California Water Plan Update 2018

Supporting Documentation for Water Portfolios

April 2019

This is one of several documents published in support of *California Water Plan Update 2018*.
Links to the other documents are available on the Update 2018 webpage.

Contents

California Water Plan Update 2018 Supporting Documentation for Water Portfolios 1

Introduction 1
Study Areas 6
Water Use 6
Water Supply 7
Precipitation 8
Hydrologic Summary 9
Water Balances 11
Water Balance Database Project 25
Challenges, Risks, and Next Steps 25
Online Files and Folders Descriptions 27
Water Portfolio-related Definitions 32
References 45

Tables

Table 1 30-Year Averages of Annual Precipitation 8

Table 2 California Hydrologic Summary (in million acre-feet) 10

Figures

Figure 1 California Water: How It Was Used and Where It Came From, 2011–2015 3

Figure 2 Regional Water Uses and Supplies in Water Year 2011 (Wet Year) 4

Figure 3 Regional Water Uses and Supplies in Water Year 2014 (Critically Dry Year) 5

Figure 4 Hydrologic Regions, Planning Areas, and Detailed Analysis Units 6

Figure 5 Average Annual Precipitation, 1986–2015 9

Figure 6 Disposition of Average Annual Precipitation and Inflow (1998–2015) 11

Figure 7 North Coast Water Balance by Water Years 2011–2015 13

Figure 8 San Francisco Bay Water Balance by Water Years 2011–2015 14

Figure 9 Central Coast Water Balance by Water Years 2011–2015 15

Figure 10 South Coast Water Balance by Water Years 2011–2015 16

Figure 11 **Sacramento River Water Balance by Water Years 2011–2015** **17**

Figure 12 **San Joaquin River Water Balance by Water Years 2011–2015** **18**

Figure 13 **Tulare Lake Water Balance by Water Years 2011–2015** **19**

Figure 14 **North Lahontan Water Balance by Water Years 2011–2015** **20**

Figure 15 **South Lahontan Water Balance by Water Years 2011–2015** **21**

Figure 16 **Colorado River Water Balance by Water Year 2011–2015** **22**

Figure 17 **Regional Inflows and Outflows, Water Year 2011** **23**

Figure 18 **Regional Inflows and Outflows, Water Year 2014** **24**

Acronyms and Abbreviations

CalSIMETAW	California Simulation of Evapotranspiration of Applied Water
CNRA	California Natural Resources Agency
DAU	detailed analysis unit
DAUCO	detailed analysis unit by county
Delta	Sacramento-San Joaquin Delta
DWR	California Department of Water Resources
GIS	geographic information system
HR	hydrologic region
maf	million acre-feet
PA	planning area
PRISM	Parameter-elevation Relationships on Independent Slopes Model
QA/QC	quality assurance/quality control
Update 2018	California Water Plan Update 2018
WaDE	Water Data Exchange
Water Plan	California Water Plan
WY	Water Year

California Water Plan Update 2018

Supporting Documentation for Water Portfolios

Introduction

California Water Plan Update 2018 (Update 2018) supporting documentation for water portfolios includes descriptions and accountings of water uses and their supplies for the state in Figures 1 and 5, and for 10 hydrologic regions in Figures 7 through 16. They include pictures of conditions in California, along with water balance data for Water Years (WYs) 2011–2015. Regional inflow and outflow Figures 17 and 18 provide a geographic overview of California and surface water inflows and outflows with adjoining states, between hydrologic regions, and to the Pacific Ocean, for a wet year between two drought sequences, and a critically dry year in a drought sequence. More extreme and variable hydrology seems to have become the new normal, and not just for California. California has been, and will continue to be, a useful example of extremes brought on by a wide variety of climates and terrains. To better understand these diversities, plan for future needs, and move toward water resources sustainability, the California Department of Water Resources (DWR) analyzes water use and supply conditions for each water year at various spatial scales for the entire state. This accounting of water uses and supplies is the only statewide analysis that exists. The California Water Plan (Water Plan) water balance data is used by many in and out of the water community. Data and information requests come from other DWR programs, State and federal agencies, cities and counties, local water agencies and purveyors, research institutes, universities, non-governmental organizations, private sector companies, lawyers, elected officials, news media, documentaries, book writers, students, interested public, other states, and even other countries because California is recognized as a leader in integrated water resources management. The following excerpt is from Update 2018, Chapter 1, “California Water Today,” section on California’s Diverse Water Supplies and Uses.

> Precipitation, specifically snowpack and snowmelt from the Sierra Nevada, is the primary source of water supply and natural groundwater recharge in California — though it varies from place to place, season to season, year to year. The timing, quantity, and location of precipitation in California are largely misaligned with agricultural and urban water uses. California’s water resources are managed in part to address this misalignment. California’s water is also managed for restoring and enhancing terrestrial, wetland, and aquatic ecosystems. Healthy ecosystems and watersheds provide benefits — such as better air quality, recreational opportunities, flood attenuation, groundwater recharge, and natural water filtration — to all Californians.
>
> California residents are heavily dependent on healthy, forested watersheds. The federal government manages approximately 47 percent of California’s 100 million-plus acres, which makes it the largest land manager in the state (California Department of Water Resources 2014). These watersheds provide much of the state’s water supply; they also protect water quality and help reduce the severity of flooding in downstream regions. Water originating in these forests

has economic value that equals or exceeds that of any other forest resource (Krieger 2001) such as timber, grazing lands, or outdoor recreation.

The statewide water balance for Water Years 2011–2015 [Figure 1] demonstrates the state's highly variable water use and water supply in the face of annual hydrologic extremes. California's water resources support cities and communities, agriculture, and the environment. *Applied water* refers to how much water was applied and used by urban and agricultural sectors and was dedicated to the environment. *Water supply* details where the water came from each year to meet those uses.

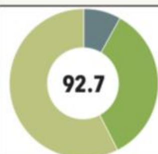
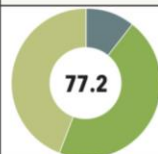
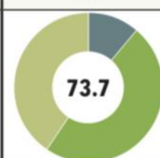
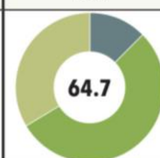
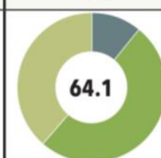
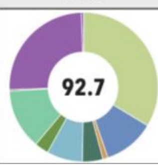
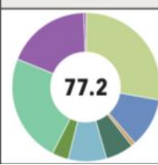
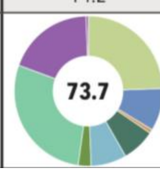
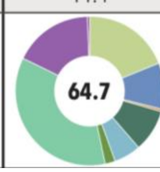
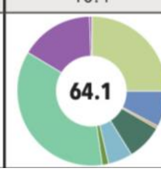
[Figures 2 and 3] depict water uses and supplies on a regional scale. These figures illustrate two hydrologic extremes and how water use changes, region by region, in response to changes in available supply. [Figure 2] summarizes water balances for each of California's 10 hydrologic regions for Water Year 2011, a wet year. [Figure 3] shows regional water balances for Water Year 2014, which was classified as a critically dry year statewide (based on California's Water Year Hydrologic Classification Indices).

Comparing regional water uses and supplies with statewide amounts underscores, in all aspects, the diversity among the state's regions. Each region has unique and variable characteristics and needs that must be addressed locally with a unique set of programs and projects. California's hydrologic regions are the size of some states, where characteristics — including precipitation, runoff, developed water supplies, and water use — can vary greatly from year to year, even within a single region.

Estimates of groundwater extraction are available online at the Water Portfolio webpage. Further discussion and analysis of 2010–2016 groundwater supplies by hydrologic region, county, and groundwater basin will be provided in the 2020 update of Bulletin 118, "California's Groundwater." Additional data, tools, and reports highlighting California's current groundwater conditions are provided online at DWR's SGMA Groundwater Management "Data and Tools" webpage. [https://water.ca.gov/Programs/Groundwater-Management/Data-and-Tools].

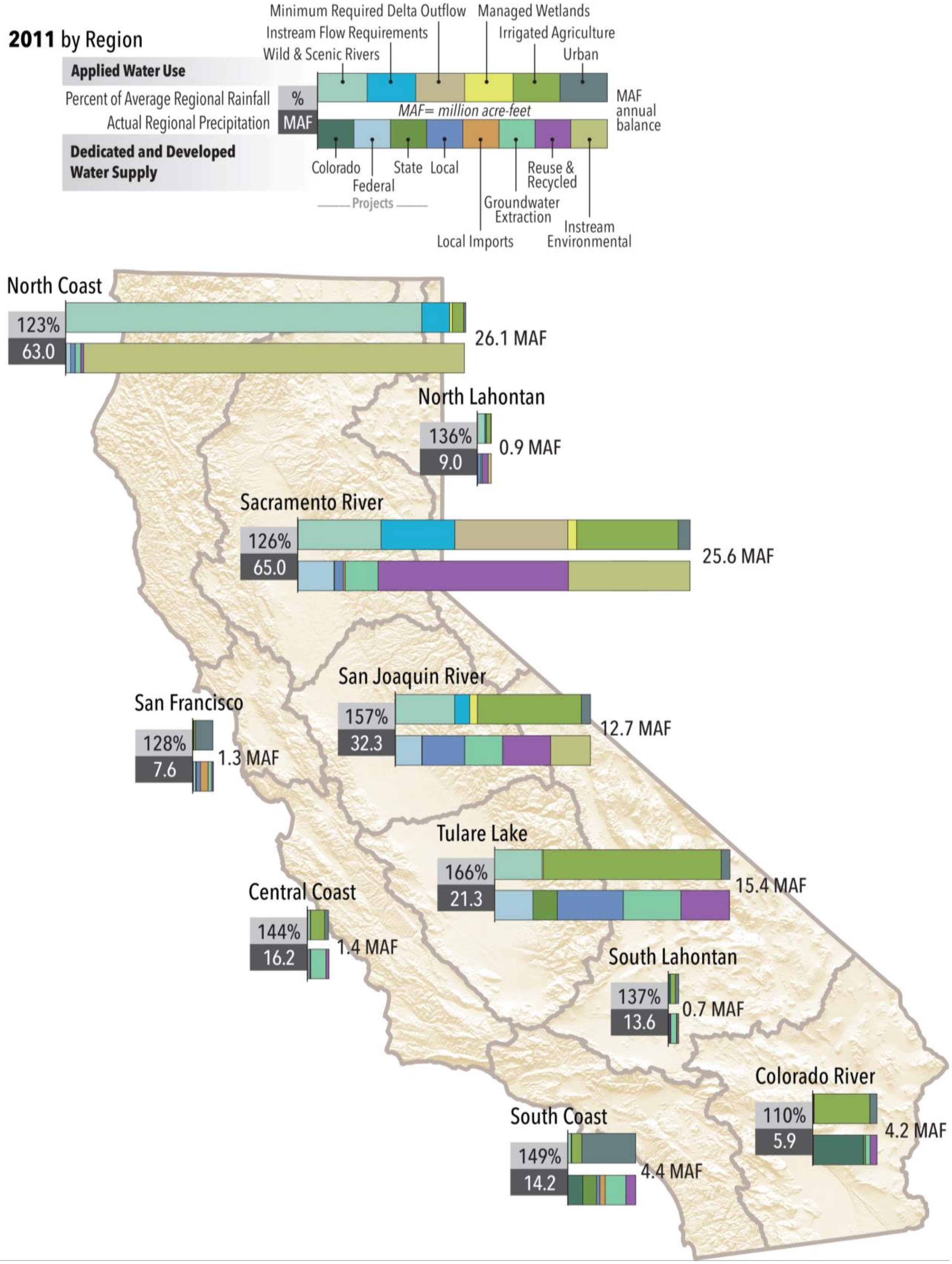
For more information about California's water use and water supply, including regional water balances for additional years, hydrologic summaries, regional inflows and outflows, and data for smaller analysis areas within each region, refer to the Water Portfolios section of the Water Plan webpages and the Update 2018 Supporting Documents webpage. (California Department of Water Resources 2019)

Figure 1 California Water: How It Was Used and Where It Came From, 2011–2015

Water Year % Average Rainfall *Precipitation in millions of acre feet (MAF)*	**2011** 134% *248.1*	**2012** 75% *138.9*	**2013** 77% *142.0*	**2014** 56% *102.6*	**2015** 77% *143.3*
Applied Water Use - how water was used ...					millions of acre feet
Urban	**7.7**	**8.3**	**8.3**	**8.1**	**7.0**
Large Landscape	0.6	0.8	0.7	0.8	0.7
Commercial	1.1	1.1	1.2	1.1	1.0
Industrial	0.4	0.4	0.4	0.3	0.3
Energy Production	0.1	0.1	0.1	0.1	0.1
Residential - Interior	2.4	2.7	2.7	2.9	2.4
Residential - Exterior	2.3	2.4	2.5	2.4	1.9
Conveyance Applied Water	0.4	0.4	0.4	0.4	0.3
Groundwater Recharge Applied Water	0.5	0.5	0.2	0.1	0.2
Irrigated Agriculture	**31.7**	**35.0**	**35.7**	**35.0**	**32.4**
Applied Water - Crop Production	26.9	31.6	32.6	32.5	30.5
Conveyance Applied Water	3.4	3.0	2.9	2.3	1.8
Groundwater Recharge Applied Water	1.4	0.3	0.2	0.2	0.1
Environmental Water	**53.2**	**33.9**	**29.8**	**21.7**	**24.7**
Managed Wetlands	1.5	1.6	1.6	1.6	1.5
Minimum Req'd Delta Outflow	7.4	5.3	4.5	4.0	3.7
Instream Flow Requirements	7.9	6.8	6.6	5.6	5.3
Wild & Scenic Rivers	36.5	20.2	17.1	10.5	14.2
Total Uses	 **92.7**	 **77.2**	 **73.7**	 **64.7**	 **64.1**
Dedicated and Developed Water Supply - where it came from ...					millions of acre feet
Instream Enviro. Supply	31.3	21.6	18.0	12.4	16.2
Local Projects	10.3	8.2	6.8	6.3	4.9
Local Imported Deliveries	1.0	0.8	0.7	0.5	0.4
Colorado River Project	4.2	4.7	5.3	5.8	5.0
Federal Projects	7.1	6.4	5.7	3.9	3.3
State Project	2.9	2.8	2.0	1.3	0.9
Groundwater Extraction	12.1	18.1	20.8	23.0	22.9
Inflow & Return Flow for Carryover Storage	0.1	0.1	0.1	0.1	0.1
Reuse and Recycled Water	23.6	14.4	14.2	11.4	10.4
Total Supplies	 **92.7**	 **77.2**	 **73.7**	 **64.7**	 **64.1**

