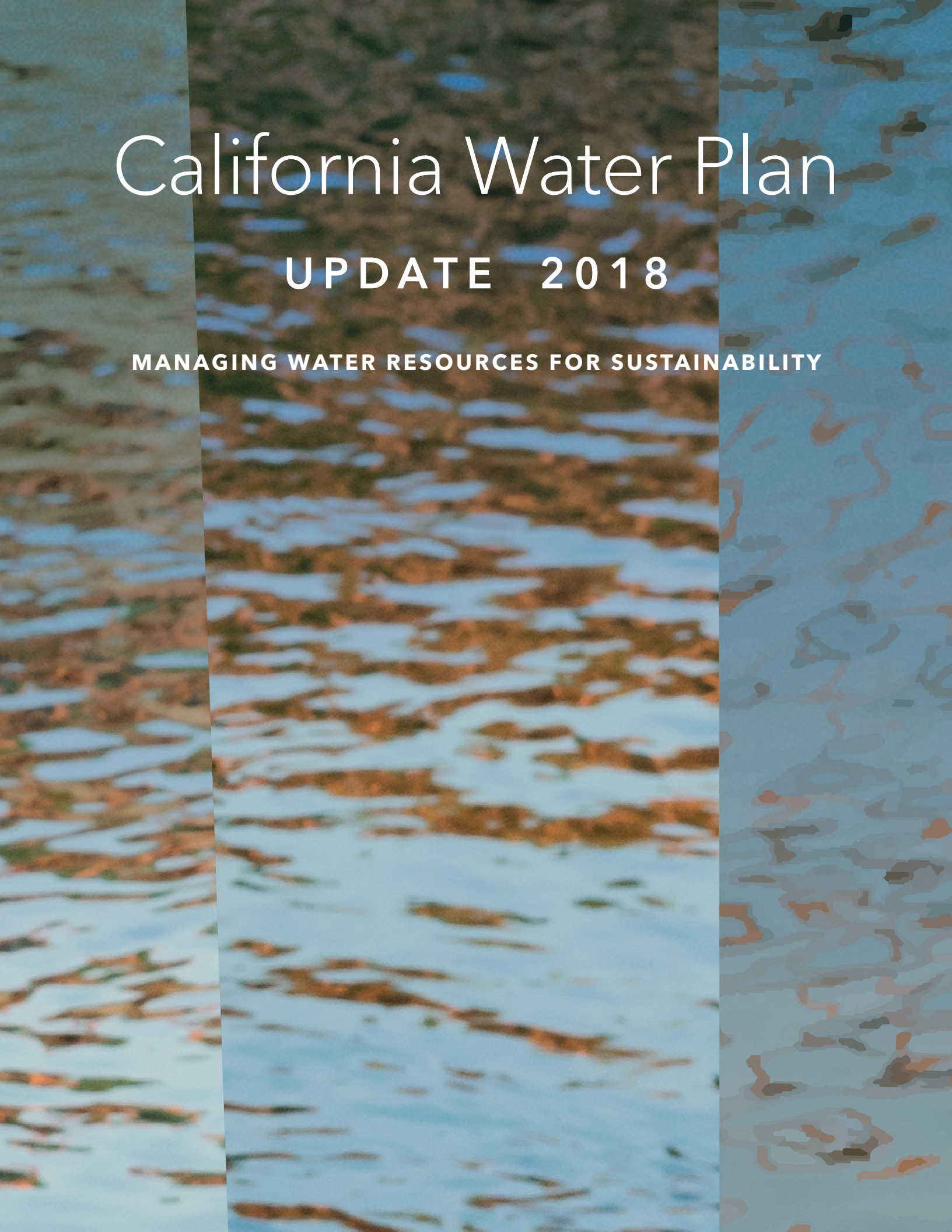

California Water Plan

UPDATE 2018

MANAGING WATER RESOURCES FOR SUSTAINABILITY

About the California Water Plan

The California Water Plan (Water Plan) is the State's strategic plan for sustainably managing and developing water resources for current and future generations. The Water Plan provides a forum for elected officials, agencies, California Native American Tribes, resource managers, businesses, academia, stakeholders, and the public to collaboratively develop findings and recommendations that inform decisions about water policies, regulations, actions, and investments. Required by California Water Code Section 10005(a), the plan presents the status and trends of the state's water-dependent natural resources; water uses and supplies; and future agricultural, urban, and environmental water demands and supplies for a range of plausible climate and socio-economic scenarios. The plan is intended to guide State investments in innovation and infrastructure, and advance integrated watershed management with sustainable outcomes.

The California Department of Water Resources (DWR) is responsible for updating the Water Plan every five years. *California Water Plan Update 2018* (Update 2018) is the twelfth in a series of such plans since 1957. It builds on *California Water Plan Update 2013* (Update 2013), which is extensive in its coverage of water management in California. Update 2013 provides detailed descriptions of current and potential regional and statewide water conditions, "state of the region" reports on each of the state's hydrologic regions and overlay areas, and an integrated water management toolbox of more than 30 resource management strategies.

At less than 50 pages, Update 2018 is a concise and prioritized State framework to manage California's water resources for sustainability. The plan sets goals, recommends actions, offers funding scenarios, and provides a State water investment strategy. It advocates for shared intent, for learning from what is working and adapting to lessons learned; it also seeks to bolster regional and local efforts to overcome California's challenges to sustainability.

During the Newsom Administration, DWR will engage with the statewide water planning community, including federal and Tribal partners, to flesh out the recommended actions and prepare an implementation plan in support of the administration's water resilience portfolio.

More detailed information about the plan is available in the supporting documents and companion State plans listed at the back of this document and posted on the Update 2018 webpage.

Notes: *The development of Update 2018 was informed by documents that provide methodology, assumptions, data, estimates, and other information. These "supporting documents" are listed and described in the back pages of this plan. The chapter or chapters each document helped to inform are included in the description; if the document has "global" or "general" applicability, that is stated.*

See the inside back cover for a guide to the ***Update 2018 webpage****. Titles and terms in* ***purple*** *throughout the plan correspond to links in the* ***Useful Web Links*** *section.* ***Key terms*** *in Update 2018, appearing in* ***brown****, are listed at the beginning of the plan, while the full California Water Plan* ***Glossary*** *is available as a supporting document.*

California Water Plan

Update 2018

Managing Water Resources for Sustainability

JUNE 2019

State of California

The Natural Resources Agency

Department of Water Resources

GAVIN NEWSOM
Governor
State of California

WADE CROWFOOT
Secretary for
Natural Resources
Natural Resources Agency

KARLA NEMETH
Director
Department of
Water Resources

Secretary's Message

Water management in California is a grand exercise in partnerships. Whether it's coordinating water project operations, co-funding infrastructure improvements, or sharing technical expertise, State government and our many partners achieve more when we work together.

The California Water Plan (Water Plan) is a key tool for strengthening these partnerships. The Water Plan, required by State law to be updated every five years by the California Department of Water Resources, takes stock of current efforts and helps to orient future work. *California Water Plan Update 2018* (Update 2018) is well-timed; it highlights emerging approaches in recent years and points out promising new directions for the Newsom Administration.

Perhaps most importantly, Update 2018 prioritizes supporting local and regional efforts to build water supply resilience across California. This approach recognizes that different regions of the state face different challenges and opportunities, yet all benefit from coordinated State support.

