<0.001	r	r	r	r	r	r	<0.001	<0.001
Dissolved Sodium	mg/L	52	50	24	21	68	46	56	54	76	80	79	71	45	48
Total Dissolved Solids	mg/L	275	274	151	124	347	236	270	261	345	367	370	357	230	249
Total Suspended Solids	mg/L	2	11	7	20	2	11	1	3	1	1	r	1	1	2.3
Volatile Suspended Solids	mg/L	1	<1	1	2	<1	3	r	1	1	r	r	r	<1	<1
Dissolved Strontium	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dissolved Sulfate	mg/L	42	43	26	25	45	35	44	40	52	52	47	52	31	36
Dissolved Zinc	mg/L	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	r`	r	r	r	r	r	<0.005	<0.005
Zinc	mg/L	N/A	N/A	N/A	<0.005	<0.005	<0.005	0.005	r	r	r	r	0.007	<0.005	<0.005
pH		8	8.2	7.6	7.7	7.8	8.1	7.6	7.8	8.6	8.7	8	8.2	7.7	8.6999

http://www.water.ca.gov/waterdatalibrary/waterquality/station_county/select_station.cfm?URLStation=KA017226&source=map
mg/L = milligrams per liter
µS/cm = microSiemens per centimeter

The SWP water quality is generally very good for irrigation purposes, although even good quality water contains some salt. The evapotranspiration (ET) process returns water to the atmosphere but leaves the salts behind in the soil. To avoid damaging buildup of salt in the crop root zone, water in excess of the crops' ET is required. The amount of excess water needed, known as the leaching requirement, varies with the crop, soil, climate and quality of the applied water and is used as an indicator of the minimum amount of water needed to flush salts from the root zone.

2. Groundwater Supply

Groundwater aquifers in the BMWD area are considered to be unconfined or semi-confined. Shallow groundwater is naturally recharged by infiltration from runoff in intermittent stream channels and natural depressions which has a significant impact on quality. However, this is a minor, local effect that does not affect the deeper aquifer in the Tulare/alluvium formation as significantly as recharge from the adjacent Temblor Range which is comprised of mainly of tilted and folded marine sediments. Groundwater quality in the deeper aquifer (Tulare Formation) beneath the District is by nature of poorer quality, because of its recharge source (Temblor Range). Because of its limited lateral and vertical extent, poor quality and relatively low permeability, neither the shallow nor deeper aquifers provide an adequate groundwater supply to irrigate lands extensively in the District.

Groundwater quality has not been monitored on a consistent basis in BMWD because historically this water has not been considered a reliable water supply. The limited data and historical use indicate that the groundwater is saline. Total dissolved solids (TDS) concentrations have ranged from 500 to over 6,000 mg/L. The groundwater quality of most wells in the District is not generally considered suitable for most agricultural applications unless it is blended with better quality water. By comparison, TDS concentrations in SWP water provided to BMWD generally ranges from 150 to 500 mg/L. In portions of BMWD, the groundwater also contains high boron and sulfate concentrations, which further reduces its suitability for agricultural purposes. Until recently, use of groundwater as a supplemental water supply was thought to be uneconomical. However, because recent reliability studies from DWR indicate reliable supplies on the SWP around 20% of Table A amounts, and given the tolerance of some crops, namely pistachios and some cotton varieties, to higher concentrations of salts, two landowners have blended a limited amount of groundwater with surface water to supplement their supplies. However, the viability of these sources as long-term supplies is still in question, as the quality has been declining.

BMWD does participate in groundwater banking projects outside of the District boundaries just southwest of the City of Bakersfield. Appendix 4 shows the location of the banking facilities location with respect to the District boundary. The Pioneer Project and Berrenda Mesa Project are discussed in the groundwater recharge section.

3. Other Water Supplies

BMWD relies on surface water and very limited groundwater supplies. There are no other water supplies used in BMWD.

4. Drainage from the Water Supplier's Service Area

BMWD has no drainage water and therefore there is no drainage reuse.

C. Water Quality Monitoring Practices

1. Source Water

BMWD's main water supply is the SWP. DWR maintains records of all water diversions, water quality, and storage operations related to the SWP. Operational reports are distributed weekly and monthly to the District and published annually in Bulletin 132. DWR maintains water quality standards for its downstream urban users (Metropolitan Water District of Southern California and Central Coast Water Authority). BMWD is located at the terminus of the Coastal Aqueduct and thus there are no potential downstream agencies. TDS concentrations in the SWP water provided to BMWD generally ranges from 150 to 500 mg/L, suitable for agricultural use.

