Section V: Water Accounting and Water Supply Reliability

A. Quantifying the Water Supplier's Water Supplies

1. Agricultural Water Supplier Water Quantities

Table 39 shows typical water diversions from the CA Aqueduct during the representative water year (2016-2020).

Table 39.1 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	24,302													24,302
Other Surface Water	16,553													16,553
Banked water recovery	36,350													36,350
Carryover	21,899													21,899
Recycled Water	0													0
Other	0													0
Total Supply														99,104
Monthly Deliveries		971	5006	3108	6278	14043	16571	20551	15704	9545	4752	1444	1131	99,104

Notes:

The District doesn't track monthly deliveries by individual water type. The Agency does.

Carryover balance is water from 2019

Table 39.2 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	91,131													91,131
Other Surface Water	-2,476													-2,476
Banked water recovery	1,738													1,738
Carryover	22,472													22,472
Recycled Water	0													0
Other	0													0
Total Supply														112,865
Monthly Deliveries		1496	4279	4655	9248	14399	17101	20417	18545	10858	7588	2091	2188	112,865

Table 39.3 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	42,528													42,528
Other Surface Water	41356													41356
Banked water recovery	9635													9635
Carryover	15590													15590
Recycled Water	0													0
Other	0													0
Total Supply														109,109
Monthly Deliveries		1,729	5,385	3,334	8,626	15,016	15,913	21,379	16,599	9,828	7,080	2,047	2,173	109,109

Table 39.4 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	103,282													103,282
Other Surface Water	69,976													69,976
Banked water recovery	-69770													-69770
Carryover	21,627													21627
Recycled Water	0													0
Other	0													0
Total Supply	125,115													125,115
Monthly Deliveries		3497	7194	8897	9088	14995	18462	20315	17271	9754	6532	5781	3329	125,115

Table 39.5 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	72,905													72,905
Other Surface Water	12,472													12,472
Banked water recovery														
Carryover	18,350													18,350
Recycled Water	**0**													0
Other	**0**													0
Total Supply	**103,727**													103,727
Monthly Deliveries		916	3511	8064	9636	13065	17815	19573	16029	8686	4611	1295	526	103,727

Table 40 summarizes groundwater pumped by BWSD from groundwater banking projects located inside the District's boundaries during the representative year when SWP allocations were normal. There are no groundwater banking projects located inside the District boundaries.

Table 40. 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				**1187**

Table 41. 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	215	1.78	2520	1.83	2651	2.09	2774	2.27	3064
February	0	0	1	2832	0.19	551	1.6	4247	0.04	108
March	1.91	5485	1.45	4106	1.55	4491	0.53	1407	0.77	2078
April	2.43	6978	0.21	595	0.08	232	0	0	0.81	2186
May	0.01	29	0.71	2010	0.02	58	0	0	0.02	54
June	0	0	0	0	0.02	58	0	0	0	0
July	0	0	0	0	0	0	0	0	0	0
August	0.04	115	0	0	0	0	0	0	0.23	621
September	0	0	0	0	0	0	0.75	1991	0	0
October	0	0	0	0	0	0	0.14	372	0	0
November	0.38	1091	1.03	2917	1	2898	0.06	159	0.04	108
December	0.34	488	1.33	1883	0.29	420	0.18	239	1.16	1566
Total	5.26	14402	7.51	16863	4.98	11358	5.35	11187	5.34	9784

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.

B. Quantification of Water Uses

Table 43 shows the volume of water delivered to BWSD's irrigation water customers in 2020 for delivery into the Service Area. The water delivered is based on the field personnel water measurements to the customers. During 2020, the volume of water delivered 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 recharged or carried over to the next year (see Table 42).

Table 42. Applied Water (AF)					
	2020	**2019**	**2018**	**2017**	**2016**
Applied Water (fromTable 46)	99,104	112,865	109,109	125,115	103,727

Table 43 summarizes the crop water use within the BWSD service area in 2020.

Table 43. Quantify Water Use (AF)					
Water Use	**2020**	**2019**	**2018**	**2017**	**2016**
Crop Water Use (from Table 25)					
1. Crop Evapotranspiration*	120078	114441	124197	115795	122196
2. Leaching*	7742	7571	8153	7536	7964
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
Environmental Use (consumptive)					
9. Environmental use – wetlands (from Table 27)	0	0	0	0	0
10. Environmental use – Other (from Table 27)	0	0	0	0	0
11. Riparian vegetation (from Table 27)	0	0	0	0	0
12. Recreational use (from Table 28)	0	0	0	0	0
Municipal and Industrial					
13. Municipal (from Table 29)	0	0	0	0	0
14. Industrial (from Table 29)	888	859	1013	1077	587
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 30)*	0	0	0	0	0
Other (from Table 31)	0	0	0	0	0
Subtotal	**128708**	**122871**	**133363**	**124408**	**130747**
Note:					
* Recharge outside District boundary is not accounted here.					

Table 44. 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 45. 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

C. Overall Water Budget

Table 46 and Table 47, respectively indicate the 2020 water supplies and water budget for the District.

Table 46. Quantify Water Supplies (AF)					
Water Supplies	**2020**	**2019**	**2018**	**2017**	**2016**
1. Surface Water (summary total from Table 39)	99,104	112,865	109,109	125,115	103,727
2. Groundwater (summary total from Table 40)	1,187	0	0	0	0
3. Annual Effective Precipitation (summary total from Table 41)	14,402	16,863	11,358	11,187	9,784
4. Water purchases	0	0	0	0	0
Subtotal	**114,693**	**129,728**	**120,467**	**136,302**	**113,511**

Table 47. Budget Summary (AF)					
Water Accounting	**2020**	**2019**	**2018**	**2017**	**2016**
1. Subtotal of Water Supplies (Table 39)	114,693	129,728	120,467	136,302	113,511
2. Subtotal of Water Uses (Table 43)	128,708	122,871	133,363	124,408	130,747
3. Drain Water Leaving Service Area (Table 44)	-	-	-	-	-
Excess Deep Percolation* **(Deficit Irrigation)**	**(14,015)**	**6,857**	**(12,896)**	**11,894**	**(17,236)**
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 47 for year 2020 suggests a Total Water Use Efficiency (TWUE) for the District of approximately 97% under the assumptions used in the calculations. Excess deep percolation and TWUE values vary accordingly with the year type. Crop water use estimates may be high. These results are due to uncertainties in the crop coefficients (might be high) values to estimate crop evapotranspiration and the salt tolerance threshold values to estimate the leaching requirement. These results suggest that growers are performing deficit irrigation in response to a 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 2010, the Table A allotment of 50% yielded a corresponding 97% TWUE. At Table A allotments of 35% in 2013 and 5% in 2014, growers would have been forced to abandon (some 2,000 acres have been taken out of production since 2010) or to under-irrigate their remaining crop.

Water Supply Reliability

The SWP and groundwater banking projects are BWSD's primary source of reliable water. As a participant in the Pioneer and Berrenda Mesa groundwater banking projects, BWSD has been actively banking SWP water when available. Water stored in the water banks is available to supplement SWP supplies, primarily in years of SWP delivery deficiencies. Annually, the maximum amount BWSD can extract from both banking projects varies based on down stream demand in the California Aqueduct. Additional surface storage, well recovery capacity and groundwater recharge capacity are 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 will 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.

D. 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 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.

E. 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.