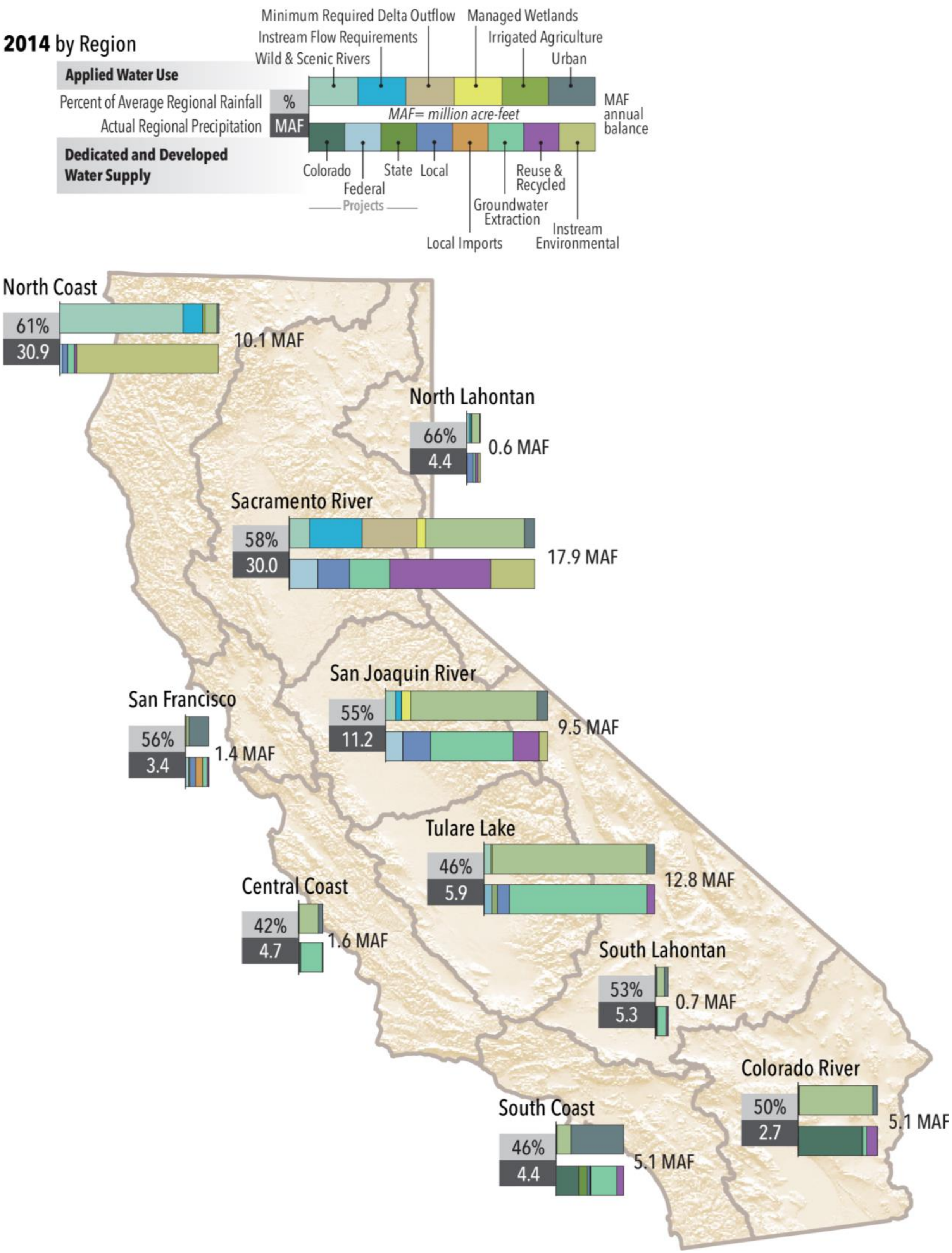
Source: *California Water Plan Update 2018*, Figure 1-1

Figure 2 Regional Water Uses and Supplies in Water Year 2011 (Wet Year)



Source: *California Water Plan Update 2018*, Figure 1-2

Figure 3 Regional Water Uses and Supplies in Water Year 2014 (Critically Dry Year)



Source: *California Water Plan Update 2018*, Figure 1-3

Study Areas

DWR subdivides California into specific geographical study areas for planning purposes and data collection. Besides the state as a whole, the largest study areas are the 10 hydrologic regions (HRs) that correspond to the state's major drainage basins. Using the drainage basins as planning boundaries allows logical tracking of water runoff and accounting of supplies. The Water Plan subdivides HRs into 56 planning areas (PAs) that are composed of 278 detailed analysis units (DAUs). The DAUs are often split by county, so the smallest study area used in the water balances is DAU by county (DAUCO). These 500 study areas are a mix of hydrologic and political boundaries. This means that when counties change their boundaries, even slightly, the DAUCO boundaries change. In a few cases, a river is a boundary to a study area. When the river veers, it causes a change to a boundary area. Spatial data is adjusted every few years, or as deemed necessary by DWR's geographic information system (GIS) committee. Many planning studies begin at the DAUCO, or PA, level depending on available data. The results are aggregated to county or hydrologic region for presentation, reporting, and sharing. Different study areas are shown in Figure 4. More information on boundaries can be found in the "Online Files and Folders Description" section of this report.

Figure 4 Hydrologic Regions, Planning Areas, and Detailed Analysis Units

Water Use

Water Plan water balances include water used for urban and agricultural sectors and dedicated environmental water. Urban water use includes water for interior and exterior residential, commercial, industrial, and landscape uses. Urban applied water use is the quantity of water delivered to the intake of a water supplier's system. It equals the amount of water delivered to customers plus water used for conveyance and/or groundwater recharge. Urban water data in the water balances was analyzed on a per capita basis by using population data and public water system statistics data. Statewide urban water use for WY 2015 was 7 million acre-feet (maf), the lowest since 1991, even as the population increased by almost 10 million people, exceeding 39 million people in 2015. This was likely a result of required and voluntary water restrictions and conservation during the recent drought sequence.

Agricultural water use is calculated from annual irrigated crop acres, precipitation, crop evapotranspiration coefficients, and other factors by using the California Simulation of Evapotranspiration of Applied Water (CalSIMETAW) model. Crop acres are estimated from DWR crop surveys, agriculture commission reports, and starting with WY 2014, by using remote sensing by LandIQ and DWR. Total applied water used in the agricultural sector is the quantity of water delivered to a farm headgate and includes applied water for crop production, water for conveyance, and applied water for groundwater recharge, including adjustments for irrigation efficiencies, as well as, the amount of water required for cultural practices such as the ponding of water in rice fields or extra water applied to leach accumulated salts from the soil.

Additional information about urban and agricultural water use can be found on DWR Land and Water Use web page: https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use. Population information can be found on DWR Demographics web page: https://water.ca.gov/Library/Modeling-and-Analysis/Statewide-models-and-tools/Economic-Modeling-and-Analysis-Tools.

Environmental water includes water used to manage wetlands and water dedicated to the environment for minimum required Sacramento-San Joaquin Delta (Delta) outflow, instream flow requirements, and flow volumes for rivers and river reaches designated Wild and Scenic. Managed wetlands include impounded freshwater and nontidal brackish water wetlands. Water use is calculated in a manner very similar to agricultural water use. Delta outflow volumes are compiled by using daily data for total outflow (Dayflow). Minimum required outflow relies on DWR operational data for the amount required by law to maintain flow and water quality standards to protect the beneficial uses within the Delta. While it is acknowledged that this water benefits all water uses, it is grouped here for convenience. Instream flow requirements volumes consist of actual flows released by project operators or within their natural watercourse as specified in a water rights permit, court decision, agreement, or Federal Energy Regulatory Commission license to support natural ecosystems or create habitat for plants and animals. Instream flow requirements generally vary by water year type. Volumes are collected from project operators and/or stream gauges. Wild and Scenic Rivers are federally and/or State-designated river systems under the Wild and Scenic Rivers Acts. More than 2,000 miles of rivers and river reaches are designated wild, scenic, or recreational in California. Unimpaired natural flow volumes are collected or calculated for designated rivers and river reaches. Wild and Scenic volumes depend on how wet or dry a year was; the volumes ranged from 36.5 maf to 10.5 maf for WYs 2011–2015.

Water Supply

Water balances include information for developed and dedicated water that supplied water uses. Dedicated and developed water supplies include surface water, groundwater, reused, and recycled water. Supplies are grouped into categories for summary graphics. Supply categories include local, local imported, Colorado River, federal, and State water projects; return flow to carryover storage from the previous year; instream environmental supply; groundwater; and reuse and recycled. Dedicated and developed water supply averages 40 percent to 50 percent of total annual precipitation. Applied water balances shown in Figures 1, 2, 3, and Figures 7 through 16 include water that is used multiple times and water that has multiple benefits.

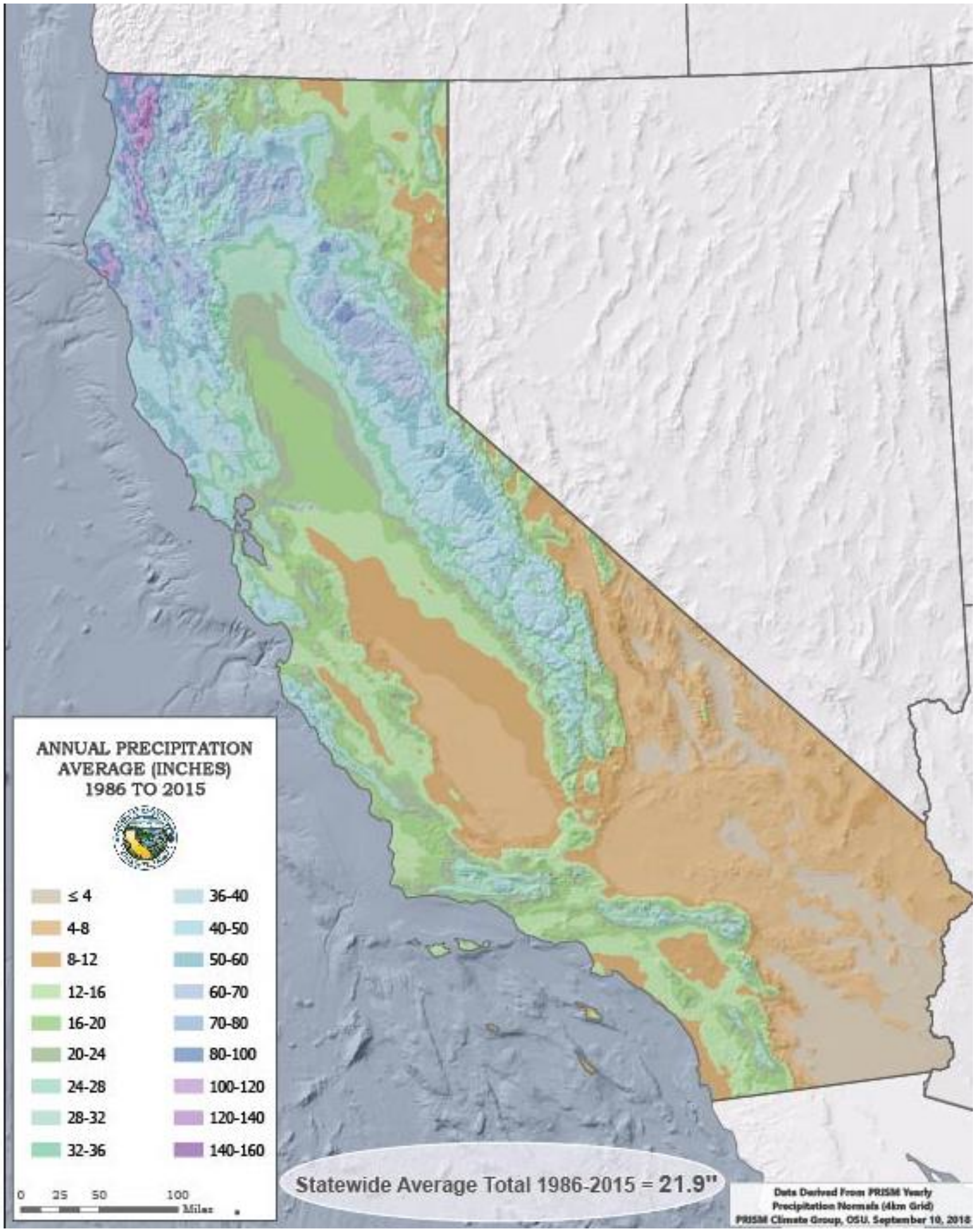
Precipitation

Precipitation amounts differ so dramatically between the northern regions of California and its southeast portions that average conditions presented for the entire state are not useful for regional or local planning. Precipitation is calculated at the DAUCO level by application of yearly Parameter-elevation Relationships on Independent Slopes Model (PRISM) data at a 4-kilometer scale. Some very general trends can be examined by using statewide average conditions. For a recent 30-year average, California's precipitation provided approximately 185 maf. The 30-year average for 1986–2015 was 1.5 inches, or 12.8 maf, less than the 1981–2010 average. Table 1 shows three different 30-year averages for precipitation in the state. Figure 5 maps the distribution of average annual precipitation across the state.