DWR maintains an automated sampling station at Check 21 (just upstream from the District turnouts) that records electrical conductivity, water temperature, and turbidity on a daily basis. In addition, grab samples are taken on monthly intervals.

Table 36 summarizes sampled constituents and sampling frequency.

Table 36. Water Quality Monitoring Practices

Water Source	Monitoring Location	Measurement/ Monitoring Method or Practice	Frequency
Surface water	DWR California Aqueduct (Kettleman City) Check 21 Station KA017226	See DWR standards	DWR standards
Groundwater	Various	As required by ILRP	As Required by ILRP
Subsurface drainage water	Pond influent sumps and pond itself	Grab sampling of drainwater at influent sumps and evaporation pond	Quarterly

37. Water Quality Monitoring Programs for Surface/Sub-Surface Drainage

Table 37. Water Quality Monitoring Programs for Surface/Sub-Surface Drainage

Constituent	Units	Standard
Total Alkalinity as CaCO3	mg/L	Std Method 2320 B
Total Aluminum	mg/L	EPA 200.8 (T)
Dissolved Ammonia as N	mg/L	EPA 350.1
Dissolved Arsenic	mg/L	EPA 200.8 (D)
Total Arsenic	mg/L	EPA 200.8 (T)
Total Barium	mg/L	EPA 200.8 (T)
Dissolved Beryllium	mg/L	EPA 200.8 (D)
Total Beryllium	mg/L	EPA 200.8 (T)
Dissolved Boron	mg/L	EPA 200.7 (D)
Total Cadmium	mg/L	EPA 200.8 (T)
Dissolved Calcium	mg/L	EPA 200.7 (D)
Dissolved Chloride	mg/L	EPA 300.0 28d Hold
Dissolved Chromium	mg/L	EPA 200.8 (D)
Total Chromium	mg/L	EPA 200.8 (T)
Conductance (EC)	µS/cm	Std Method 2510-B
Dissolved Copper	mg/L	EPA 200.8 (D)
Total Copper	mg/L	EPA 200.8 (T)
Dissolved Hardness as Ca	mg/L	Std Method 2340 B
Dissolved Iron	mg/L	EPA 200.8 (D)
Total Iron	mg/L	EPA 200.8 (T)
Total Kjeldahl Nitrogen a:	mg/L	EPA 351.2
Dissolved Lead	mg/L	EPA 200.8 (D)
Total Lead	mg/L	EPA 200.8 (T)
Dissolved Lithium	mg/L	EPA 200.8 (D)
Dissolved Magnesium	mg/L	EPA 200.7 (D)
Dissolved Manganese	mg/L	EPA 200.8 (D)
Total Manganese	mg/L	EPA 200.8 (T)
Dissolved Mercury	mg/L	EPA 200.8 (Hg Dissolved)
Dissolved Molybdenum	mg/L	EPA 200.8 (D)
Dissolved Nickel	mg/L	EPA 200.8 (D)
Total Nickel	mg/L	EPA 200.8 (T)
Dissolved Nitrate	mg/L	EPA 300.0 28d Hold
Dissolved Nitrate + Nitrit	mg/L	l Method 4500-NO3-F (28Da
Dissolved Ortho-phospha	mg/L	EPA 365.1 (DWR Modified)
Total Phosphorus	mg/L	EPA 365.4
Dissolved Selenium	mg/L	EPA 200.8 (D)
Total Selenium	mg/L	EPA 200.8 (T)
Total Silver	mg/L	EPA 200.8 (T)
Dissolved Sodium	mg/L	EPA 200.7 (D)
Total Dissolved Solids	mg/L	Std Method 2540 C
Total Suspended Solids	mg/L	EPA 160.2
Volatile Suspended Solid	mg/L	EPA 160.4
Dissolved Strontium	mg/L	EPA 200.8 (D)
Dissolved Sulfate	mg/L	EPA 300.0 28d Hold
Dissolved Zinc	mg/L	EPA 200.8 (D)
Total Zinc	mg/L	EPA 200.8 (T)
pH	pH	Std Method 2320 B

Source of data:
http://www.water.ca.gov/waterdatalibrary/waterquality/station_county/select_station.cfm?URLStation=KA017226&source=map

Water Accounting and Water Supply Reliability

D. Quantifying the Water Supplier's Water Supplies

1. Agricultural Water Supplier Water Quantities

Table 38.1-38.5 (2016-2020) shows typical water diversions from the CA Aqueduct during the representative water year 2020.