In April 2019, Governor Newsom signed an executive order calling for State agencies to work together to form a comprehensive strategy for building climate-resilient water systems through the 21st century. This strategy will be built to meet the long-term needs of California's communities, economy, and environment. Update 2018 plays an important role informing our work in the Newsom Administration to build this water resilience strategy.

Climate change and other pressures place big challenges on our water systems. At the same time, creative multi-benefit solutions abound to meet these challenges. Our Governor and Legislature prioritize "thinking long" on water solutions and making investments to strengthen our water systems in coming decades.

I look forward to building on Update 2018 to prioritize actions for water resilience and to identify how we can improve integration across State agencies to implement these priorities.

Onward!

Wade Crowfoot, Secretary
California Natural Resources Agency

Director's Message

In the past decade alone, California weathered the deepest drought and wettest period on record. These two extremes illustrate the increasing volatility and uncertainty of California's hydrology, which will only accelerate over time. Warmer winters and decreased snowpack in the Sierra Nevada diminish our natural water storage. Groundwater overdraft and the resulting land subsidence have pushed some groundwater basins to the brink. Although many communities have shown considerable resilience, those with limited resources and capacity remain vulnerable to water insecurity.

Amidst these intensifying challenges to our water systems is some good news. Californians are more aware than ever about the vital importance of clean water supplies to our quality of life. We are now living in the new climate reality and we know we must respond. The consequences of inaction will be too severe. While precise strategies still require ample debate, our goals are clear – to face our critical, institutional, and systemic challenges head-on and build a more sustainable future.

Since *California Water Plan Update 2013*, the water community has experienced a growing sense of urgency in our need to implement improved water management strategies statewide. In that spirit, *California Water Plan Update 2018* (Update 2018) recommends concrete, measurable actions to achieve water use efficiency, regional self-reliance, safe water for all communities, and integrated water management across all levels of government. Abundant water expertise is flexed at the regional and local levels, where much of the work and progress will happen. The California Department of Water Resources is proud to provide policy and technical support to regional water agencies and organizations that implement actions in their respective watersheds, groundwater basins, and communities. It is an honor to have worked with all of you to develop Update 2018. This document is a product of many hearts, minds, and hands from across the state.

Implementing the recommendations promoted in Update 2018 will be coordinated with the implementation of Governor Gavin Newsom's executive order, which directs State agencies to prepare a water resilience portfolio for California. As climate change increasingly threatens our water system reliability, it is imperative that we work together to ensure clean, reliable water supplies for people and the environment. As we face longer, drier droughts and more intense flood events, we must work on a statewide approach with innovative solutions and partnerships to build climate resiliency into everything we do.

I look forward to working with our colleagues across the Newsom Administration, local governments, Tribal groups, community partners, and all of you to respond to California's water challenges and implement the vision advanced by Update 2018 and the new water resilience portfolio.

Karla Nemeth, Director
California Department of Water Resources

STATE OF CALIFORNIA

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2018 Tribal Water Summit Proceedings
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California Must Enhance Groundwater Recharge and Storage
California Economic Summit and University of California Agriculture and Natural Resources

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California Natural Resources Agency, California Department of Food and Agriculture, and California Environmental Protection Agency

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Workshop Planning Committee

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Pacific Institute

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Funding Scenario Analysis
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Future Water Scenarios
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Historical Expenditures and Current and Future Needs
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Lucian Filler, Paul Massera

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California Department of Water Resources and Environmental Science Associates

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Water Budget Pilot Projects
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Comments on Public Review Draft

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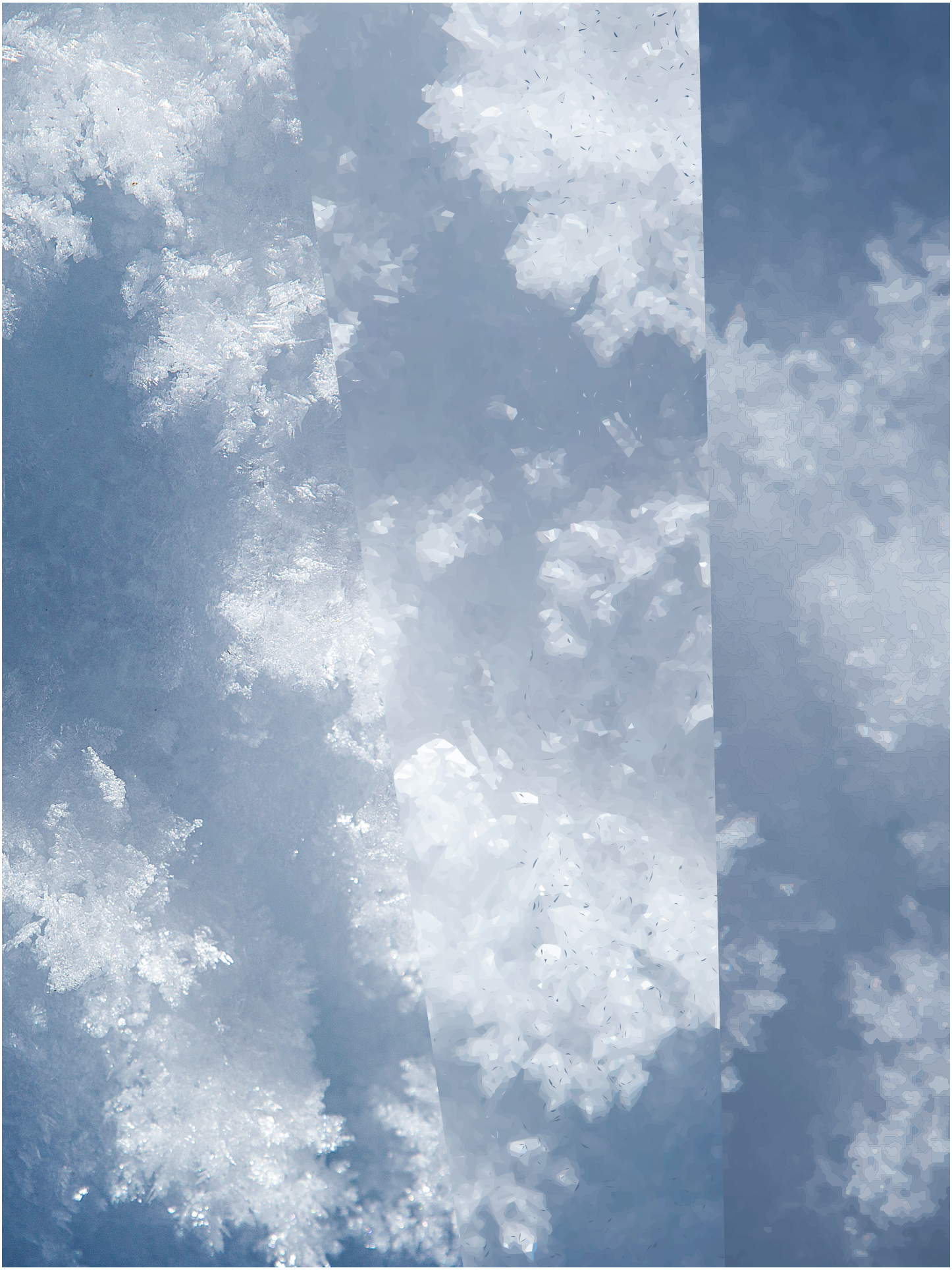