Table 1 30-Year Averages of Annual Precipitation

Years	Inches of Precipitation	Million Acre-Feet
1971–2000	23.5	198.1
1981–2010	23.4	197.5
1986–2015	21.9	184.7

Figure 5 Average Annual Precipitation, 1986–2015



Hydrologic Summary

Hydrologic summary tables in the Water Plan water portfolio itemize water entering the region, water leaving the region, and storage changes in the region. Table 2 is a hydrologic summary table for California, showing data for WYs 2011–2015, and an 18-year average. Figure 6 charts the disposition of precipitation for the 18-year average. Figure 6 shows that, on average, approximately one-third of California's precipitation stays in the system as runoff, if runoff used for consumptive use and change in storage from the previous year is included. And 30 percent of that one-third is depleted as non-designated (though often beneficial) outflow to the Pacific Ocean, other salt sinks, and/or other states. This additional runoff is significantly reduced to approximately 10 percent of precipitation in dry years to as low as 0 percent in critical years and drought sequences. On average, approximately two-thirds of precipitation is depleted through evapotranspiration by trees and other native vegetation, evaporates to the atmosphere, or is stored as effective precipitation. Water portfolio supporting-documentation files include hydrologic summary tables for 10 hydrologic regions and the state for WYs 1998–2015. Hydrologic region tables make clear that not only is precipitation highly variable, but the disposition of precipitation and runoff differs dramatically among regions in the state by water year type and by different hydrologic sequences. California's variability makes standardization of water management nearly impossible.

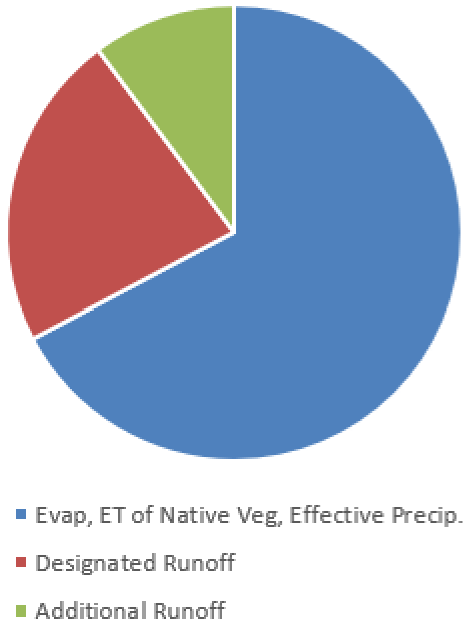
Table 2 California Hydrologic Summary (in million acre-feet)

	Water Year (Percent of Average Precipitation)					Average 1998–2015
	2011 (134%)	2012 (75%)	2013 (77%)	2014 (56%)	2015 (78%)	
Water Entering California						
Precipitation	249.4	138.9	142.0	102.6	143.3	182.2
Inflow from Oregon/Mexico	1.3	1.0	0.8	0.8	0.7	1.3
Inflow from Colorado River	4.2	4.7	5.3	5.8	5.0	4.9
Imports from Other Regions	NA	NA	NA	NA	NA	NA
Total	**254.9**	**144.6**	**148.1**	**109.2**	**149.0**	**188.4**
Water Leaving California						
Consumptive Use[a] of Applied Water (Agricultural, Municipal and Industrial, Wetlands)	26.5	30.6	30.9	30.8	29.4	27.3
Outflow to Oregon/Nevada/Mexico	2.1	0.9	0.9	0.6	0.4	1.1
Exports to Other Regions	NA	NA	NA	NA	NA	NA
Statutory Required Outflow to Salt Sink	32.6	22.6	18.8	13.1	16.6	25.3
Additional Outflow to Salt Sink	28.8	8.0	9.8	3.8	7.2	19.2
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural/Incidental Runoff, Agricultural Effective Precipitation, and Other Outflows	164.7	102.7	107.4	84.4	115.2	126.8
Total	**254.6**	**164.8**	**167.8**	**132.7**	**168.8**	**199.6**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage						
Change in Supply — Surface Reservoir	6.2	-7.4	-4.1	-5.1	-0.8	-0.6
Change in Supply — Groundwater Storage	-5.9	-12.8	-15.8	-18.4	-19.0	-10.6
Total	**0.3**	**-20.2**	**-19.9**	**-23.5**	**-19.8**	**-11.2**

Note: NA = not applicable

[a] Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.

Figure 6 **Disposition of Average Annual Precipitation and Inflow (1998–2015)**



Notes:
Average annual precipitation (1998–2015) = 182.2 million acre-feet (maf)
Inflow from other states/regions = 6.1 maf
Total surface inflow = 188.4 maf
Evaporation, evapotranspiration of native vegetation, effective precipitation = 126.8 maf
Designated runoff = 42.4 maf
Additional runoff = 19.2 maf

Water Balances

There is no cookie cutter approach to meeting a region's water needs. The amount of water required to meet a region's needs depends on several factors, including the region's water uses, opportunities to reapply water in the region, and the types of resource management strategies that are implemented in the region. The Water Plan provides applied, net, and depletion water balances. These water balances are analyses of developed and dedicated water supplies, water uses, water reuses, and operational characteristics for an area. Water balance analyses show the amount of water applied to actual uses. In this way, use equals supply. Water uses are collected and calculated, then compared and computed with supply data collected and estimated by the Water Supply and Balance Team. An applied water balance provides an upper bound on water used because it includes consumptive use, reuse, and outflows. *Applied water* refers to the total amount of water diverted from any source to meet uses without adjusting for water that is used up, returned to the developed supply, or irrecoverable (losses). Net water supply and net water use are less than applied water. *Net water use* consists of water that is consumed in the system, irrecoverable water, and outflow. Applied water includes reuse of surface and groundwater supplies. *Water depletion* is net water use minus water that can be later recovered, such as deep percolation and return flow to a developed supply. Applied water methodology is easier for local water agencies to evaluate because applied water use information is closer in concept to agency water-system-delivery data. Environmental water "use" includes water that is required to remain in stream because of an instream flow requirement, Wild and Scenic river designation, or required Delta outflow, even though this water is not applied in the traditional sense of being diverted and applied. The designated water supply, called instream environmental, is the water that is required by law, code, or agreement to remain in a stream. Applied, net, and depletion water balances by PA, HR, and the state for WYs 1998–2015 can be found in folder 3-Summary files. Detailed DAUCO results are in folder 4-DAUCO-Data_Entry_Level00-combined. Hydrologic region water balances by water year, from 2011 to 2015, follow as Figures 7 through 16 and are found in folder 2-Graphics, in the supporting documentation files. Detailed water balance parameters and equations can be found in the Standard Operating Procedures file. Links are available in the "Online Files and Folders Descriptions" section of this document.

Figure 7 North Coast Water Balance by Water Years 2011–2015

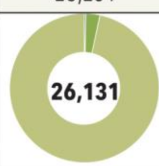
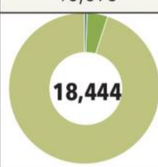
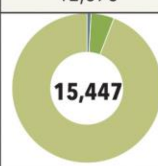
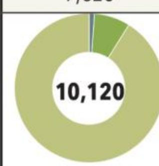
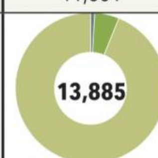
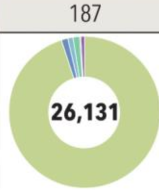
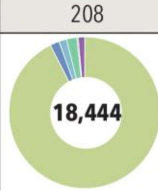
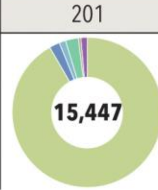
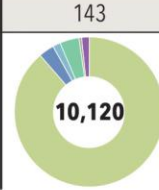
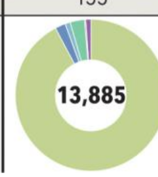
Water Year % Average Rainfall *Precipitation in thousands of acre feet (TAF)*	2011 *123%* *63,011*	2012 *93%* *47,610*	2013 *94%* *48,251*	2014 *61%* *30,906*	2015 *89%* *45,493*
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**139**	**140**	**149**	**137**	**125**
Large Landscape	9	10	12	10	9
Commercial	17	17	18	17	15
Industrial	3	2	3	2	2
Energy Production	26	26	28	25	27
Residential - Interior	50	50	50	48	43
Residential - Exterior	26	26	29	25	23
Conveyance Applied Water	8	10	9	9	5
Groundwater Recharge Applied Water	0	0	0	0	0
Irrigated Agriculture	**738**	**795**	**782**	**771**	**729**
Applied Water - Crop Production	578	706	703	700	660
Conveyance Applied Water	160	89	80	71	70
Groundwater Recharge Applied Water	0	0	0	0	0
Environmental Water	**25,254**	**17,509**	**14,516**	**9,212**	**13,031**
Managed Wetlands	187	204	192	131	121
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	1,817	1,613	1,450	1,257	1,259
Wild & Scenic Rivers	23,251	15,693	12,873	7,825	11,651
Total Uses	 **26,131**	 **18,444**	 **15,447**	 **10,120**	 **13,885**
Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	24,890	17,112	14,168	8,989	12,814
Local Projects	298	339	351	327	324
Local Imported Deliveries	1	1	2	2	2
Colorado River Project	0	0	0	0	0
Federal Projects	299	299	232	174	166
State Project	0	0	0	0	0
Groundwater Extraction	360	409	425	429	392
Inflow & Return Flow for Carryover Storage	96	77	69	58	55
Reuse and Recycled Water	187	208	201	143	133
Total Supplies	 **26,131**	 **18,444**	 **15,447**	 **10,120**	 **13,885**

Figure 8 San Francisco Bay Water Balance by Water Years 2011–2015

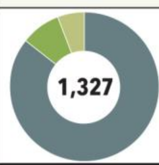
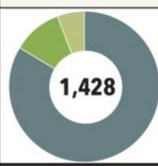
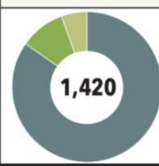
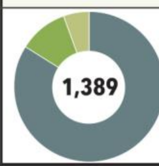
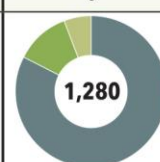
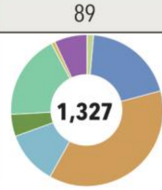
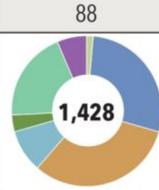
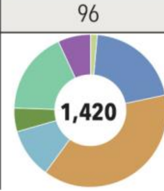
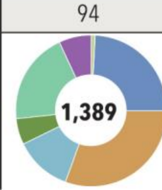
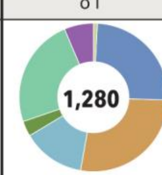
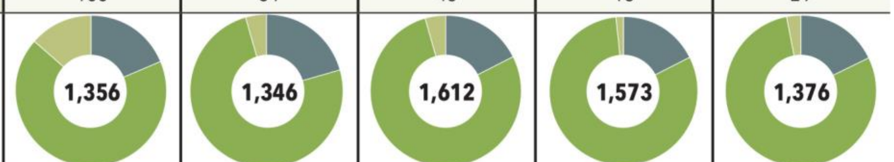
Water Year	**2011**	**2012**	**2013**	**2014**	**2015**
% Average Rainfall	*128%*	*71%*	*80%*	*56%*	*86%*
Precipitation in thousands of acre feet (TAF)	*7,594*	*4,230*	*4,746*	*3,351*	*5,098*
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**1,138**	**1,194**	**1,206**	**1,169**	**1,057**
Large Landscape	75	87	89	84	75
Commercial	214	198	199	192	177
Industrial	82	87	82	89	92
Energy Production	13	9	33	26	15
Residential - Interior	381	437	417	442	430
Residential - Exterior	226	226	227	215	175
Conveyance Applied Water	81	76	87	85	55
Groundwater Recharge Applied Water	67	73	73	36	39
Irrigated Agriculture	**114**	**154**	**136**	**146**	**151**
Applied Water - Crop Production	109	138	130	142	144
Conveyance Applied Water	4	5	4	5	5
Groundwater Recharge Applied Water	2	12	2	0	2
Environmental Water	**75**	**80**	**78**	**74**	**72**
Managed Wetlands	53	60	58	61	59
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	22	20	20	13	13
Wild & Scenic Rivers	0	0	0	0	0
Total Uses					
Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	22	20	20	13	13
Local Projects	257	404	291	337	317
Local Imported Deliveries	495	454	546	425	348
Colorado River Project	0	0	0	0	0
Federal Projects	150	131	148	167	172
State Project	63	51	71	79	45
Groundwater Extraction	238	279	250	274	304
Inflow & Return Flow for Carryover Storage	13	0	0	0	0
Reuse and Recycled Water	89	88	96	94	81
Total Supplies					

Figure 9 Central Coast Water Balance by Water Years 2011–2015

Water Year % Average Rainfall Precipitation in thousands of acre feet (TAF)	2011 144% 16,193	2012 69% 7,688	2013 58% 6,461	2014 42% 4,672	2015 69% 7,791
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**253**	**277**	**284**	**277**	**245**
Large Landscape	22	25	26	27	22
Commercial	36	42	42	39	40
Industrial	10	10	11	10	9
Energy Production	13	13	13	13	13
Residential - Interior	70	80	79	78	66
Residential - Exterior	87	94	98	92	74
Conveyance Applied Water	5	3	3	8	10
Groundwater Recharge Applied Water	10	11	12	9	10
Irrigated Agriculture	**922**	**1,012**	**1,259**	**1,270**	**1,088**
Applied Water - Crop Production	894	992	1,247	1,256	1,069
Conveyance Applied Water	10	5	6	7	9
Groundwater Recharge Applied Water	19	16	7	7	10
Environmental Water	**181**	**57**	**68**	**26**	**42**
Managed Wetlands	0	0	0	0	0
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	25	25	25	12	13
Wild & Scenic Rivers	155	31	43	13	29
Total Uses	**1,356**	**1,346**	**1,612**	**1,573**	**1,376**
Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	0	30	0	13	0
Local Projects	21	19	26	21	22
Local Imported Deliveries	0	0	0	0	0
Colorado River Project	0	0	0	0	0
Federal Projects	99	105	87	66	76
State Project	26	25	24	25	22
Groundwater Extraction	1,003	1,111	1,381	1,403	1,189
Inflow & Return Flow for Carryover Storage	10	10	10	10	9
Reuse and Recycled Water	197	47	84	34	58
Total Supplies	**1,356**	**1,346**	**1,612**	**1,573**	**1,376**