Table 38.1 Surface and Other Water Supplies for 2020

Source	Supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CVP Class 1 Contracts	0													0
Pre-1914 Rights	0													0
SWP water contract	18,520													18,520
Other Surface Water	26,673													26,673
Banked water recovery	15,797													15,797
Carryover	31,647													31,647
Recycled Water	0													0
Other	0													0
Total Supply														92,637
Monthly Deliveries		**2081**	**4695**	**3670**	**5306**	**11341**	**15862**	**18127**	**15533**	**9841**	**5693**	**141**	**347**	**92637**

Notes:
The District doesn't track monthly deliveries by individual water type. The Agency does.
Carryover balance is water from 2019

Table 38.2 Surface and Other Water Supplies for 2019

Source	Supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CVP Class 1 Contracts	0													0
Pre-1914 Rights	0													0
SWP water contract	69,450													69,450
Other Surface Water	6,437													6,437
Banked water recovery	1,763													1,763
Carryover	14,459													14,459
Recycled Water	0													0
Other	0													0
Total Supply														92,109
Monthly Deliveries		**1992**	**5030**	**2071**	**6504**	**11981**	**16000**	**17768**	**15424**	**9278**	**5756**	**212**	**93**	**92109**

Table 38.3 Surface and Other Water Supplies for 2018														
Source	**Supply**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
CVP Class 1 Contracts	0													0
Pre-1914 Rights	0													0
SWP water contract	32,410													32,410
Other Surface Water	0													52,090
Banked water recovery	13846													13846
Carryover	-5932													-5932
Recycled Water	0													0
Other	0													0
Total Supply	40,324													92,414
Monthly Deliveries		**229**	**5922**	**2743**	**6694**	**11900**	**15837**	**17097**	**16317**	**9560**	**5741**	**220**	**154**	**92414**

Table 38.4 Surface and Other Water Supplies for 2017														
Source	**Supply**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
CVP Class 1 Contracts	0													0
Pre-1914 Rights	0													0
SWP water contract	78,710													78,710
Other Surface Water	61,541													60,595
Banked water recovery	-73,198													73,198
Carryover	32126													32126
Recycled Water	0													0
Other	0													0
Total Supply	99179													98233
Monthly Deliveries		**857**	**6939**	**4948**	**6840**	**12012**	**15566**	**17329**	**15142**	**10257**	**5808**	**553**	**1982**	**98233**

Table 38.5 Surface and Other Water Supplies for 2016														
Source	**Supply**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
CVP Class 1 Contracts	**0**													0
Pre-1914 Rights	**0**													0
SWP water contract	55,560													55,560
Other Surface Water	14,549													14,549
Banked water recovery														
Carryover	19,797													19,797
Recycled Water	**0**													0
Other	**0**													0
Total Supply	**89,906**													89,906
Monthly Deliveries		**585**	**3611**	**5840**	**7078**	**10697**	**15290**	**17231**	**14682**	**9547**	**4867**	**453**	**25**	**89906**

Table 39 summarizes groundwater pumped by BMWD from groundwater banking projects located outside the District's boundaries during the representative year when SWP allocations were normal.

Table 39 Groundwater Supplies Summary for 2020 (AF)							
Month	**Pumped by the Water Supplier**			**Pumped within Service Area by Customers**			**TOTAL**
	Basin 1	**Basin 2**	**Basin 3**	**Basin 1**	**Basin 2**	**Basin 3**	
TOTAL	0	0	0				**674**

2. Other Water Sources Quantities

Effective precipitation is accounted for as a water source within the cropped irrigated area (Table 40).