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Acronyms and Abbreviations

10-Year Plan	Salton Sea Management Program Phase I: 10-Year Plan
A.B.	Assembly Bill
Bay-Delta	San Francisco Bay/Sacramento-San Joaquin Delta
CDFW	California Department of Fish and Wildlife
CNRA	California Natural Resources Agency
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
Delta	Sacramento-San Joaquin Delta
DWR	California Department of Water Resources
EIFD	enhanced infrastructure finance district
Flood-MAR	flood-managed aquifer recharge
GGRF	Greenhouse Gas Reduction Fund
GHG	greenhouse gas
G.O. bond	general obligation bond
HSP	Healthy Soils Program
IRWM	integrated regional water management
m.a.f.	million acre-feet
SASC	Water Plan State Agency Steering Committee
SGMA	Sustainable Groundwater Management Act
Update 2013	California Water Plan Update 2013
Update 2018	California Water Plan Update 2018
Water Action Plan	California Water Action Plan
Water Plan	California Water Plan

Key Terms

*The key terms below appear in **brown** font, upon first occurrence or where they are defined, in Chapters 1 through 4.*

Applied water: Refers to the volume of water that was applied and used by urban and agricultural sectors and was dedicated to the environment.

Biodiversity hotspot: A region with a high amount of biodiversity that experiences habitat loss by human activity. To qualify as a biodiversity hotspot, according to Conservation International, a region must contain at least 1,500 species of vascular plants (more than 0.5 percent of the world's total) as endemics, and it must have lost at least 70 percent of its original habitat.

California Native American Tribe: A federally recognized California Native American Tribe or a non-federally recognized California Native American Tribe that is on the contact list maintained by the Native American Heritage Commission.

Critical challenge: An ongoing or imminent problem (e.g., increasing flood risk, declining ecosystems) that adversely affects public health and safety, the state's economy, ecosystems, or opportunities for enriching experiences.

Disadvantaged community: A community with an annual median household income of less than 80 percent of the statewide average.

Flood-managed aquifer recharge (Flood-MAR): An integrated and voluntary resource management strategy that uses floodwater resulting from, or in anticipation of, rainfall or snowmelt for managed aquifer recharge on agricultural lands; working landscapes; and managed natural landscapes, including but not limited to refuges, floodplains, and flood bypasses.

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.

Integrated watershed management: A coordinated effort among agencies and organizations to manage watersheds or groundwater basins for sustainability.

Intended outcome: Intended results from an action taken.

Legacy impacts: Inheritance of negative impacts from anthropogenically induced change, such as legacy pollution and legacy changes to ecosystems or individual species.

Multi-benefit project: A project that accomplishes two or more intended outcomes. These projects are the result of collaboration among water management sectors, are multi-disciplinary, and leverage multiple funding sources.

Novel funding mechanism: Method not widely used by the State to generate funds for implementing California Water Plan actions. These methods can be administered by local, regional, or State government.

Resource management strategy: A project, program, or policy that helps federal, State, or local agencies manage water and related resources. Resource management strategies in the California Water Plan are grouped by these management objectives: reduce water demand, improve operational efficiency and transfers, increase water supply, improve water quality, practice resource stewardship, improve flood management, and recognize people's relationship to water.

Sustainability: Sustainability of California's water systems means meeting current needs – expressed by water stakeholders as public health and safety, healthy economy, ecosystem vitality, and opportunities for enriching experiences – without compromising the needs of future generations.

Systemic and institutional challenges: Outdated, ineffective, or inflexible statutes, policies, or practices that increase the time, effort, or cost to mitigate adverse effects from critical challenges.

Vulnerable community: A community highly susceptible to the impacts of flood and drought, or lacking the resources needed to effectively manage for water resource sustainability.

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 supply: For the California Water Plan water portfolios, this represents where the water came from each year to meet the water uses.

Water supply reliability: Percentage of the time water supplies meet demands.

Working landscape: Includes farmland; ranches; forests; wetlands; mines; water bodies; and other natural resource lands, private and public.

Executive Summary

California Water Plan Update 2018 (Update 2018) provides recommended actions, funding scenarios, and an investment strategy to bolster efforts by water and resource managers, planners, and decision-makers to overcome California's most pressing water resource challenges. Update 2018 builds on progress made in *California Water Plan Update 2013*; it reaffirms State government's unique role and commitment to sustainable and equitable water resource management.

Challenges to Sustainability

For generations, California has represented much more than a place. It invokes images of exceptionally satisfying ways of life and well-being coupled with enduring, world-renowned natural resources. Yet the people and ecosystems of California are increasingly vulnerable to extremes that underscore the need to bolster planning and infrastructure to prepare for the effects of climate change. Update 2018 documents challenges that significantly affect the state's ability to manage water resources for sustainability. Among them:

- One in five Californians lives in a floodplain. More than $580 billion in assets is at risk.
- Thousands of Californians lack access to safe, clean water and adequate sanitation.
- Many ecosystems and the services they provide continue to decline.
- Groundwater overdraft and unreliable water supplies persist in some regions.
- Extensive tree mortality has contributed to the most destructive wildfires in the state's history and to devastating mudslides.
- Climate change is exacerbating many critical challenges, including flood risk, reduced water supply, and wildfire.

Communities proactively planning and investing in water management strategies are showing resilience. At the same time, many communities remain vulnerable – those with limited resources and insufficient technical, managerial, and/or financial capacity to manage water resources.

Bold Action to Overcome Challenges

This plan recommends significant additional investment in infrastructure and ecosystem improvements to overcome challenges to sustainability. It also recommends actions to resolve systemic and institutional issues that contribute to many of the state's water challenges. The plan describes scenarios to leverage existing funding for California water management and discusses some additional concepts that can inform funding decisions over the long term.

The recommended actions, listed in Table ES-1, are organized according to six goals for sustainability:

- Improve Integrated Watershed Management.
- Strengthen Resiliency and Operational Flexibility of Existing and Future Infrastructure.
- Restore Critical Ecosystem Functions.
- Empower California's Under-Represented or Vulnerable Communities.
- Improve Inter-Agency Alignment and Address Persistent Regulatory Challenges.
- Support Real-Time Decision-Making, Adaptive Management, and Long-Term Planning.

Table ES-1 Update 2018 Recommended Actions Organized by Goal

Goal	Action #	Recommended Action
Improve Integrated Watershed Management	1.1	Strengthen State Support for Integrated Regional Water Management and Vulnerable Communities
	1.2	Support the Role of Working Landscapes
	1.3	Promote Flood-Managed Aquifer Recharge and Sustainable Groundwater Management Practices
Strengthen Resiliency and Operational Flexibility of Existing and Future Infrastructure	2.1	Improve Infrastructure and Promote Long-Term Management
Restore Critical Ecosystem Functions	3.1	Address Legacy Impacts
	3.2	Facilitate Multi-Benefit Water Management Projects
	3.3	Quantify Natural Capital
Empower California's Under-Represented or Vulnerable Communities	4.1	Expand Tribal Involvement in Regional Planning Efforts
	4.2	Engage Proactively with Disadvantaged Community Liaisons
Improve Inter-Agency Alignment and Address Persistent Regulatory Challenges	5.1	Incorporate Ecosystem Needs into Water Management Infrastructure Planning and Implementation
	5.2	Streamline Ecosystem Restoration Project Permitting
	5.3	Address Regulatory Challenges
Support Real-Time Decision-Making, Adaptive Management, and Long-Term Planning	6.1	Facilitate Comprehensive Water Resource Data Collection and Management
	6.2	Coordinate Climate Science and Monitoring Efforts
	6.3	Improve Performance Tracking
	6.4	Develop Regional Water Management Atlas
	6.5	Report on Outcomes of Projects Receiving State Financial Assistance
	6.6	Expand Water Resource Education
	6.7	Explore Ways to Develop Stable and Sufficient Funding

A Shared Vision for California's Water Future

Update 2018 envisions a future where all Californians benefit from reduced flood risk, more reliable water supplies, reduced groundwater depletion, and greater habitat and species resiliency. It recommends actions to help align decision-making processes, track outcomes, and adaptively manage programs and investments to make the state's water resource systems more resilient and achieve the sustainability goals.