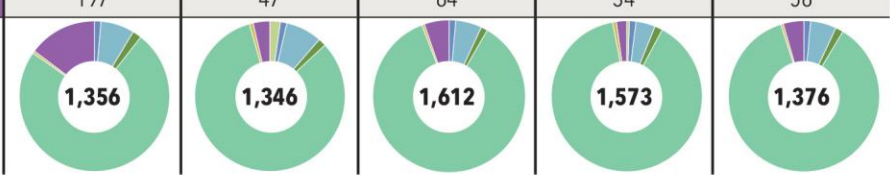
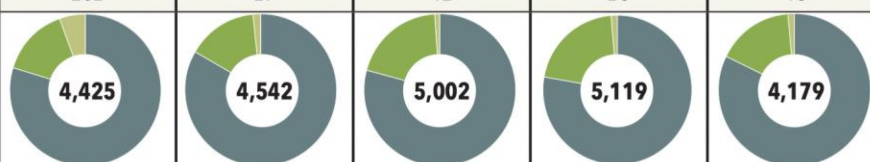


Figure 10 **South Coast Water Balance by Water Years 2011–2015**

Water Year % Average Rainfall *Precipitation in thousands of acre feet (TAF)*	**2011** *149%* *14,235*	**2012** *67%* *6,402*	**2013** *50%* *4760*	**2014** *46%* *4364*	**2015** *76%* *7,289*
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**3,530**	**3,794**	**3,967**	**3,992**	**3,439**
Large Landscape	372	483	424	428	427
Commercial	504	548	564	530	508
Industrial	85	92	82	63	78
Energy Production	18	20	15	19	17
Residential - Interior	1,259	1,394	1,448	1,571	1,263
Residential - Exterior	989	1,040	1,197	1,158	897
Conveyance Applied Water	148	141	145	138	143
Groundwater Recharge Applied Water	156	75	92	85	107
Irrigated Agriculture	**655**	**680**	**985**	**1,061**	**691**
Applied Water - Crop Production	644	669	973	1,046	680
Conveyance Applied Water	11	11	13	15	11
Groundwater Recharge Applied Water	0	0	0	0	0
Environmental Water	**240**	**68**	**50**	**66**	**50**
Managed Wetlands	32	35	32	34	31
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	6	6	6	6	6
Wild & Scenic Rivers	202	27	12	26	13
Total Uses	**4,425**	**4,542**	**5,002**	**5,119**	**4,179**
Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	0	0	0	0	0
Local Projects	214	237	197	168	164
Local Imported Deliveries	351	229	100	79	35
Colorado River Project	959	905	1,307	1,733	1,601
Federal Projects	2	0	0	0	0
State Project	904	1,174	1,064	646	460
Groundwater Extraction	1,351	1,484	1,824	1,986	1,462
Inflow & Return Flow for Carryover Storage	0	0	0	0	0
Reuse and Recycled Water	645	513	510	506	457
Total Supplies	**4,425**	**4,542**	**5,002**	**5,119**	**4,179**



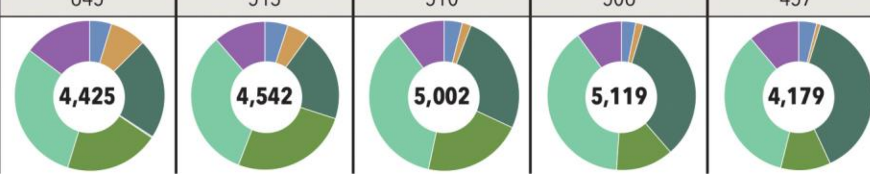


Figure 11 **Sacramento River Water Balance by Water Years 2011–2015**

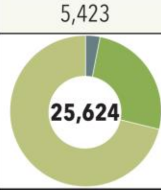
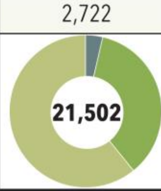
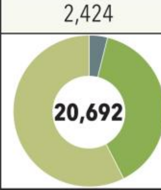
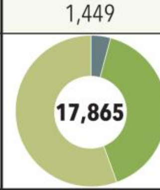
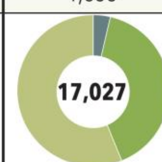
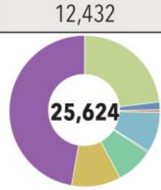
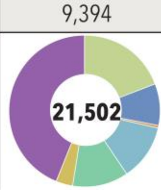
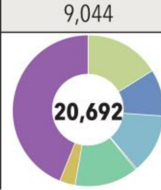
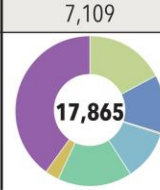
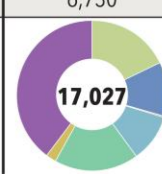
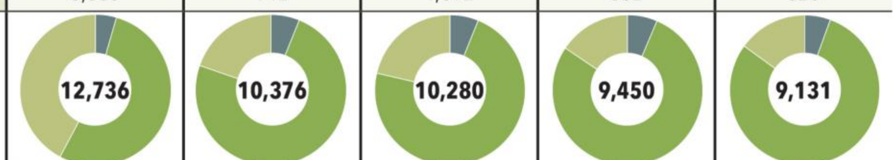
Water Year % Average Rainfall *Precipitation in thousands of acre feet (TAF)*	**2011** *126%* *65,043*	**2012** *73%* *37,471*	**2013** *84%* *43,262*	**2014** *58%* *29,912*	**2015** *78%* *40,104*
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**784**	**832**	**856**	**757**	**661**
Large Landscape	63	66	79	66	56
Commercial	133	135	134	132	119
Industrial	29	32	30	24	26
Energy Production	5	6	11	3	4
Residential - Interior	215	255	257	234	241
Residential - Exterior	275	273	277	237	166
Conveyance Applied Water	63	65	68	61	49
Groundwater Recharge Applied Water	0	0	0	0	0
Irrigated Agriculture	**6,637**	**7,606**	**7,965**	**7,194**	**6,814**
Applied Water - Crop Production	5,286	6,251	6,508	6,243	6,143
Conveyance Applied Water	1,351	1,355	1,458	951	671
Groundwater Recharge Applied Water	0	0	0	0	0
Environmental Water	**18,203**	**13,063**	**11,871**	**9,914**	**9,552**
Managed Wetlands	578	637	614	642	613
Minimum Req'd Delta Outflow	7,385	5,296	4,499	3,999	3,710
Instream Flow Requirements	4,818	4,408	4,335	3,825	3,594
Wild & Scenic Rivers	5,423	2,722	2,424	1,449	1,636
Total Uses	 **25,624**	 **21,502**	 **20,692**	 **17,865**	 **17,027**
Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	5,149	4,157	3,354	3,113	3,035
Local Projects	580	1,905	2,067	2,237	2,025
Local Imported Deliveries	120	131	10	10	9
Colorado River Project	0	0	0	0	0
Federal Projects	2,345	2,533	2,663	1,948	1,757
State Project	30	35	37	32	10
Groundwater Extraction	2,151	2,557	2,795	2,835	3,091
Inflow & Return Flow for Carryover Storage	2,818	790	722	581	370
Reuse and Recycled Water	12,432	9,394	9,044	7,109	6,730
Total Supplies	 **25,624**	 **21,502**	 **20,692**	 **17,865**	 **17,027**

Figure 12 San Joaquin River Water Balance by Water Years 2011–2015

Water Year % Average Rainfall *Precipitation in thousands of acre feet (TAF)*	**2011** *157%* *32,305*	**2012** *66%* *13,583*	**2013** *73%* *14,960*	**2014** *55%* *11,218*	**2015** *61%* *12,614*
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**601**	**636**	**636**	**607**	**514**
Large Landscape	38	42	40	39	31
Commercial	64	65	64	62	52
Industrial	93	88	86	90	86
Energy Production	1	1	5	4	4
Residential - Interior	185	207	197	197	168
Residential - Exterior	176	185	197	174	135
Conveyance Applied Water	43	48	46	40	38
Groundwater Recharge Applied Water	0	1	1	1	1
Irrigated Agriculture	**6,792**	**7,701**	**7,449**	**7,393**	**7,272**
Applied Water - Crop Production	5,810	7,058	6,970	7,085	7,014
Conveyance Applied Water	436	436	387	301	252
Groundwater Recharge Applied Water	545	208	92	7	6
Environmental Water	**5,344**	**2,038**	**2,195**	**1,450**	**1,345**
Managed Wetlands	501	530	534	536	504
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	983	596	569	333	313
Wild & Scenic Rivers	3,860	912	1,092	582	528
Total Uses	**12,736**	**10,376**	**10,280**	**9,450**	**9,131**
Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	2,606	723	852	500	501
Local Projects	2,774	2,505	1,993	1,601	1,031
Local Imported Deliveries	3	0	0	0	0
Colorado River Project	0	0	0	0	0
Federal Projects	1,708	1,616	1,466	982	743
State Project	28	28	45	31	14
Groundwater Extraction	2,480	3,559	3,855	4,835	5,287
Inflow & Return Flow for Carryover Storage	4	4	4	4	3
Reuse and Recycled Water	3,135	1,941	2,065	1,497	1,553
Total Supplies	**12,736**	**10,376**	**10,280**	**9,450**	**9,131**



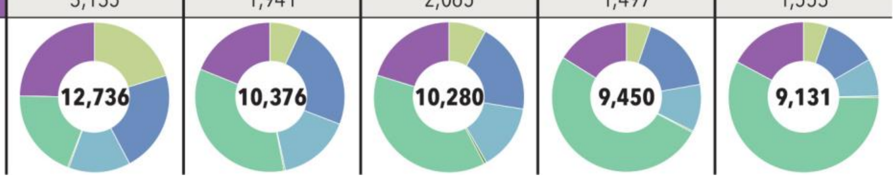
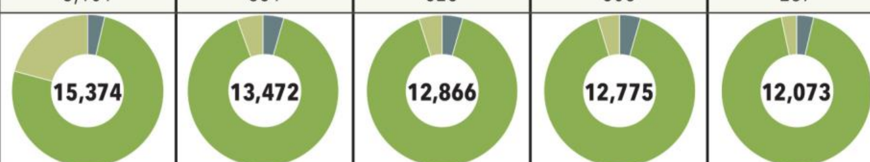


Figure 13 Tulare Lake Water Balance by Water Years 2011–2015

Water Year % Average Rainfall *Precipitation in thousands of acre feet (TAF)*	**2011** *166%* *21,340*	**2012** *71%* *9,201*	**2013** *52%* *6,670*	**2014** *46%* *5,887*	**2015** *62%* *7,941*
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**570**	**599**	**585**	**597**	**468**
Large Landscape	16	17	17	17	14
Commercial	39	40	40	40	32
Industrial	55	56	57	58	45
Energy Production	15	15	14	16	16
Residential - Interior	216	225	223	227	176
Residential - Exterior	227	235	234	238	185
Conveyance Applied Water	0	0	0	0	0
Groundwater Recharge Applied Water	1	11	1	1	1
Irrigated Agriculture	**11,619**	**12,127**	**11,663**	**11,576**	**11,226**
Applied Water - Crop Production	10,096	11,688	11,426	11,303	11,139
Conveyance Applied Water	684	364	209	141	88
Groundwater Recharge Applied Water	839	75	28	132	0
Environmental Water	**3,186**	**745**	**618**	**602**	**379**
Managed Wetlands	85	93	94	96	92
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	0	2	0	0	0
Wild & Scenic Rivers	3,101	651	525	506	287
Total Uses	**15,374**	**13,472**	**12,866**	**12,775**	**12,073**



Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	0	0	0	0	0
Local Projects	4,313	1,921	1,067	886	520
Local Imported Deliveries	0	0	0	0	0
Colorado River Project	0	0	0	0	0
Federal Projects	2,498	1,738	1,136	572	356
State Project	1,582	1,246	619	419	306
Groundwater Extraction	3,770	7,839	9,410	10,316	10,496
Inflow & Return Flow for Carryover Storage	0	0	0	0	0
Reuse and Recycled Water	3,179	729	603	582	366
Total Supplies	**15,374**	**13,472**	**12,866**	**12,775**	**12,073**