Table 40. Effective Precipitation Summary (AF)

Month	2020		2019		2018		2017		2016	
	Gross (in)	Effective (AF)*	Gross (in)	Effective (AF)*	Gross (in)	Effective (AF)*	Gross (in)	Effective (AF)*	Gross (in)	Effective (AF)*
January	0.15	153	1.78	1338	1.83	1380	2.09	1576	2.27	1712
February	0	0	1	1504	0.19	287	1.6	2413	0.04	60
March	1.91	3908	1.45	2180	1.55	2338	0.53	799	0.77	1161
April	2.43	4973	0.21	316	0.08	121	0	0	0.81	1222
May	0.01	20	0.71	1068	0.02	30	0	0	0.02	30
June	0	0	0	0	0.02	30	0	0	0	0
July	0	0	0	0	0	0	0	0	0	0
August	0.04	82	0	0	0	0	0	0	0.23	347
September	0	0	0	0	0	0	0.75	1131	0	0
October	0	0	0	0	0	0	0.14	211	0	0
November	0.38	778	1.03	1549	1	1508	0.06	90	0.04	60
December	0.34	348	1.33	1000	0.29	219	0.18	136	1.16	875
Total	5.26	10262	7.51	8954	4.98	5912	5.35	6357	5.34	5467

Note:
*Assumes an effectiveness coefficient of 50% for the months of December and January and 100% for the remaining months. Volumes in AF result from multiplying the effective precipitation depth in a given year and the irrigated acreage.

E. Quantification of Water Uses

Table 41 shows the volume of water charged to BMWD's irrigation water customers in 2020 for delivery into the Service Area. The water charged is based on the field personnel water measurements to the customers. During 2020, the volume of water charged to the customers is within an estimated plus or minus 2% of the actual deliveries. The difference between the applied water versus the allocated water is the amount of water that was carried over for use the following year (Table 41).

Table 41. Applied Water (AF)

	2020	2019	2018	2017	2016
Applied Water (fromTable 38)	92,637	92,109	92,414	98,233	89,906

Table 42 summarizes the crop water use within the BMWD service area in 2020.

Table 42. Quantify Water Use (AF)					
Water Use	**2020**	**2019**	**2018**	**2017**	**2016**
Crop Water Use (from Table 23)					
1. Crop Evapotranspiration*	86753	82631	87427	90113	93495
2. Leaching*	5509	5339	5665	5827	6054
3. Cultural practices	0	0	0	0	0
Conveyance & Storage System					
4. Conveyance seepage	0	0	0	0	0
5. Conveyance evaporation	0	0	0	0	0
6. Conveyance operational spills	0	0	0	0	0
7. Reservoir evaporation	0	0	0	0	0
8. Reservoir seepage	0	0	0	0	0
Municipal and Industrial					
13. Municipal (from Table 26)	0	0	0	0	0
14. Industrial (from Table 26)	2149	1843	2862	1920	2879
Outside the District					
15. Transfers or Exchanges out of the service area (not included)	0	0	0	0	0
Conjunctive Use					
16. In-District Groundwater recharge (from Table 32)*	0	0	0	0	0
Other (from Table 33)	0	0	0	0	0
Subtotal	**94,411**	**89,813**	**95,954**	**97,860**	**102,428**
Note:					
* Recharge outside District boundary is not accounted here.					

There is no water leaving the District (Table 43) and irrecoverable water losses (Table 44).

Table 43. Quantify Water Leaving the District (AF)					
	2020	**2019**	**2018**	**2017**	**2016**
1. Surface drain water leaving the service area	0	0	0	0	0
2. Subsurface drain water leaving the service area	0	0	0	0	0
Subtotal	0	0	0	0	0

Table 44. Irrecoverable Water Losses (Optional) (AF)					
	2020	**2019**	**2018**	**2017**	**2016**
Flows to saline sink	0	0	0	0	0
Flows to perched water table	0	0	0	0	0
Subtotal	0	0	0	0	0

F. Overall Water Budget

Table 45 and Table 46, respectively indicate the representative year water supplies and water budget for the District.