This aerial view looking east, along the San Joaquin River, features Mandeville Tip in the foreground. Located in the Sacramento-San Joaquin Delta, this freshwater marsh complex is a valuable wildlife habitat and is particularly popular with kayakers. In recent years, the invasive water hyacinth has clogged the surface of these waters, requiring such management measures as mechanical harvesting and herbicide treatment.

The California Natural Resources Agency, the California Environmental Protection Agency, the California Department of Food and Agriculture, in consultation with the Department of Finance, shall together prepare a water resilience portfolio that meets the needs of California's communities, economy, and environment through the 21st century.

– Governor Gavin Newsom
From Executive Order N-10-19, issued April 29, 2019

Update 2018 plays an important role informing our work in the Newsom Administration to build this water resilience strategy.

– Wade Crowfoot, Secretary for Natural Resources
From "Secretary's Message" (p. ii) – regarding Governor Newsom's Executive Order N-10-19

We are now living in the new climate reality and we know we must respond. The consequences of inaction will be too severe. While precise strategies still require ample debate, our goals are clear — to face our critical, institutional, and systemic challenges head-on and build a more sustainable future.

– Karla Nemeth, Director, California Department of Water Resources
From "Director's Message" (p. iii) – outlining the need for action to reach the goals of Governor Newsom's Executive Order N-10-19

Chapter 1. California Water Today

This chapter describes water-use and supply conditions as well as key State initiatives and historical investments that affect water resource management and planning in California today. (For more detailed information about California's water resources, see Chapter 3, "California Water Today," in Volume 1 of *California Water Plan Update 2013* [Update 2013].)

Setting the Context for California Water Plan Update 2018

The state relies on a complex network of water storage and conveyance systems to control, capture, and store water when it is available in the wet winter and spring for use during the dry summer and fall. Many of these systems reflect World War II-era investments and were not designed to meet today's environmental requirements or Californians' current values and evolving needs. Deferred maintenance and the effects of a changing climate are affecting the ability of these systems to reliably meet those needs.

Since Update 2013, California has endured an unprecedented multi-year drought that threatened the water supplies of communities and residents. The drought also decreased agricultural production in many areas; worsened groundwater overdraft and subsidence, with associated impacts on essential water, transportation, and other utility infrastructure; and harmed fish, wildlife, and ecosystems. It was ended by record-breaking rainfall that underscored the vulnerability of California's aging flood and water management infrastructure and fragile ecosystems.

State Initiatives and Investments

In the face of those risks, consequences, and vulnerabilities, California has adopted substantive policy changes and made significant investments in water resource infrastructure and watershed management improvements, as summarized in the *California Water Action Plan Implementation Report: 2014–2018 Summary of Accomplishments*. Many of these plans and initiatives are described in the following list.

- The *California Water Action Plan*, released by the Brown Administration in January 2014 and updated in January 2016, describes a set of essential actions intended to lay the foundation for sustainable water management in the coming decades. Actions recommended in Update 2018 would significantly contribute to achieving the plan's three broad objectives: more reliable water supplies; the restoration of important species and habitat; and a more resilient, sustainably managed water resource system (i.e., surface and groundwater supply, water quality, flood protection, and the environment).
- On April 29, 2019, Governor Gavin Newsom directed his administration to pursue a water resilience portfolio – a major new initiative for water, including how to make California's water supplies more climate resilient for people and the environment. As part of the state's effort to ensure climate resilient water infrastructure, Governor Newsom has directed DWR to pursue modernized conveyance in the Delta through construction of a single tunnel to ensure clean water deliveries throughout California. The modernized conveyance project will protect water supplies for 27 million Californians and up to 3 million acres of farmland against earthquakes, rising seas and climate change, as well as preserve the Delta ecosystem.
- The Sustainable Groundwater Management Act of 2014 (SGMA) set in motion a transformation in governance, planning, and management of groundwater basins in California. SGMA requires local agencies in high- and medium-priority basins to halt overdraft and bring basins into balance. In a major step toward achieving SGMA's goals, 99 percent of affected basins are now covered by local groundwater sustainability agencies. Proactive management will need to continue for decades to keep delivering the intended outcomes.
- In the wake of the Lake Oroville spillways incident in February 2017, Governor Brown announced a four-point plan to bolster dam safety and flood protection. Consistent with that plan, California is carrying out a suite of initiatives to ensure California remains a leader in dam safety.
- Senate Bill 606 (Hertzberg) and Assembly Bill (A.B.) 1668 (Friedman), signed by Governor Brown in May 2018, build on the ongoing efforts to "make water conservation a California way of life." Together, the two bills establish a foundation for long-term improvements in water conservation and drought planning that will help the state adapt to climate change and longer, more intense droughts that result from it. These bills establish new State agency authorities and local agency responsibilities, facilitating permanent water-use efficiency improvements.
- The Human Right to Water (A.B. 685, Eng, 2012) is intended to ensure universal access to safe water. The policy declares that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitation purposes. It requires State agencies to consider the human right to water when "revising, adopting, or establishing policies, regulations, and grant criteria" that affect water used for domestic purposes.

- California EcoRestore, initiated by the California Natural Resources Agency (CNRA) in 2015, is advancing the restoration of at least 30,000 acres of Delta habitat by 2020. Progress on this initiative continued to accelerate in 2018, with five significant habitat restoration projects breaking ground. A first-of-its-kind "request for proposal" mechanism was developed for the California Department of Water Resources (DWR) Fish Restoration Program, facilitating public-private partnerships aimed at restoring thousands of acres of tidal habitat.

White pelicans congregate on the Salton Sea's slowly receding shores. Throughout 2018, the State, in collaboration with federal, regional, Tribal, and local partners, continued work on habitat restoration, air quality, and water supply projects to protect the sea's future.