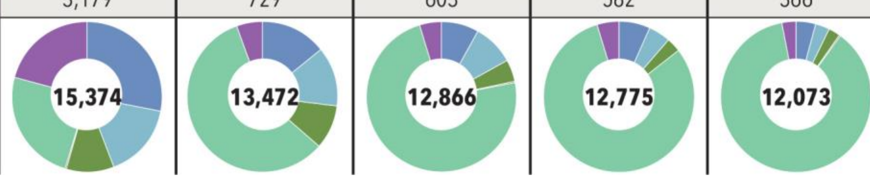


Figure 14 North Lahontan Water Balance by Water Years 2011–2015

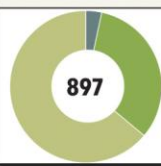
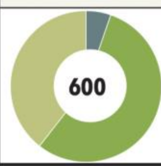
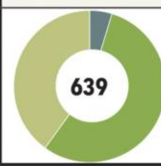
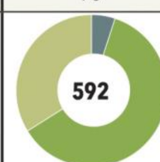
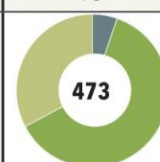
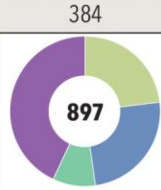
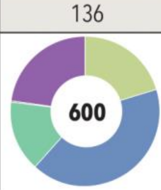
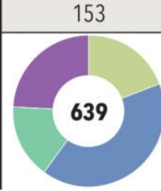
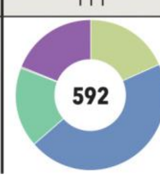
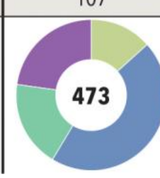
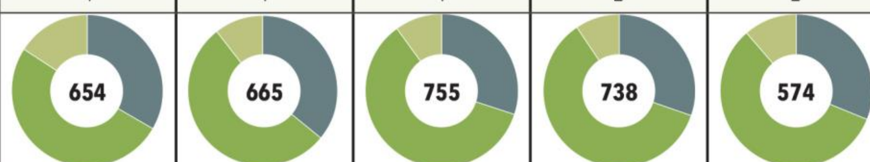
Water Year % Average Rainfall *Precipitation in thousands of acre feet (TAF)*	**2011** *136%* *9,024*	**2012** *59%* *3,936*	**2013** *82%* *5,421*	**2014** *66%* *4,371*	**2015** *83%* *5,490*
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**30**	**32**	**31**	**30**	**26**
Large Landscape	1	1	1	1	1
Commercial	5	8	8	7	5
Industrial	0	0	1	1	0
Energy Production	1	1	1	1	0
Residential - Interior	11	10	10	10	10
Residential - Exterior	7	7	7	6	7
Conveyance Applied Water	5	5	5	5	4
Groundwater Recharge Applied Water	0	0	0	0	0
Irrigated Agriculture	**295**	**332**	**354**	**362**	**292**
Applied Water - Crop Production	276	314	332	341	274
Conveyance Applied Water	19	18	22	22	18
Groundwater Recharge Applied Water	0	0	0	0	0
Environmental Water	**573**	**236**	**254**	**199**	**155**
Managed Wetlands	19	22	22	23	21
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	83	84	85	81	41
Wild & Scenic Rivers	471	129	148	96	93
Total Uses					
Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	208	122	124	109	64
Local Projects	221	250	261	268	215
Local Imported Deliveries	0	0	0	0	0
Colorado River Project	0	0	0	0	0
Federal Projects	0	0	0	0	0
State Project	0	0	0	0	0
Groundwater Extraction	83	91	101	103	88
Inflow & Return Flow for Carryover Storage	1	2	1	1	1
Reuse and Recycled Water	384	136	153	111	107
Total Supplies					

Figure 15 South Lahontan Water Balance by Water Years 2011–2015

Water Year	2011	2012	2013	2014	2015
% Average Rainfall	137%	52%	41%	53%	73%
Precipitation in thousands of acre feet (TAF)	13,562	5,186	4,052	5,261	7,173
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**218**	**240**	**228**	**225**	**180**
Large Landscape	7	9	11	19	11
Commercial	30	25	24	23	27
Industrial	1	1	1	3	3
Energy Production	4	7	2	6	4
Residential - Interior	29	30	31	29	23
Residential - Exterior	142	155	149	136	102
Conveyance Applied Water	4	4	5	5	5
Groundwater Recharge Applied Water	2	9	5	5	6
Irrigated Agriculture	**333**	**356**	**453**	**444**	**330**
Applied Water - Crop Production	332	355	453	444	330
Conveyance Applied Water	1	1	0	0	0
Groundwater Recharge Applied Water	0	0	0	0	0
Environmental Water	**103**	**70**	**74**	**69**	**64**
Managed Wetlands	0	0	0	0	0
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	99	69	74	67	63
Wild & Scenic Rivers	4	1	1	2	2
Total Uses	**654**	**665**	**755**	**738**	**574**



Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	80	50	48	50	46
Local Projects	44	40	42	41	40
Local Imported Deliveries	0	0	0	0	0
Colorado River Project	0	0	0	0	0
Federal Projects	0	0	0	0	0
State Project	85	108	71	37	32
Groundwater Extraction	374	399	496	519	396
Inflow & Return Flow for Carryover Storage	0	0	0	0	0
Reuse and Recycled Water	71	69	99	91	61
Total Supplies	**654**	**665**	**755**	**738**	**574**

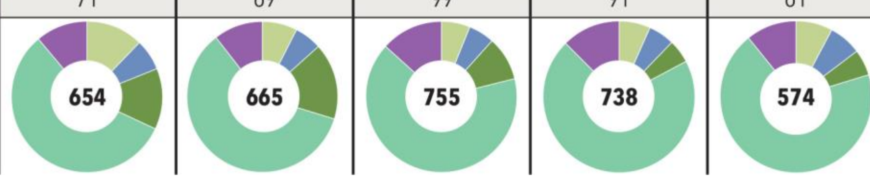
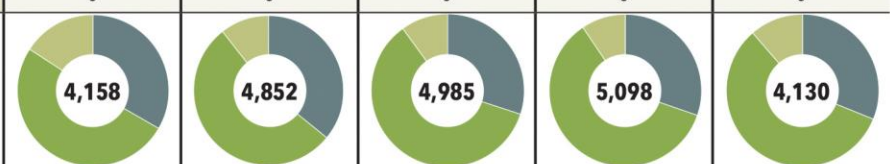


Figure 16 Colorado River Water Balance by Water Year 2011–2015

Water Year	**2011**	**2012**	**2013**	**2014**	**2015**
% Average Rainfall	*110%*	*67%*	*65%*	*50%*	*81%*
Precipitation in thousands of acre feet (TAF)	*5,863*	*3,559*	*3,456*	*2,664*	*4,282*
Applied Water Use - how water was used ...					thousands of acre feet
Urban	**477**	**591**	**338**	**302**	**269**
Large Landscape	31	61	24	62	61
Commercial	25	33	108	54	27
Industrial	1	2	1	0	0
Energy Production	25	25	26	28	27
Residential - Interior	24	32	17	28	27
Residential - Exterior	108	150	127	122	119
Conveyance Applied Water	0	0	0	0	4
Groundwater Recharge Applied Water	262	288	35	9	5
Irrigated Agriculture	**3,637**	**4,217**	**4,616**	**4,750**	**3,817**
Applied Water - Crop Production	2,915	3,429	3,827	3,953	3,072
Conveyance Applied Water	690	755	754	761	708
Groundwater Recharge Applied Water	32	33	35	36	37
Environmental Water	**44**	**44**	**30**	**45**	**45**
Managed Wetlands	44	44	30	45	45
Minimum Req'd Delta Outflow	0	0	0	0	0
Instream Flow Requirements	0	0	0	0	0
Wild & Scenic Rivers	0	0	0	0	0
Total Uses	**4,158**	**4,852**	**4,985**	**5,098**	**4,130**
Dedicated and Developed Water Supply - where it came from ...					thousands of acre feet
Instream Enviro. Supply	0	0	0	0	0
Local Projects	2	2	2	2	2
Local Imported Deliveries	0	0	0	0	0
Colorado River Project	3,260	3,782	3,998	4,115	3,448
Federal Projects	0	0	0	0	0
State Project	133	169	94	19	53
Groundwater Extraction	317	390	222	266	163
Inflow & Return Flow for Carryover Storage	0	0	0	0	0
Reuse and Recycled Water	446	510	669	697	465
Total Supplies	**4,158**	**4,852**	**4,985**	**5,098**	**4,130**



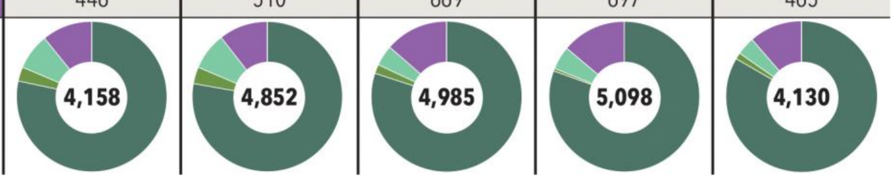
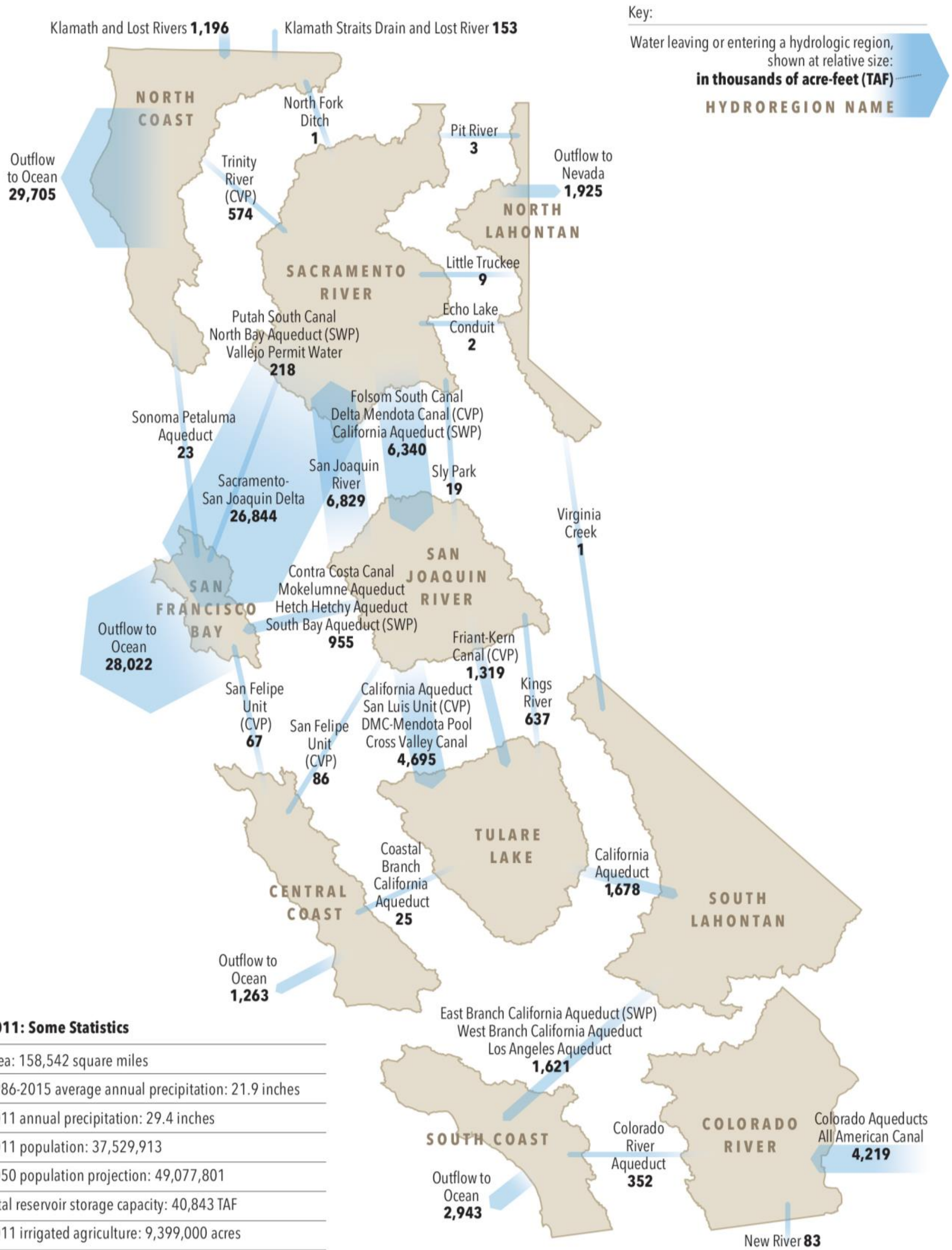


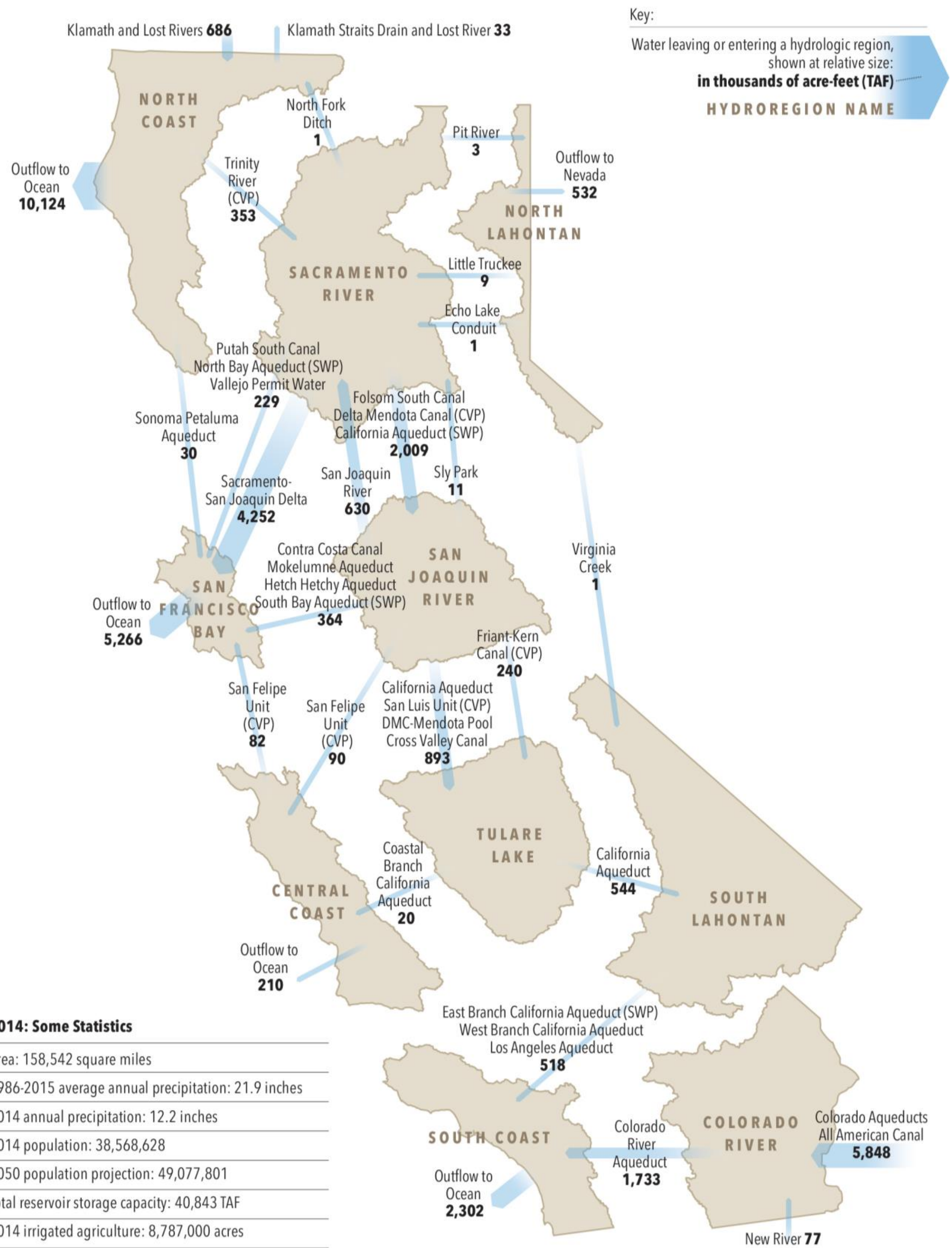
Figure 17 Regional Inflows and Outflows, Water Year 2011