Table 45. Quantify Water Supplies (AF)					
Water Supplies	2020	2019	2018	2017	2016
1. Surface Water (summary total from Table 38)	92,637	92,109	92,414	98,239	89,906
2. Groundwater (summary total from Table 39)	674	0	0	0	0
3. Annual Effective Precipitation (summary total from Table 41)	10,262	8954	5912	6357	5467
4. Water purchases	0	0	0	0	0
Subtotal	**103,573**	**101,063**	**98,326**	**104,596**	**95,373**

Table 46. Budget Summary (AF)					
Water Accounting	**2020**	**2019**	**2018**	**2017**	**2016**
1. Subtotal of Water Supplies (Table 45)	103,573	101,063	98,326	104,596	95,373
2. Subtotal of Water Uses (Table 42)	94,411	89,813	95,954	97,860	102,428
3. Drain Water Leaving Service Area (Table 43)	-	-	-	-	-
Excess Deep Percolation* **(Deficit Irrigation)**	9,162	11,250	2,372	6,736	(7,055)
Note:					
*Calculated from lines 2 and 3 subtracted from line 1					

The District as a whole appears to be very efficient with its water supply. Data from Table 46 for year 2020 suggests a Total Water Use Efficiency (TWUE) for the District of approximately 96% under the assumptions used in the calculations (see Table 46 for details). Excess deep percolation and TWUE values vary accordingly with the year type. Crop water use estimates may appear high. These results are due to uncertainties in the crop coefficient (might be high) values to estimate crop evapotranspiration and the salt tolerance threshold values to estimate the leaching requirement. These results though suggest that growers are very efficient with their limited, unreliable, and expensive water supply. These results also collaborate mobile lab results which indicate distribution uniformities (DU) for District Water Users ranged between 91% and 97% from 2006 to 2020.

In addition, it is probable that the growers are deficit irrigating in response to multiple years of insufficient water supplies. In 2012, the Table A allotment of 50% yielded a corresponding 96% TWUE. At Table A allotments of 35% in 2013 and 5% in 2014, growers would have been forced to abandon (some 3,000 acres have been taken out of production since 2010) or to under-irrigate their remaining crop.

G. Water Supply Reliability

BMWD's utilizes water from groundwater banking projects to supplement SWP supplies, primarily in years of SWP delivery deficiencies. Annually, the maximum amount BMWD can extract from both banking projects is 30,000-40,000 AF, although this varies when downstream demand is limited. Currently, they have banked a total of 113,458 AF in these projects. Additional surface storage would be one means to improve water reliability.

Another source of reliable water for certain landowners is through access to other groundwater banking projects located outside the District's boundaries.

The water supply reliability for the District is parallel to that of the SWP and is best described by DWR in the following excerpts from "The State Water Project Final Delivery Reliability Report 2011", dated June 2012.

"The 2011 Report shows that the SWP continues to be subject to reductions in deliveries similar to those contained in the State Water Project Delivery Reliability Report 2009 (2009 Report), caused by the operational restrictions of biological opinions (BOs) issued in December 2008 and June 2009 by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) to govern SWP and Central Valley Project operations. Federal court decisions have remanded the BOs to USFWS and NMFS for further review and analysis. We expect that the current BOs will be replaced sometime in the future. The operational rules defined in the 2008 and 2009 BOs, however, continue to be legally required and are the rules used for the analyses supporting the 2011 Report."

Regulatory Restrictions on SWP Delta Exports

"*Multiple needs converge in the Delta: the need to protect a fragile ecosystem, to support Delta recreation and farming, and to provide water for agricultural and urban needs throughout much of California. Various regulatory requirements are placed on the SWP's Delta operations to protect special-status species such as delta smelt and spring- and winter-run Chinook salmon. As a result, as described below, restrictions on SWP operations imposed by State and federal agencies contribute substantially to the challenge of accurately determining the SWP's water delivery reliability in any given year."*

Biological Opinions on Effects of Coordinated SWP and CVP Operations

"*Several fish species listed under the federal Endangered Species Act (ESA) as endangered or threatened are found in the Delta. The continued viability of populations of these species in the Delta depends in part on Delta flow levels. For this reason, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) have issued several BOs since the 1990s on the effects of coordinated SWP/CVP operations on several species.*

These BOs affect the SWP's water delivery reliability for two reasons. Most obviously, they include terms that specifically restrict SWP pumping levels in the Delta at certain times under certain conditions. In addition, the BOs' requirements are based on physical and biological phenomena that occur daily while DWR's water supply models are based on monthly data.

The first BOs on the effects of SWP (and CVP) operations were issued in February 1993 (NMFS BO on effects of project operations on winter-run Chinook salmon) and March 1995 (USFWS BO on project effects on delta smelt and splittail). Among other things, the BOs contained requirements for Delta inflow, Delta outflow, and reduced export pumping to meet specified incidental take limits. These fish protection requirements imposed substantial constraints on Delta water supply operations. Many were incorporated into the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin

Delta (1995 WQCP), as described in the "Water Quality Objectives" section later in this chapter.