- The Delta Plan is a comprehensive, long-term management plan for the Delta. Required by the Delta Reform Act, it lays out the State's policy to reduce reliance on the Delta through improved regional water self-reliance. As hub of California's water supply, the Delta plays a significant role in the state's water management system. The reform act created new rules and recommendations to further the State's coequal goals for the Delta: improve statewide water supply reliability and protect and restore a vibrant and healthy Delta ecosystem. The plan was amended in 2018 to include recommendations for conveyance, storage, and operations, along with new polices for setting priorities for State investment.
- Central Valley Flood Protection Plan (CVFPP) has guided the State's participation in managing flood risk in areas protected by the State Plan of Flood Control since its adoption by the Central Valley Flood Protection Board (CVFPB) in 2012, pursuant to the Central Valley Flood Protection Act of 2008. A strategic, long-range plan, the CVFPP and its five-year updates describe a programmatic vision for flood system improvements over time, in accordance with the requirements of the 2008 act. DWR prepared, and the CVFPB adopted, the first update of the CVFPP in 2017. The 2017 CVFPP update refined and updated the State Systemwide Investment Approach, including a conservation strategy, estimated costs and implementation phasing, policy issues and recommendations to overcome them, and a framework for performance tracking.
- Salton Sea Management Program, developed by CNRA in collaboration with DWR and California Department of Fish and Wildlife (CDFW), is guiding investments to protect public health and restore aquatic ecosystems critical for migratory birds of the Pacific Flyway which depend on the Salton Sea. The Salton Sea Management Program Phase I: 10-Year Plan (10-Year Plan) describes the approach to achieving the 30,000 acres of aquatic habitat and dust mitigation projects prescribed by the Salton Sea Task Force and the State Water Resources Control Board Stipulated Order. The federal government, represented by the U.S. Department of Interior,

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

Statewide Applied Water Use - how water was used … in millions of acre-feet

Water Year	2011	2012	2013	2014	2015
% Average Rainfall	134%	75%	77%	56%	77%
Precipitation in millions of acre feet (MAF)	*248.1*	*138.9*	*142.0*	*102.6*	*143.3*
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 and Scenic Rivers	36.5	20.2	17.1	10.5	14.2
Total Uses	**92.7**	**77.2**	**73.7**	**64.7**	**64.1**

Table 1-2 California Water: How It Was Used and Where It Came From, 2011–2015

Statewide Dedicated and Developed Water Supply - where it came from … in millions of acre-feet

Water Year	2011	2012	2013	2014	2015
% Average Rainfall	134%	75%	77%	56%	77%
Precipitation in millions of acre feet (MAF)	*248.1*	*138.9*	*142.0*	*102.6*	*143.3*
Instream Environmental 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 and 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**

Figure 1-1 Regional Water Uses and Supplies in Water Year 2011 (Wet Year)

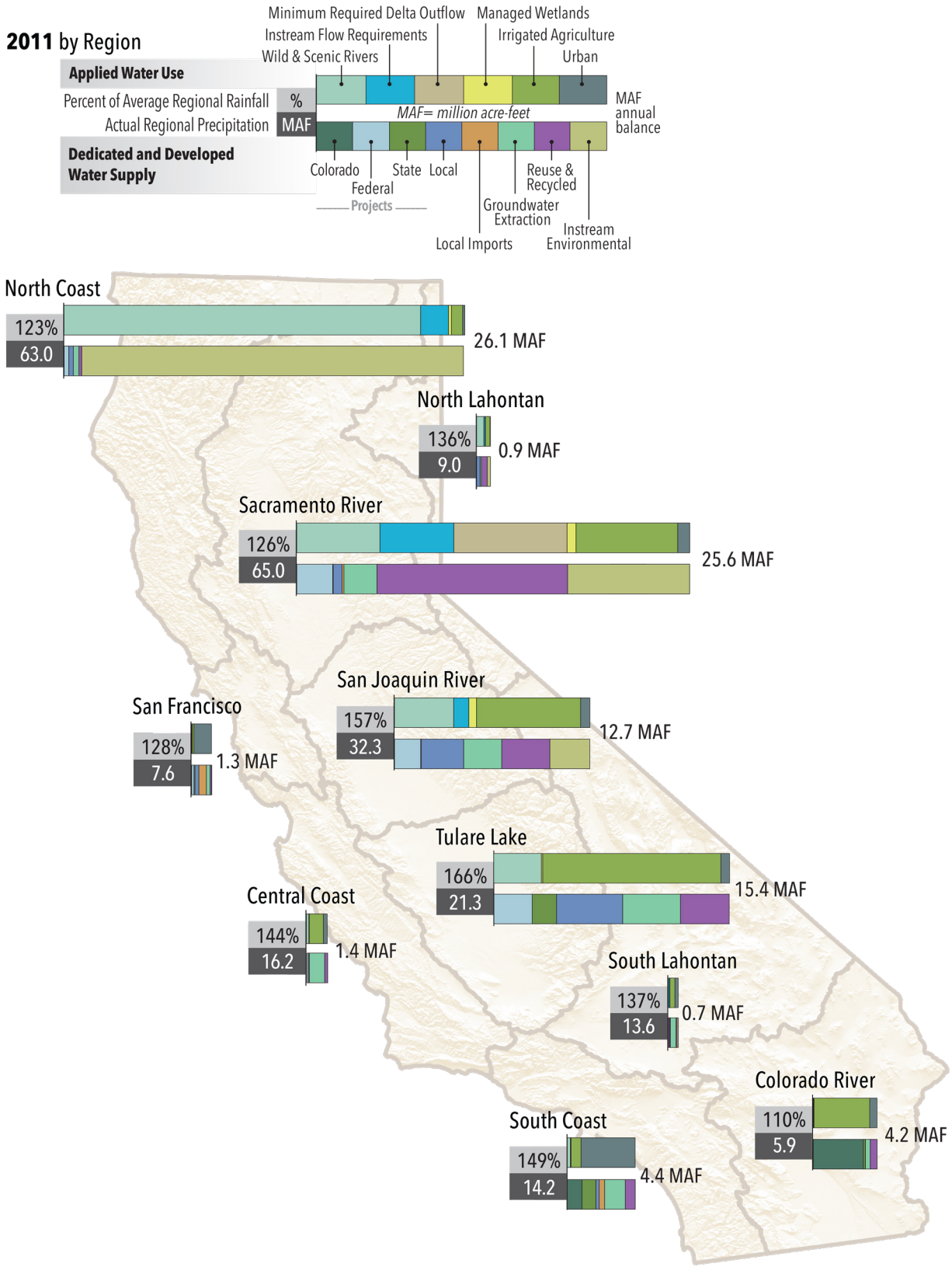


Figure 1-2 Regional Water Uses and Supplies in Water Year 2014 (Critically Dry Year)