2011: Some Statistics

Area: 158,542 square miles
1986-2015 average annual precipitation: 21.9 inches
2011 annual precipitation: 29.4 inches
2011 population: 37,529,913
2050 population projection: 49,077,801
Total reservoir storage capacity: 40,843 TAF
2011 irrigated agriculture: 9,399,000 acres

Figure 18 Regional Inflows and Outflows, Water Year 2014



2014: Some Statistics
Area: 158,542 square miles
1986-2015 average annual precipitation: 21.9 inches
2014 annual precipitation: 12.2 inches
2014 population: 38,568,628
2050 population projection: 49,077,801
Total reservoir storage capacity: 40,843 TAF
2014 irrigated agriculture: 8,787,000 acres

Water Balance Database Project

Local, regional, and statewide water management decisions are not only dependent on water supplies, water uses, and projects or strategies that are implemented, but also on the data that provides the information. This depends not only on the collection, calculation, and estimation accuracy or uncertainty itself, but on temporal and spatial details, access, documentation, and usability. The water balances are continually improved with every Water Plan update because of the Water Supply and Balance Team's skill and dedication, advances in technology, and improved data sets. A few examples of previous progress are:

- For WY 1998, the Water Plan began the water portfolio approach, documenting actual year data for every water year instead of a normalized and drought-conditions-only approach.
- Starting with WY 2002, water balance reporting included water supply by source for DAUCOs by using inflow-outflow methodology with completely redesigned workbooks.
- Beginning with WY 2006, environmental instream water data was input at the DAUCO level instead of by PA or HR.
- Beginning with WY 2011, final reporting tables included itemized sector water uses. There has also been a substantial increase in the use of programming for quality assurance/quality control (QA/QC) processes. For example, Python scripts are being used for QA/QA of urban water use data from public water system statistics, and R programming (language for statistical computing and graphics) has assisted with an unprecedented level of QA/QC for input data and water balance results.

Results have improved because of water use models, such as CalSIMETAW, or improved water supply information resulting from more local collaboration. Information technology constantly improves to better address data issues, as well.

To continue addressing some known issues with water balances, a database project was started by using WY 2010 as a pilot year with applied water use and supply as the pilot data. The project expanded for WYs 2011–2015 with full input of DAUCO data and computation equations for applied, net, and depletion water balances, including reuse adjustment equations for aggregation to planning area, hydrologic region, and the state. Six years of water balance data has been successfully integrated by using a PostgreSQL database management system. Transition from excel workbooks to a database enables a more standardized directory structure, consistent data formatting, controlled vocabulary, and better documentation. It will enable implementation of a scale of accuracy for water use, supply, and balance terms; improve data reporting, adaptability, visualization, and mapping; and improve usability, access, and timeliness. Initial release goals include interoperability with the California Natural Resources Agency (CNRA) Open Data Platform and the Water Data Exchange (WaDE) network. Included in water portfolio supporting documentation files are the project's standard operating procedures, and links to the CNRA Open Data Platform and WaDE.

Challenges, Risks, and Next Steps

Water resource planning is regularly vulnerable to risks such as demand increasing during a dry, hot summer while supply is reduced. Other risks include increasing precipitation, runoff, wildfires, species and ecosystem declines, water quality degradation, sea level rise, aging infrastructure, and catastrophic events. The ongoing challenge is to reduce risks with a mix of strategies such as water transfers, economic incentives, education and outreach, system reoperation, water reuse, groundwater recharge, floodplain management, forest management, meadow and riparian restoration, storage, and conveyance. Water portfolio optimization at the very basic level requires a detailed knowledge of water use, reuse, supplies, and water management strategies (current and future). Water portfolio optimization requires the best available data, access to that data, relationships with partners to align and share data, and sufficient resources and support from all levels of data advocates.

At an October 2018 water accounting meeting there was discussion about challenges, opportunities, risks, priorities, and next steps for the water balances team and the larger DWR water accounting (data) community. Breakout groups focused on three main topics to help tell the water accounting story:

- Data resources and gaps.
- Data sharing, coordination, and dependencies.
- Data partners and advocates.

The data resources and gaps group focused not only on data resources that have been lost and the resulting data gaps, but also on how people are filling that gap, the impacts of those lost resources, the risk of not addressing lost resources, and end products that are affected. One highlight in this discussion was the need to move toward a qualitative or quantitative range of accuracies for various input data pieces and output results.

The data sharing and coordination group focused on how current data program efforts can be more effective and efficient. Issues related to data sharing such as scale, metadata, and reproducibility were discussed. These affect the ability to connect data across programs and agencies. How people are working together and timelines of data dependencies that affect the lag time for end products were also examined.

The data partners and advocates topic included a survey of external parties who do (or could) inform data efforts, as well as, who is using what type of data. There was discussion on working together to better understand each other's data needs and resources; and as partners, to become better advocates for each other's data efforts.

There is a lot of good work being done, important work for integrated water management and water resources sustainability. But, there is even more work to do when it comes to increasing data availability, requests, and new requirements. High-quality data and analysis takes resources. To obtain stable funding and to be resourced properly, data advocates are needed at all levels. Part of the job of water experts is to increase the awareness and understanding of the work being done. Most resources are spent getting the data and results out, with little left to address some very important and costly issues.

Previously, Water Plan updates published water balance data for a block of years. There have been multiple requests to reduce the lag time for publishing data. The Water Supply and Balance Team is transitioning to annual water balance reporting, but there will remain a two- to three-year delay after the end of a water year because of data dependencies. WYs 2016 and 2017 are planned to be released as a two-year set. Continuing database transition steps include adjusting configuration management, integration of data reporting and visualization, shortening report-out timeframes, and defining a range of accuracy. Inherent in the challenge and opportunity to reduce the time lag for water balance results is addressing data dependencies.

Water balances bring together many different data pieces. Each data set has its own timeline that affects end products. The timelines for an input dataset range from zero to three years. One cause for longer timelines is QA/QC and reporting processes. For example, stream-gauge data is often collected from U.S. Geological Survey water-data reports that have undergone QA/QC and been published in an annual report. These annual water-data reports are released two to three years after the water year is complete. If DWR instead collected data from online queries, the quality would be reduced because that data wouldn't have the same level of QA/QC. This becomes a tradeoff of quality for time. But how much accuracy, what level of quality reduction, and what amount of time is involved? Each data piece affects water balance results in a different way. Especially for input data, it is best to have the highest-quality data possible. The water balance database project reduces the water balance QA/QC and reporting process, and increases the understanding of data dependencies.

Next steps include continued and extended collaboration to address challenges and opportunities inherent in a large data community, as well as continuous improvement of DWR's water balance methods and supporting documentation. Water portfolios were originally intended to provide a full accounting of water in California and to identify any data gaps. This process evolved over multiple Water Plan updates and much work has been done to fill data gaps and improve results. With the passage of the Sustainable Groundwater Management Act, and the need for local water budgets at a groundwater basin spatial scale, the Water Budget Design Team is developing guidelines and regional pilot studies for full water budgets that include the groundwater system, land system, surface water system, and atmosphere, for the state at a spatial scale applicable to all boundaries. Update 2018 supporting documents include the Handbook of Water Budget Development: With or Without Models, Water Budget Pilot Projects, and the Strategic Data Framework. Supporting documents can be found on the Update 2018 webpage. (https://water.ca.gov/Programs/California-Water-Plan/Update-2018#Supporting-Documents).

Online Files and Folders Descriptions

Water portfolio online files and folders are linked below. Folders 1 through 6 are linked to a .zip folder that contains the files described.

- Link to Written Discussion: Water-Portfolios-and-Balances.pdf.
    - Link to Water Balance Standard Operating Procedures: OWIA-SOP-Master.pdf.
    - Link to CNRA Open Data Platform: https://data.cnra.ca.gov/.
    - Link to WaDE: http://wade.westernstateswater.org/.
- DWR has developed a Tableau interactive data visualization tool for water balance results at the hydrologic regions and state levels for WYs 1998–2015.
    - Link: https://tableau.cnra.ca.gov/t/DWR_WaterBudgets/views/Water_Balance/HRButterflyChart?iframeSizedToWindow=true&:embed=y&:showAppBanner=false&:display_count=no&:showVizHome=no.
- Water Management Planning Tool — DWR has developed a web-based map application to assist local agencies in water management planning efforts. The Water Management Planning Tool is an interactive map application that allows users to overlay numerous GIS layers onto a map of California. It allows for those GIS layers to be toggled on and off while varying each layer's transparency. Each planning layer includes a brief description and a location or source where the user can find additional information regarding that layer. The Water Management

Planning Tool is intended to assist local agencies with their responsibilities related to the California Water Plan, integrated regional water management, and the Sustainable Groundwater Management Act. It is also an informational tool for all interested parties. Please read the disclaimer on the tool's webpage.

- Link to the Water Management Planning Tool: https://gis.water.ca.gov/app/boundaries/.

Folder 1 includes a downloadable PDF layered map of California and available information on the layers at the time of development. Layers can be clicked on or off. The map is printable on an 8.5 × 11 sheet of paper. Available layers include:

- Various boundaries including counties, planning areas, hydrologic regions, groundwater basins, and watersheds.
- Water conveyance and features.
- Cities and roads.
- Designated river reaches.
- Instream requirement locations.

The levels of detail for current water balance boundaries can be seen below:

State > Hydrologic Region (HR) > Planning Area (PA) > Detailed Analysis Unit by County (DAUCO).

The link for current spatial data sets for boundaries is available from the online DWR GIS Atlas: https://gis.water.ca.gov/arcgis/rest/services/Boundaries. To view the PDF map, the PDF file must be downloaded to a computer and opened with Adobe Reader. On the left menu, select the layers tab to turn on the different layers contained in the PDF.

- /1-BoundaryMap-DAUCO-DAU-CO-PA_HR_State/.
  - California_layered-online-map_10.pdf.
  - CWP_layered-map_list-of-files.xls.
    - /CWP_layered_map-GISshapefiles/… (not included online-by request only-these are outdated data sets, for current spatial datasets, go to the DWR GIS Atlas).

Folder 2 includes water balance graphics in PDF file type as well as the data file used for the graphics.

- /2-Graphics/.
  - Data_for_waterbalance-donuts--2005-2015-v3.xls (compiled from summary files).
  - Data_for_Regional_Imports_and_Exports2018_final.xls (compiled from multiple sources described in file).
  - Figures-WaterBalance2011-2015-Combined-CAandRegions-Graphics.pdf.
  - Figure-Map-Precipitation-30yr-avg.pdf (PRISM data).
  - Figures-Regional_Inflow_and_Outflow_maps.pdf.

Folder 3 includes summary files mostly from the data entry workbooks in folder 4. Data entry workbooks are developed for each water year with many linked worksheets in each book. Summary files include multiple-year trends and various summary pieces. In parenthesis after each file is a description of the source file, work sheet, or information about the summary.

- /3-Summary_files/.

- CA_18_year_waterbalances_1998-2015.xls (source: data entry sheet, "CA STATEWIDE BALANCES").
- Fifteen_year_County_totals_6-7-18.xls (source: data entry sheet, "TBL_{WATER USE} {SUPPLY} CO").
- HistoricalTrend-1972-2015_statewide_water_data_5-4-18.xls.
- HydrologicSummary_CAandRegions_1998-2015.xls (source: data entry sheet, "SUMMARY {HR}").
- PA_18_year_balances_avgs-1-10-19.xls (source: data entry sheet, "{PA, HR, OR ST} BALANCES").
- Portfolios_18_years_1-10-19.xls (source: data entry sheet, "CA& REGION WATER PORTFOLIO").
- StatewideWaterBalance-data-1998-2015andAvg-v2.xls (source: data entry sheet, "BAR CHART {ST OR HR}").
- Water_code_requirements-data(10-03-2018)-et+mr.xls.
- WaterPortfolioDataInventory.xls (data type, scale, source, linkages, etc. — in development).
- /Regional_Summary_files/ (source: HR sheets from data entry workbooks).
  - Regional_Summary_Central_Coast_6-21-18.xls.
  - Regional_Summary_Colorado_River_6-21-18.xls.
  - Regional_Summary_Mountain_Counties_6-21-18.xls.
  - Regional_Summary_North_Coast_6-21-18.xls.
  - Regional_Summary_North_Lahontan_6-21-18.xls.
  - Regional_Summary_Sacramento_River_6-21-18.xls.
  - Regional_Summary_San Joaquin River_6-21-18.xls.
  - Regional_Summary_San_Francisco_Bay_6-21-18.xls.
  - Regional_Summary_South_Coast_6-21-18.xls.
  - Regional_Summary_South_Lahontan_6-21-18.xls.
  - Regional_Summary_Tulare_Lake_6-21-18.xls.