The terms of the USFWS and NMFS BOs have become increasingly restrictive in recent years. In December 2008, USFWS issued a new BO covering effects of the SWP and CVP on delta smelt, and in June 2009, NMFS issued a BO covering effects on winter-run and spring-run Chinook salmon, steelhead, green sturgeon, and killer whales. These BOs replaced BOs issued earlier by the federal agencies.

The USFWS BO includes additional requirements in all but 2 months of the year. The BO calls for "adaptively managed" (adjusted as necessary based on the results of monitoring) flow restrictions in the Delta intended to protect delta smelt at various life stages. USFWS determines the required target flow, with the reductions accomplished primarily by reducing SWP and CVP exports. Because this flow restriction is determined based on fish location and decisions by USFWS staff, predicting the flow restriction and corresponding effects on export pumping with any great certainty poses a challenge. The USFWS BO also includes an additional salinity requirement in the Delta for September and October in wet and above-normal water years, calling for increased releases from SWP and CVP reservoirs to reduce salinity. Among other provisions included in the NMFS BO, limits on total Delta exports have been established for the months of April and May. These limits are mandated for all but extremely wet years.

The 2008 and 2009 BOs were issued shortly before and shortly after the Governor proclaimed a statewide water shortage state of emergency in February 2009, amid the threat of a third consecutive dry year. NMFS calculated that implementing its BO would reduce SWP and CVP Delta exports by a combined 5% to 7%, but DWR's initial estimates showed an impact on exports closer to 10% in average years, combined with the effects of pumping restrictions imposed by BOs to protect delta smelt and other species. The 2008 USFWS and 2009 NMFS BOs have been subject to considerable litigation. Recent decisions by U.S. District Judge Oliver Wanger changed specific operational rules for the fall/ winter of 2011–2012, and both the USFWS BO and NMFS BO have been remanded to the agencies for further review and analysis. However, the operational rules specified in the 2008 and 2009 BOs continue to be legally required and are the rules used in the analyses presented in Chapters 5, 6, and 7 of this report. Chapter 5 presents a comparison of monthly Delta exports as estimated for this 2011 Report with those estimated for the 2005 Report, illustrating how the 2008 and 2009 BOs have affected export levels from the Delta.

The California Department of Fish and Game (DFG) issued consistency determinations for both BOs under Section 2080.1 of the California Fish and Game Code. The consistency determinations stated that the USFWS BO and the NMFS BO would be consistent with the California Endangered Species Act (CESA). Thus, DFG allowed incidental take of species listed under both the federal ESA and CESA to occur during SWP and CVP operations without requiring DWR or the U.S. Bureau of Reclamation to obtain a separate State-issued permit.

Specific restrictions on Delta exports associated with the USFWS and NMFS BOs and their effects on SWP pumping levels are described further in Chapter 5, "SWP Delta Exports," of this report."

Water Quality Objectives
"*Because the Delta is an estuary, salinity is a particular concern. In the 1995 WQCP, the State Water Board set water quality objectives to protect beneficial uses of water in the Delta and Suisun Bay. The objectives must be met by the SWP (and federal CVP), as specified in the water right permits issued to DWR and the U.S. Bureau of Reclamation. Those objectives—minimum Delta outflows, limits on SWP and CVP Delta exports, and maximum allowable salinity levels— are enforced through the provisions of the State Water Board's Water Right Decision 1641 (D-1641), issued in December 1999 and updated in March 2000.*

DWR and Reclamation must monitor the effects of diversions and SWP and CVP operations to ensure compliance with existing water quality standards. Monitoring stations are shown in Figure 4-1.

Among the objectives established in the 1995 WQCP and D-1641 are the "X2" objectives. D-1641 mandates the X2 objectives so that the State Water Board can regulate the locations of the Delta estuary's salinity gradient during the months of February–June. X2 is the position in the Delta where the electrical conductivity (EC) level, or salinity, of Delta water is 2 parts per thousand. The location of X2 is used as a surrogate measure of Delta ecosystem health. For the X2 objective to be achieved, the X2 position must remain downstream of Collinsville in the Delta (shown in Figure 4-1) for the entire 5- month period, and downstream of other specific locations in the Delta on a certain number of days each month from February through June. This means that Delta outflow must be at certain specified levels at certain times—which can limit the amount of water the SWP may pump at those times at its Harvey O. Banks Pumping Plant in the Delta. Because of the relationship between seawater intrusion and interior-Delta water quality, meeting the X2 objective also improves water quality at Delta drinking-water intakes; however, meeting the X2 objectives can require a relatively large volume of water for outflow during dry months that follow months with large storms.