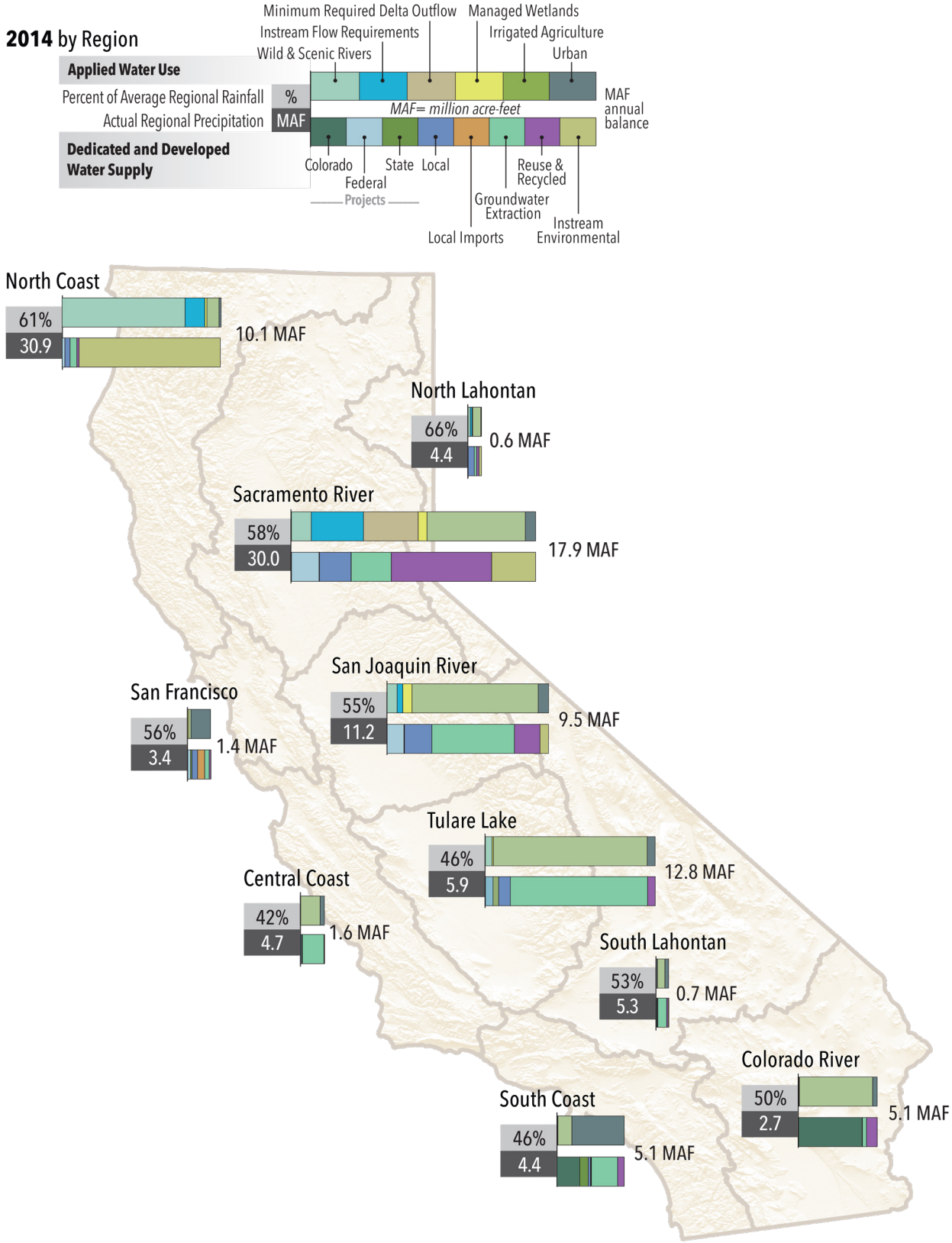


Table 1-3 Regional Applied Water Use, in Million Acre-Feet, Water Year 2011 (Wet Year)

Hydrologic Region	Precipitation (Percent of Annual Average)	Wild and Scenic Rivers	Instream Flow Require-ments	Minimum Required Delta Outflow	Managed Wetlands	Irrigated Ag.	Urban	Annual Balance
North Coast	63.01 or 123%	23.25	1.82	0	0.19	0.74	0.14	26.13
San Francisco	7.6 or 128%	0	0.02	0	0.05	0.11	1.14	1.33
Central Coast	16.2 or 144%	0.16	0.03	0	0	0.92	0.25	1.36
South Coast	14.2 or 149%	0.20	0.01	0	0.03	0.66	3.53	4.43
Sacramento River	65.0 or 126%	5.42	4.82	7.39	0.58	6.64	0.78	25.62
San Joaquin River	32.3 or 157%	3.86	0.98	0	0.50	6.79	0.60	12.74
Tulare Lake	21.3 or 166%	3.10	0	0	0.09	11.62	0.57	15.37
North Lahontan	9.0 or 136%	0.47	0.08	0	0.02	0.30	0.03	0.90
South Lahontan	13.6 or 137%	<0.01	0.10	0	0	0.33	0.22	0.65
Colorado River	5.9 or 110%	0	0	0	0.04	3.64	0.48	4.16

Table 1-3 Notes: Ag. = agriculture
More information is available in the supporting document, *Water Portfolios and Balances*.

Table 1-4 Regional Dedicated and Developed Water Supply, in Million Acre-Feet, Water Year 2011 (Wet Year)

Hydrologic Region	Precipitation (Percent of Annual Average)	Colorado	Fed.	State	Local	Local Imports	Groundwater Extraction	Reuse and Recycle	Instream Environmental	Annual Balance
North Coast	63.0 or 123%	0	0.30	0	0.30	<0.01	0.36	0.19	24.89	26.13
San Francisco	7.6 or 128%	0	0.15	0.06	0.26	0.50	0.24	0.09	0.02	1.33
Central Coast	16.2 or 144%	0	0.10	0.03	0.02	0	1.00	0.20	0	1.36
South Coast	14.2 or 149%	0.96	<0.01	0.90	0.21	0.35	1.35	0.65	0	4.43
Sacramento River	65.0 or 126%	0	2.35	0.03	0.58	0.12	2.15	12.43	5.15	25.62
San Joaquin River	32.3 or 157%	0	1.71	0.03	2.77	<0.01	2.48	3.14	2.61	12.74
Tulare Lake	21.3 or 166%	0	2.50	1.58	4.31	0	3.77	3.18	0	15.37
North Lahontan	9.0 or 136%	0	0	0	0.22	0	0.08	0.38	0.21	0.90
South Lahontan	13.6 or 137%	0	0	0.09	0.04	0	0.37	0.07	0.08	0.65
Colorado River	5.9 or 110%	3.26	0	0.13	<0.01	0	0.32	0.45	0	4.16

Table 1-4 Notes: Fed. = federal

More information is available in the supporting document, *Water Portfolios and Balances*.

Table 1-5 Regional Applied Water Use, in Million Acre-Feet, Water Year 2014 (Critically Dry Year)

Hydrologic Region	Precipitation (Percent of Annual Average)	Wild and Scenic Rivers	Instream Flow Require-ments	Minimum Required Delta Outflow	Managed Wetlands	Irrigated Ag.	Urban	Annual Balance
North Coast	30.9 or 61%	7.83	1.26	0	0.13	0.77	0.14	10.12
San Francisco	3.4 or 56%	0	0.01	0	0.06	0.15	1.17	1.39
Central Coast	4.7 or 42%	0.01	0.01	0	0	1.27	0.28	1.57
South Coast	4.4 or 46%	0.03	0.01	0	0.03	1.06	3.99	5.12
Sacramento River	30.0 or 58%	1.45	3.83	4.00	0.64	7.19	0.76	17.87
San Joaquin River	11.2 or 55%	0.58	0.33	0	0.54	7.39	0.61	9.45
Tulare Lake	5.9 or 46%	0.51	0	0	0.10	11.58	0.60	12.78
North Lahontan	4.4 or 66%	0.10	0.08	0	0.02	0.36	0.03	0.59
South Lahontan	5.3 or 53%	<0.01	0.07	0	0	0.44	0.22	0.74
Colorado River	2.7 or 50%	0	0	0	0.05	4.75	0.30	5.10

Table 1-5 Notes: Ag. = agriculture

More information is available in the supporting document, *Water Portfolios and Balances*.