Folder 4 includes data entry workbooks compiled for each water year from 1998 through 2015. The workbooks are a large compilation of linked spreadsheets that include flow diagrams and tables (also called portfolio tables or water portfolio tables); applied, net, and depletion water balances by PA, HR, and the state; regional office entry sheets by DAUCO; hydrologic summary tables for HRs and the state; planning area summaries; county summaries; water use summaries; groundwater supply by county summaries; bar charts; an index; balance checks; and a description of any revisions. Water portfolios were originally intended to provide a full accounting of water in California and to identify any data gaps. This process evolved over multiple Water Plan updates and much work has been done to fill data gaps. Developing a full water budget that includes a groundwater system, land system, surface water system, and atmosphere is now being done by the Water Budget Design Team.

Notes: (1) Supply-by-sector data is not available for WYs 1998, 2000, and 2001; (2) statewide files include PA, HR, and state data only for WYs 1998, 2000, and 2001; (3) data entry files in folder 4 are a statewide compilation of regional office workbooks for each water year. Regional office (506) raw data files are available by request only at cwpcom@water.ca.gov.

- /4-DAUCO-Data_Entry_Level00-COMBINED/.
  - 1998_2000_2001_Balances_Spreadsheet_9-12-16.xls.

- 1999_Data_Entry_9-13-16_final.xls.
- 2002_Data_Entry_9-12-16final.xls.
- 2003_Data_Entry_9-13-16_final.xls.
- 2004_Data_Entry_9-13-16_final.xls.
- 2005_Data_Entry_9-12-16_final.xls.
- 2006_Data_Entry_6-24-15_w-SNC.xls.
- 2007_Data_Entry_6-24-15_w-SNC.xls.
- 2008_Data_Entry_6-26-15_w-SNC.xls.
- 2009_Data_Entry_1-8-19.xls.
- 2010_Data_Entry_1-8-19.xls.
- 2011_1-Data_Entry_Statewide.xls.
- 2012_1-Data_Entry_Statewide.xls.
- 2013_1-Data_Entry_Statewide.xls.
- 2014_1-Data_Entry_Statewide.xls.
- 2015_1-Data_Entry_Statewide.xls.
- /DAUCO-Inflow_Outflow-DataEntry-Level00-RAW/ (35-50 files per year, by request only).
  - /1999/.
  - /2002/.
  - /2003/.
  - /2004/.
  - /2005/.
  - /2006/.
  - /2007/.
  - /2008/.
  - /2009/.
  - /2010/.
  - /2011/.
  - /2012/.
  - /2013/.
  - /2014/.
  - /2015/.

Folder 5 includes source files for the general category of instream environmental data. The Water Plan quantifies minimum required Delta outflow, instream flow requirement volumes, and designated Wild and Scenic River volumes. These environmental water files document the actual stream-gauge data collected, source and amount of requirement, legal descriptions of designated reaches, and how data are included in the water balances.

- /5-EnvrWater/.
  - DeltaOutflow(5_3_2016)-Total_MinReqd.xls.
  - InstreamEnvrBalanceforDAUs_11-28-18.xls.
  - Instream_Flow_Requirements_2010-2015_FG_05302017_FINAL_4_Jennifer.xlS.
  - InstreamData_Tables_Gage_Info-RequirementsTables-2010example.xls.
  - State-Level-Environmental-Data-wys2011-2015.xls.
  - Wild_and_Scenic_River_Data_WY_2010-2015_06202016_FG.xls.

Folder 6 include source files for surface reservoir storage and evaporation estimates.

- /6-ReservoirStorage&Evaporation/.
    - Lake_Evaporation_Estimates_for_Update_2018.xls.
    - ResStor_2000-2015_2016-02-02.xls.

Water Portfolio-related Definitions

A

acre-foot — The volume of water that would cover 1 acre to a depth of 1 foot; equal to 43,560 cubic feet or 325,851 gallons.

adjudication (water rights) — A determination of water rights for a stream or groundwater basin, or parts of those waters. In the context of an adjudicated groundwater basin, landowners or other parties have turned to the courts to settle disputes over how much groundwater can be extracted by each party to the decision.

applied water use — The total amount of water diverted from any source and applied to meet the uses of urban and agricultural sectors and dedicated to the environment, including water applied for groundwater recharge. Applied water is the quantity of water delivered to the intake to a city water system, a factory, or a farm headgate, either directly or by incidental flows to a marsh or wetland for wildlife areas. For existing instream use, applied water is the portion of the streamflow dedicated to instream use or reserved under the federal or State Wild and Scenic Rivers acts, or the flow needed to meet required standards in the Sacramento-San Joaquin Delta. Applied water includes consumptive use, reuse, and outflows. Applied water includes all sources of supply (surface water, groundwater, reuse, and recycled water).

average annual runoff — The average value of total annual runoff volume calculated for a selected period of record, at a specified location or area.

B

beneficial use — (1) As part of the nine regional water quality control boards' basin planning efforts, as many as 25 water-quality beneficial use categories for water have been identified. Most are for human and instream uses. From Section 13050(f) of California's Porter-Cologne Water Quality Control Act: "'Beneficial uses' of the waters of the state that may be protected against water quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves." (2) As part of the State Water Resources Control Board's water rights program, the California Water Code Section 1240 states, "The appropriation must be for some useful or beneficial purpose, and when the appropriator or his successor in interest ceases to use it for such a purpose (typically five years or greater) the right ceases." In the water rights process, beneficial uses are defined in the California Code of Regulations. Categories of beneficial uses recognized in California include aquaculture, domestic, fire protection, fish and wildlife, frost protection, heat control, industrial use, mining, municipal, power, recreation, stockwatering, and water quality control.

brackish water — Water with a salinity that exceeds normally acceptable standards for municipal, domestic, and irrigation uses but has less salinity than seawater.

C

Central Valley Project (CVP) deliveries — The volume of water supplied to a given area through the Central Valley Project.

Central Valley Project (CVP) base deliveries — The delivery of prior rights water to Central Valley Project base or settlement contractors.

Central Valley Project (CVP) project deliveries — The delivery of project water to Central Valley Project contractors.

Colorado River deliveries —The volume of water diverted from the mainstem Colorado River by Metropolitan Water District of Southern California, Imperial Irrigation District, Coachella Valley Water District, the Yuma Project, and others under California's consumptive use entitlement to use Colorado River water.

consumptive use — The amount of water used and not available for reuse as a source of supply. It includes water that evaporates, transpires, or is incorporated into products, plant tissue, or animal tissue.

conveyance — A structure, either natural or human-made, that provides for the movement of water. Conveyance infrastructures include natural watercourses, such as streams, rivers, and groundwater aquifers; and constructed facilities, such as canals and pipelines, including control structures such as weirs. Conveyance facilities range in size from small, local, end-user distribution systems to large systems that deliver water to, or drain, areas as large as multiple hydrologic regions. Conveyance facilities may also require associated infrastructure, such as pumping plants and power supply, diversion structures, fish ladders, and fish screens.

conveyance applied water — The amount of applied water used to convey water from the source to the use (e.g., if 200 acre-feet is diverted into a canal and 180 acre-feet arrive at its place of use, then 20 acre-feet is the amount of conveyance applied water). This includes water that is both recoverable (outflows such as seepage and deep percolation) and irrecoverable (depletions such as evapotranspiration, evaporation, or deep percolation to a salt sink).

conveyance evaporation and evapotranspiration— The water evaporated into the atmosphere from conveyance systems and evapotranspired by vegetation in and near a conveyance.

conveyance return flows to developed supply — The portion of conveyance water that seeps through channels and returns as surface flow in another area.

conveyance seepage —The portion of conveyance water that seeps through channels and returns to surface or groundwater.

crop production applied water — The portion of applied water solely for crop production. This doesn't include groundwater recharge applied water or conveyance applied water.

D

dedicated and developed water supplies — Water provided for urban and agricultural uses and dedicated to the environment. Sources of supply include surface water, groundwater, reuse, and recycled water. In any year, some of the dedicated supply includes water that is used multiple times (reuse) and water held in storage from previous years. On average, this equals 40 percent to 50 percent of precipitation.

deep percolation — Vertical movement of water through the soil/unsaturated zones reaching the saturated zone of the aquifer (groundwater system).

Delta outflow — Freshwater outflow from the Sacramento-San Joaquin Delta.

depletion — The quantity of water consumed within a service area and no longer available as a source of supply. Depletion includes evaporation, evapotranspiration, and outflow to a salt sink.

desalination — A treatment process to remove salts from water to produce a water of lesser salinity than the source water.

detailed analysis units (DAUs) — A subsection of a planning area. The smallest hydrologic study area for the analysis of water supply and use balances by the California Water Plan. DAUs are often split by county, so the smallest study area used in the water balances is DAU by county (DAUCO). Many planning studies begin at the DAUCO, DAU, or planning area level, depending on available data. The results are aggregated to county or hydrologic region for presentation.

E

effective precipitation — That portion of precipitation stored in the root zone that is available for plant evapotranspiration. It includes precipitation stored in the soil before and during the growing season. It is sometimes referred to as consumptive use of precipitation.

evaporation — The physical process by which a liquid or solid is transformed to a gaseous state.

evaporation from lakes and reservoirs — The annual surface evaporation from lakes and reservoirs.

evapotranspiration — The amount of water transpired by plants, retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces.

evapotranspiration of applied water (ETAW) — The amount of consumptive use by crops, landscapes, or other vegetation. ETAW is the portion of evapotranspiration that was provided by applied irrigation water.

excess Delta outflow — The freshwater outflow from the Sacramento-San Joaquin Delta that exceeds the amount required by law.

F

federal projects — The Central Valley Project and other federal projects.

flow diagram — A diagram that characterizes a region's hydrologic cycle by documenting sources of water, such as precipitation and inflows, and tracks the water as it flows (through many different uses) to its ultimate destinations.

flow diagram table — An itemized listing of all the categories contained in a flow diagram organized by "inputs" and "withdrawals."

G

groundwater — Water that occurs beneath the land surface and fills the pore spaces of the alluvium, soil, or rock formation in which it is situated. It excludes soil moisture, which refers to water held by capillary action in the upper unsaturated zones of soil or rock. Groundwater classified as underflow of a surface water system, a "subterranean stream flowing through a known and definite channel," is subject to statutory permitting processes. But, most groundwater in California is presumed to be "percolating water" (i.e., water in underground basins and groundwater that has escaped from streams and is not subject to a permitting process). See also "subterranean stream."

groundwater bank — Consists of water that is "banked" during wet or above-normal water years. The water to be banked is provided by the entity that will receive the water in times of need. Although transfers or exchanges may be needed to get the water to the bank and from the bank to the water user, groundwater banks are not transfers in the typical sense. The water user stores water for future use; this is not a sale or lease of water rights. It is typical for fees to apply to the use of groundwater banks.

groundwater basin — An alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom.

groundwater budget — An analysis of a groundwater basin's inflows and outflows to determine the change in groundwater storage.

groundwater extractions (adjudicated) — The amount of water withdrawn from basins that have been adjudicated from the beginning of the water year to the end of the water year.

groundwater extractions (banked) — The amount of water withdrawn from formal interagency banking programs during a water year.

groundwater extractions (unadjudicated) — The amount of water withdrawn during a water year from basins or fractured bedrock that are not adjudicated or part of a contract banking program.

groundwater overdraft — The condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions.

groundwater recharge — The natural or managed infiltration or injection of water into a groundwater aquifer.

groundwater recharge applied water — The amount of water that is intentionally recharged through deep percolation methods into a water bank or other unconfined alluvial aquifer system for storage for future use, or an applied water outflow or return flow to developed supply that goes into groundwater storage.

groundwater recharge evaporation and evapotranspiration — The amount of evaporation and evapotranspiration occurring from intentional groundwater recharge.

groundwater recharge, adjudicated basins — The amount of water recharged into groundwater basins that have been adjudicated by a court of law.

groundwater recharge, contract banking — The amount of water recharged into groundwater basins under formal contract programs.

groundwater recharge, unadjudicated basins — The amount of water recharged into groundwater basins that are neither adjudicated nor part of formal contract banking programs.

groundwater storage — Groundwater storage can be defined in three ways, depending on the context of its use: (1) the quantity of water that occurs beneath the land surface and fills the pore spaces of the alluvium, soil, or rock formation beneath the land surface; (2) the volume of usable physical space available to store water in the pore spaces of the alluvium, soil, or rock formation beneath the land surface; or (3) the act of storing water in the pore spaces of the alluvium, soil, or rock formation beneath the land surface.

groundwater subbasin — A subdivision of a groundwater basin created by using geologic and hydrologic conditions or institutional boundaries to divide the basin. See “groundwater basin.”

groundwater subsurface inflow — The amount of water that flows underground and into an underground region, basin or study area.

groundwater subsurface outflow — The amount of water that flows underground and out of a region, basin or study area.

H

hydrologic region — A geographical division of the state based on the local hydrologic basins. The California Department of Water Resources divides California into 10 hydrologic regions that correspond to the state’s major water drainage basins: North Coast, North Lahontan, Sacramento River, San Francisco Bay, Central Coast, San Joaquin River, Tulare Lake, South Coast, South Lahontan, and Colorado River.

hydrologic unit — The United States is divided and subdivided into successively smaller hydrologic units, which are classified into four levels: regions, subregions, accounting units, and cataloging units.