The 1995 WQCP and D-1641 also established an export/inflow (E/I) ratio. The E/I ratio, presented in Table 3 of the 1995 WQCP (SWRCB 1995:18– 22), is designed to provide protection for the fish and wildlife beneficial uses in the Bay-Delta estuary (SWRCB 1995:15). The E/I ratio limits the fraction of Delta inflows that are exported. When other restrictions are not controlling, Delta exports are limited to 35% of total Delta inflow from February through June and 65% of inflow from July through January."

In addition to these potential reductions, the District's ability to deliver a reliable water supply to its landowners is further impacted by capacity issues on the Coastal Branch of the Aqueduct. Not only is DWR responsible for maintaining facilities, it is also responsible for controlling aquatic weed growth. Often during peak irrigation demand (May-September) the dense growth of aquatic weeds impacts DWR's ability to convey an adequate supply through the Coastal Branch. This forces the District to allocate capacity and reduce the amount of water available to landowners during the most critical growing period.

Climate Change

Within the five year horizon of this Plan, the District is <u>much more</u> concerned regarding the current reliability (or lack thereof) of the State Water Project (SWP) than it is about climate change. However, the potential effects of climate change, which DWR projects to impact both the District's local area and result in statewide changes that could affect the State Water Project and its water supplies in the longer term, are a substantial concern beyond the planning horizon of this Plan.

DWR estimates indicate that by 2050 the Sierra Nevada snowpack, which provides 65 percent of California's water supply, will be significantly reduced. Much of the precipitation is expected to fall as rain instead of snow during winter and cannot be stored in our current water system for later use. The climate is also expected to become more variable and extreme, bringing more droughts and floods. Thus the District will need to be prepared to adapt to greater variability in weather patterns.

H. Potential Climate Change Effects

Within the next 20 years, DWR expects that water supplies, water demand, sea level, and the occurrence and increased severity of floods will be affected by climate change. Some of these potential changes are presented below.

The District will need to consider the following climate change effects, many of which are already documented in California, and reviewed in the latest State Water Project Reliability Report prepared by DWR.

1. Water Demand

Predicted results of climate change, such as, shorter winters, more hot days and nights, and a longer irrigation season could potentially increase water demand in the District, and increase competition for water by others, if the affects of climate change occur.

2. Water Supply and Quality

Reduced snowpack, shifting spring runoff to earlier in the year has the potential to impact water supply and quality, if they should occur.

3. Sea Level Rise

The Delta, which is in the hub of the SWP could be at greater risk to increased salinity should sea level rise occur. Sea level could continue to rise if warming of the oceans continues. This could also affect Delta levee stability in low-lying areas.

4. Disaster

Disasters may become more frequent if climate change continues as some scientists believe.

I. Specific Points to Consider

As the District continues to address near-term periods of water deficiency from the State Water Project during the five years of this planning cycle, it will consider the following potential climate change impacts projected by DWR in its longer term plans and work with DWR and State Water Contractors in planning for:

1. Irrigation Demand

Irrigation demand may increase if temperatures rise and rainfall becomes more variable.

2. Permanent Crops

Permanent crops, which make up the majority in the District, may be adversely affected by climate change and may be more difficult to shift to alternative crops, causing reduced flexibility for adapting to changing climatic conditions.

3. Flooding Risk

Flooding risk may increase as a result of more severe rainfall patterns and warmer winter rains. This could affect water supply and conveyance of State and local water distribution facilities.

4. Snowpack

Snowpack may significantly diminish if the climate warms. Diminished snowfall in the mountains and earlier runoff may result in reduced SWP water supply and other sources derived from Sierra Nevada Snowpack.

5. The Sacramento-San Joaquin River Delta

The Sacramento-San Joaquin River Delta could be vulnerable to impacts of climate change, if it occurs. One impact could be sea level rise. Higher sea levels could make it more difficult to export water from the Delta with the existing infrastructure and may result in reduced water deliveries over time.