Table 1-6 Regional Dedicated and Developed Water Supply, in Million Acre-Feet, Water Year 2014 (Critically Dry Year)

Hydrologic Region	Precipitation (Percent of Annual Average)	Colorado	Fed.	State	Local	Local Imports	Groundwater Extraction	Reuse and Recycle	Instream Environmental	Annual Balance
North Coast	30.9 or 61%	0	0.17	0	0.33	<0.01	0.43	0.14	8.99	10.12
San Francisco	3.4 or 56%	0	0.17	0.08	0.34	0.43	0.27	0.09	0.01	1.39
Central Coast	4.7 or 42%	0	0.07	0.03	0.02	0	1.40	0.03	0.01	1.57
South Coast	4.4 or 46%	1.73	0	0.65	0.17	0.08	1.99	0.51	0	5.12
Sacramento River	30.0 or 58%	0	1.95	0.03	2.24	0.01	2.84	7.11	3.11	17.87
San Joaquin River	11.2 or 55%	0	0.98	0.03	1.60	0	4.84	1.50	0.50	9.45
Tulare Lake	5.9 or 46%	0	0.57	0.42	0.89	0	10.32	0.58	0	12.78
North Lahontan	4.4 or 66%	0	0	0	0.27	0	0.10	0.11	0.11	0.59
South Lahontan	5.3 or 53%	0	0	0.04	0.04	0	0.52	0.09	0.05	0.74
Colorado River	2.7 or 50%	4.11	0	0.02	<0.01	0	0.27	0.70	0	5.10

Table 1-6 Notes: Fed. = federal

More information is available in the supporting document, *Water Portfolios and Balances*.

has signed a memorandum of understanding with CNRA to provide funding and support the implementation of the 10-Year Plan. CNRA, DWR, and CDFW have developed partnerships with local water and power districts, California Native American Tribes, and counties to develop detailed plans for creating habitat features and dust mitigation actions on the exposed lakebed. These partnerships are focused on developing collaborative multi-benefit projects with outcomes that achieve sustainable ecosystems and economic and public health goals for the region.

- CDFW's Regional Conservation Investment Strategies Program is using a science-based approach to identify conservation and enhancement opportunities. Created by A.B. 2087 (Levine, 2016), the program sets forth a voluntary regional planning process to improve conservation outcomes.

- California Biodiversity Initiative: A Roadmap for Protecting the State's Natural Heritage is aimed at securing the future of California's biodiversity while supporting the mutually beneficial relationship between the environment and the economy. Released in September 2018 by CNRA, the California Department of Food and Agriculture, and the Governor's Office of Planning and Research, the initiative calls for identifying what needs to be protected and developing strategies to protect, manage, and restore those ecosystems. Monitoring progress will help to inform decision-making and to adapt management actions as efforts increase in scope and accelerate. Collaboration across resource management sectors and communities is essential to the success of this initiative.

- The State Water Resources Control Board is in the process of updating the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary with revised water quality control measures and flow requirements needed to protect beneficial uses in the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) watershed. The plan is being updated through two plan amendments. The first focuses on San Joaquin River flows and southern Delta salinity, while the second plan amendment focuses on the Sacramento River and its tributaries, Delta eastside tributaries, Delta outflows, and interior Delta flows.

- To help implement Bay-Delta plan objectives, DWR and CDFW are developing voluntary agreements among stakeholders in the Sacramento and San Joaquin river watersheds, with the goal of improving instream habitat conditions for fisheries.

- The California Department of Food and Agriculture is implementing the Healthy Soils Program (HSP) that stems from the California Healthy Soils Initiative, a collaboration of State agencies and departments promoting the development of healthy soils on California's farmlands and ranchlands. An HSP incentive program provides financial assistance for implementation of conservation management to improve soil health, sequester carbon, and reduce greenhouse gas (GHG) emissions. This program includes demonstration projects that build soil organic carbon and reduce atmospheric GHGs by funding on-farm demonstration projects

and creating a platform that promotes widespread adoption of HSP conservation management practices.

- Proposition 1 – the Water Quality, Supply, and Infrastructure Improvement Act of 2014 – was approved by the voters in 2014. It authorized $7.5 billion to finance safe drinking water and water-supply reliability programs for California. The water bond provides public funding for public benefits associated with new surface water and groundwater storage projects; regional water-supply reliability; sustainable groundwater management and cleanup; water recycling; flood management; water conservation; and safe drinking water, including specific allocation of funds for disadvantaged communities. Proposition 1, as with previous State general obligation bonds, enabled effective State investment in multi-benefit actions through the integrated regional water management and other processes.
- Proposition 68 – the California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018 – was approved by voters in June 2018. It authorized $4 billion in general obligation bonds for State and local parks, environmental protection and restoration projects, water infrastructure projects, and flood protection projects. Items related to water management include river, creek, and waterway recreation and improvements; ocean, bay, and coastal protection; clean drinking water and drought preparedness; groundwater sustainability; flood protection and repair; regional sustainability for drought and groundwater; and water recycling. The measure requires 15 to 20 percent of the bond funds be dedicated to projects in communities with median household incomes of less than 60 percent of the statewide average.

Many of these plans and initiatives informed *California Water Plan Update 2018* (Update 2018). They are listed in the "Featured Companion State Plans" section of Update 2018.

Even with these important State initiatives, California still faces challenges from flooding, unreliable or unsafe water supplies, groundwater overdraft, habitat degradation, and species declines. As described in Chapter 2, many of California's ecosystems continue to decline, and much of the state's water supply and flood protection infrastructure either no longer functions as intended or has exceeded its design life (California Department of Water Resources 2014). If these trends continue, the state's water resources and prosperity will remain vulnerable to the consequences of droughts, floods, fire, environmental degradation, species extinctions, and climate change.

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 (Tables 1-1 and 1-2) provide data regarding the state's highly variable water use and water supply in the face of annual hydrologic extremes.

- 2011: Rainfall was 134 percent of average; precipitation totaled 248.1 million acre-feet (m.a.f.)
- 2012: Rainfall was 75 percent of average; precipitation totaled 138.9 m.a.f
- 2013: Rainfall was 77 percent of average; precipitation totaled 142 m.a.f.
- 2014: Rainfall was 56 percent of average; precipitation totaled 102.6 m.a.f.
- 2015: Rainfall was 77 percent of average; precipitation totaled 143.3 m.a.f.

Tables 1-1 and 1-2 provide data on California's water supply and water use during those five years.

California's water resources support cities and communities, agriculture, and the environment. *Applied water* refers to the volume of water that 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. (For more information on water use and supply, see the supporting document *Water Portfolios and Balances*.)

Figures 1-1 and 1-2 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 1-1 summarizes water balances for each of California's 10 hydrologic regions for Water Year 2011, a wet year. Figure 1-2 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). Tables 1-3 and 1-4 are numerical representations of the data depicted in Figure 1-1. Tables 1-5 and 1-6 are numerical representations of data depicted in Figure 1-2.

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 DWR's Water Portfolios 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.