The hydrologic units are arranged within each other, from the smallest (cataloging units) to the largest (regions). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits, based on the four levels of classification in the hydrologic unit system.

hydrology — A science related to the occurrence and distribution of natural water on Earth, including the annual volume and the monthly timing of runoff.

I

inflow from Mexico — This represents the New River and Alamo River inflows from Mexico.

inflow from Oregon — This represents the Klamath River inflow from Oregon.

instream environmental — The portion of stream water dedicated for instream flow requirements, Wild and Scenic Rivers, and minimum required Delta outflow.

instream flow requirements — The amount of water within its natural watercourse as specified in an agreement, water rights permit, court order, Federal Energy Regulatory Commission license, etc., to support natural ecosystems; create habitat for plants and animals; and may provide additional benefits, such as recreation. See also “required instream flows.”

instream uses — The beneficial uses of water within a stream or river without diversion from the stream.

irrecoverable water — The amount of water that flows or percolates to a salt sink, is used by the growth process of plants (evapotranspiration), or evaporates from a conveyance facility or drainage canal. See also “recoverable water.”

J

K

L

local deliveries or local supplies — The amount of water delivered by local water agencies and individuals. It includes direct deliveries of water from streamflows and local water-storage facilities. It also includes water supply that remains in the stream for instream requirements and Wild and Scenic rivers.

local imported deliveries or local imports — The amount of water transferred by local agencies from other regions of the state.

local projects – The amount of water from local water storage facilities.

M

managed wetlands - impounded freshwater and nontidal brackish water wetlands

minimum required Delta outflow — The minimum volume of freshwater outflow from the Sacramento-San Joaquin Delta required by law to maintain flow and water quality standards to protect the beneficial uses within the Delta.

multicropping — The practice of growing one or more crops on the same field two or more times within a year. For example, in a single field, broccoli may be grown in the spring and lettuce in the fall.

municipal recycled water — Recycled water that wholly or in part is derived from municipal wastewater and is subsequently beneficially reused. Beneficial reuses are not limited to municipal applications.

municipal wastewater — Municipal wastewater comes primarily from domestic sources but also includes wastewater from commercial, industrial, and institutional sources that discharge to a common collection system where it mixes with domestic wastewater before treatment.

N

net groundwater extraction — The amount of groundwater extraction in excess of recoverable deep percolation.

net water use — The amount of water needed in a water service area to meet all requirements. It includes consumptive use of applied water, irrecoverable water from the distribution system, and the outflow leaving the service area. It does not include reuse of water within a service area, including recoverable deep percolation. See also “applied water use.”

non-potable — Water that is unsafe to drink because it contains contaminants and/or is untreated. See also “potable.”

nonconsumptive environmental water use — Water dedicated to instream environmental needs that does not reduce the available water supply downstream for other uses.

O

other federal deliveries — The sum of deliveries from federal projects other than the Central Valley Project.

outflow — The amount water leaving a service area.

outflow to Mexico — The runoff that flows from California to Mexico.

outflow to Nevada — The runoff that flows from California to Nevada.

outflow to Oregon — The runoff that flows from California to Oregon.

P

planning area (PA) — A subsection of a hydrologic region containing a number of detailed analysis units (DAUs).

potable — Water that is safe for drinking and cooking. See also “non-potable.”

precipitation — The amount of water that falls to the earth as either rain, snow, hail, or is formed on the earth as dew and frost.

R

recoverable water — The amount of water that is available for supply or reuse, including surface runoff to non-saline bodies of water and deep percolation that becomes groundwater. See “irrecoverable water.”

recycled water —Volume of water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur. It includes wastewater treated, stored, distributed, and reused or recirculated for beneficial uses.

regional exports — Water transferred out of a hydrologic region.

regional imports — Water transferred into a hydrologic region from an adjoining area.

required Delta outflow — The volume of freshwater outflow from the Sacramento-San Joaquin Delta required by law to protect the beneficial uses within the Delta from the incursion of saline water.

required instream flow — The amount of water required for instream use by agreement, water rights permit, or State/federal acts.

return flow — Volume of applied water returning to the surface water system.

return flow to carryover storage (from previous year) — The surface return flows that were discharged into storage from uses the previous year instead of being depleted, then supplied for uses the next year.

return flow to developed supply — The surface return flows to channels that are available for use in another detailed analysis unit by county (DAUCO), planning area (PA), and/or hydrologic region (HR).

return flows evaporation and evapotranspiration — The volume of return flows evaporation and/or evapotranspiration by weeds and other vegetation in fringes of fields and in and near agricultural drains and sump areas.

return flows to salt sink — The volume of return flows that go to saline water bodies, such as the Salton Sea or the ocean, or to saline groundwater basins.

return-flow system — A system of pipelines or ditches to collect and convey surface or subsurface runoff from an irrigated field or landscape for reuse.

reuse groundwater — The amount of recoverable deep percolation from untreated, raw applied and conveyance water.

reuse of return flows within region, agricultural — The amount of the reuse of agricultural irrigation system tailwater and return flows to local distribution systems and streams within a region. This does not include reuse of excess applied water that percolates to groundwater.

reuse of return flows within region, urban — The amount of the reuse of urban tailwater and return flows to local distribution systems and streams within a region. This does not include reuse of excess applied water that percolates to groundwater.

reuse of return flows within region, wetlands, wild and scenic, instream — The amount of the reuse of managed wetlands irrigation system tailwater and return flows, Wild and Scenic River flows, and required instream flows to local distribution systems and streams within a region. This does not include reuse of excess applied water that percolates to groundwater.

reuse surface water — The amount of untreated, raw applied water recaptured for use through surface drainage facilities.

reused water — The application of previously used water to meet a beneficial use, whether treated or not, prior to the subsequent use. See also “recycled water.”

runoff — (1) Rainfall, snowmelt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions. Runoff is a major transporter of nonpoint-source pollutants to rivers, streams, and lakes. (2) The volume of surface flow from an area.

runoff, incidental — The portion of precipitation that would have been used by natural vegetation but now contributes to runoff. This is a result of roads, paved areas, building roofs, land drainage systems, fields developed for irrigation, and other changes in land use.

runoff, natural — The portion of precipitation that runs off the land and makes up the natural flow in rivers.

S

seepage — The gradual movement of water into, through, or from a porous medium. Also, infiltration of water into soil from canals, ditches, laterals, watercourses, reservoirs, storage facilities, or other water bodies, or from a field.

service area — The geographic area served by a water agency.

source water — The body of water from which water is taken for beneficial use.

State Water Project deliveries — The sum of all deliveries to State Water Project contractors.

subterranean stream — Subterranean streams flow through known and definite channels. They are regulated by California's surface water rights system. The following physical conditions must be present in a subterranean stream flowing in a known and definite channel: (1) a subsurface channel must be present, (2) the channel must have relatively impermeable bed and banks, (3) the course of the channel must be known or capable of being determined by reasonable inference, and (4) groundwater must be flowing in the channel.

surface storage — Surface reservoirs to collect water for later release and use.

surface supply — Water supply obtained from streams, lakes, and reservoirs.

surface water — As defined under the California Surface Water Treatment Rule, California Code of Regulations Title 22, Section 64651.83, surface water means "all water open to the atmosphere and subject to surface runoff." This would include all lakes, rivers, streams, and other water bodies. Surface water includes all groundwater sources that are deemed to be under the influence of surface water (i.e., springs, shallow wells, wells close to rivers, etc.), which must comply with the same level of treatment as surface water.

surface water change in storage — The difference between beginning-of-year and end-of-year surface water storage.

T

transpiration — An essential physiological process in which plant tissues give off water vapor to the atmosphere.

U

underground stream —See subterranean stream.

unit applied water — The quantity of water applied to a specific crop per unit area (sometimes expressed in inches of depth).

urban commercial use — The amount of the water used by light industry and non-manufacturing business establishments, including retail services, office buildings, restaurants, dry cleaners, and other consumer-oriented services or businesses. This includes employee uses and recreational facilities (temporary lodging) and may include institutional or governmental use.

urban energy production water— The amount of water needed for hydroelectric or thermoelectric power generation.

urban industrial use — Water use in water-intensive manufacturing for processing, manufacturing, and other industrial plant uses (e.g., canneries, mills, other large, complex users of supply), as defined by the North American Industry Classification System (NAICS). This water can be used as cooling water or for rinsing, washing, diluting, and other sanitation operations. Also included are on-site employee uses and landscape irrigation.

urban large landscape use— The amount of water used to irrigate recreational and large landscape areas, such as golf courses, parks, play fields, highway medians, and cemeteries.

urban residential use, multi-family, exterior — The amount of water used outside a multi-family residential housing unit. Examples include landscape irrigation, swimming pools, car washing, sidewalk cleaning, and the watering of domestic animals.

urban residential use, multi-family, interior — The amount of water used within a residential, multi-family housing unit (with two or more units, such as duplexes, apartments, or condominiums), which houses two or more households. Uses include personal hygiene, cooking, drinking, and laundry.

urban residential use, single-family, exterior — The amount of water used outside a single-family residential housing unit. Examples include landscape irrigation, swimming pools, car washing, sidewalk cleaning, and the watering of domestic animals.

urban residential use, single-family, interior — The amount of water used within a single-family, detached housing unit for such uses as personal hygiene, cooking, drinking, and laundry.

urban wastewater produced — The flow from urban areas into urban wastewater treatment plants and septic tanks.

urban water use — The use of potable and non-potable water for urban purposes, including residential, commercial, industrial, recreation, energy production, and large landscape. These are types of uses rather than places of use.

use values — Use values are based on water taken up and utilized in the environment. Non-use values are not associated with actual use of, or even an option to use, an ecosystem or its service.

V

W

water balances — Analyses of the total developed and dedicated supplies, uses, and operational characteristics for a region. The analyses show the amount of water applied to uses so that use equals supply. See also “water portfolio.”

water demand — The desired quantity of water that would be used if the water were available and if a number of other factors, such as price, did not change. Demand is not static.

water depletion — The amount of net water use minus water that can be recovered later, such as deep percolation and return flow to the developed supply. See also “depletion.”

water exchanges — Typically, water delivered by one water user to another water user. The receiving water user will return the water at a specified time or when the conditions of the parties’ agreement are met. See also “water transfers”.

water from refineries — The amount of water produced as a byproduct of the oil or gas refining process.

water in the environment — Consumptive and nonconsumptive use of water, not including agricultural and urban uses. Defined by the Sustainability Roundtable as "a measure of the water remaining in the environment after withdrawals and consumption."

water portfolio — An accounting of water uses and supplies for a given year statewide or by hydrologic region, subject to availability of data including flow diagrams, flow diagram tables, water balances, summary tables, and information.

water recycling — (1) The process of treating wastewater for beneficial use, storing and distributing recycled water, and the actual use of recycled water; (2) the reuse or recirculation of water through the same series of processes, pipes, or vessels more than once by one user, often without treatment between uses, such as in cooling towers or cascading uses within an industry where the wastewater from one process is the source water for another process. See also "recycled water" and "water reuse."

water service area — A geographic area in which a water agency is the designated water service provider.

water supply — Water provided (by nature or a water project) to meet water uses. See also "applied water use" and "dedicated and developed water supplies."

water supply exports — The amount of water that a region transfers to another to meet needs.

water supply imports — The amount of water brought in from other regions to meet needs. See "water transfer."

water transfer — A temporary or long-term change in the point of diversion, place of use, or purpose of use resulting from a transfer or exchange of water or water rights. A temporary water transfer has a duration of one year or less (California Water Code Section 1728), and a long-term water transfer has a duration of more than one year (California Water Code Section 1735). Many transfers, such as those among contractors of the State Water Project or Central Valley Project, do not fit this definition. A more general definition is that water transfers are a voluntary change in the way water is usually distributed among water users in response to water scarcity. Compare this with water exchanges, which are typically water delivered by one water user to another water user; the receiving water user will return the water at a specified time or when the conditions of the parties to the agreement are met.

water transfers, imported —The amount of water transferred across hydrologic region boundaries from one agency to another. Transfer requires approval from the State Water Resources Control Board for a change in place of use.

water transfers, regional — The amount of water transferred within a hydrologic region from one agency to another. Transfer requires approval from the State Water Resources Control Board for a change in place of use.

water year — A continuous 12-month period for which hydrologic records are compiled and summarized. Different agencies may use different calendar periods for their water years. For the California Department of Water Resources, a water year is October 1 through September 30.

watershed — The land area from which water drains into a stream, river, or reservoir. The watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

Wild and Scenic Rivers — The federally designated and State-designated river systems under the 1968 National Wild and Scenic Rivers Act and the 1972 California Wild and Scenic Rivers Act. Many rivers and river reaches in California, including many forks and tributaries — more than 2,000 miles of river — are designated wild, scenic, or recreational.

Wild and Scenic Rivers water — The annual volume of natural flows from the designated State and federal Wild and Scenic Rivers systems.

References

California Department of Water Resources. 2014. *California Water Plan Update 2013 Volume 1 – The Strategic Plan.* Sacramento (CA): California Department of Water Resources. California Natural Resources Agency. 420 pp.

California Department of Water Resources. 2019. *California Water Plan Update 2018.* Sacramento (CA): California Department of Water Resources. California Natural Resources Agency. 47 pp.

Krieger, D. 2001. *The Economic Value of Forest Ecosystem Services: A Review*. Washington, DC: Wilderness Society. 40 pp. [Website]. Viewed online at: https://www.sierraforestlegacy.org/Resources/Conservation/FireForestEcology/ForestEconomics/EcosystemServices.pdf.

DEPARTMENT OF WATER RESOURCES • STATE OF CALIFORNIA