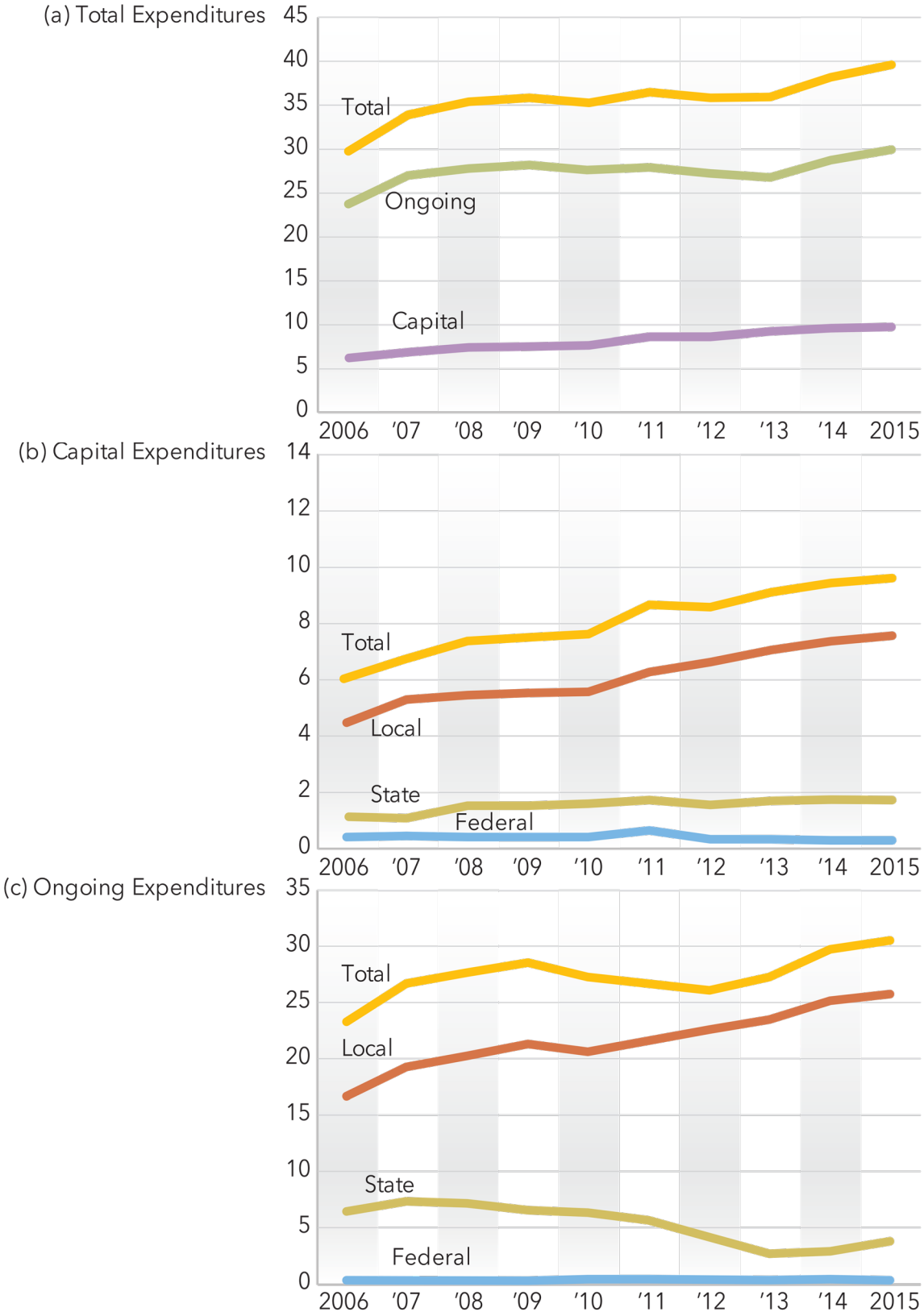
For more information about California's water use and water supply, including regional water balances for additional years, hydrologic summaries, regional inflows and outflows, and data for smaller analysis areas within each region, refer to the Water Portfolios webpage and the Update 2018 Supporting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

Historical Investment in Water Management

From 2006 through 2015, total investment in capital and ongoing expenditures (operation, maintenance, and administration) by local, State, and federal agencies averaged more than $35 billion per year (Figures 1-3a, 1-3b, and 1-3c). Capital expenditures averaged more than $8 billion per year during the same period, with most of the funds coming from local agencies. Capital expenditures have continued to be made largely in reaction to emergencies and extreme events. For example, the increase in spending in the late 2000s for flood management was in response to Hurricane Katrina; the upward trend in spending that started in the mid-2010s was in response to extended drought conditions (California Department of Water Resources 2018a).

Local agencies provided approximately 85 percent of all funding for water management in California, with capital and ongoing expenditures increasing to keep pace with the issuance of State grant programs (Hanak et al. 2014). While this reflects all water management sectors, flood and ecosystem restoration sectors have been relatively more dependent on State and federal funding. Although the State has funded capital improvements in disadvantaged communities, those communities often lack the ability to fund ongoing operations and maintenance (Hanak et al. 2014). In addition, State expenditures from the State General Fund have decreased as general obligation bond issuance has increased. This shift has led to water resource management sectors having to rely on bond funding, an unstable and uncertain source.

Figure 1-3 (a-c) Historical Local, State, and Federal Expenditures (2006–2015), in billions of dollars per year



Moreover, when considering historical expenditures for integrated water management activities and levels of government, it is important to keep in mind that such estimates require several assumptions and characterizations. No standard method is used to perform the estimates. For future Water Plan updates, DWR will continue to promote collaboration and alignment among water planning efforts in order to apply more consistent methodologies and definitions for estimating historical water expenditures.

Chapter 2. Challenges to Sustainability

Sustainability of California's water systems means meeting current needs – expressed by water stakeholders as public health and safety, healthy economy, ecosystem vitality, and opportunities for enriching experiences – without compromising the needs of future generations.

Critical, Systemic, and Institutional Challenges

Challenges that affect the State's ability to manage water resources for sustainability cannot be resolved with stopgap measures or by making minor adjustments. California's interconnected systems for using and managing water are extremely complex and subject to continually changing natural and human-made conditions. Climate change, demographic changes, and other variables underscore the need to manage these valuable water resources for sustainability. California has realized many successes in water resource management over the past several decades, driven by State-level policy initiatives and programs as well as local and regional actions. Even so, California faces foreseeable risks and unanticipated threats to sustainability. Evidence of vulnerability of the state's water resources is occurring in nearly all regions, and conflicts between ecological and human needs are increasing. Recognizing the trends and causes of these challenges will allow Californians to proactively manage and recover from droughts, floods, fires, and other disruptive events.

From 2012 through 2016, California experienced severe drought accompanied by accelerated groundwater depletion and overdraft, continued habitat and species declines, and a massive die-off of trees within California's headwaters. This dry period was followed by the second wettest year on record, resulting in extremely high runoff events. These events threatened the lives and property of people protected by levees and jeopardized Tribal cultural resources in many areas. Although communities that proactively planned and invested in water management strategies have shown considerable resilience, communities with limited income and capacity remain vulnerable and continue to suffer the most severe impacts (Hanak et al. 2017).

Many of the critical, systemic, and institutional challenges that regions and communities face are particularly complex and increasingly undermine the well-being of Californians.

Critical Challenges

Although local, regional, and State water managers tackle the following critical challenges daily, they experience varying degrees of success.

- **More-Extreme Hydrologic Events:** In any given year, the state can experience extreme hydrologic events, such as drought and flood. In times of drought, there is not enough water to meet all uses; during floods, the excess water threatens human lives, property, and economic well-being. Severe drought conditions in the western United States, followed by extreme precipitation in 2017, directly affected the health and livelihoods of Californians. The wide swings in climatic conditions are exposing the vulnerability of the state's water systems and ecosystems. Seasonal, year-to-year, and geographical variability among water sources and locations of water uses, particularly affecting disadvantaged communities, makes overcoming this challenge more difficult.

- **Increasing Flood Risk:** Risk of catastrophic flooding is exceptionally high throughout the state, with one in five Californians living in a floodplain and more than $580 billion in assets (i.e., crops, property, and public infrastructure) at risk (California Department of Water Resources and U.S. Army Corps of Engineers 2013). This risk is increasing as more precipitation falls as rain than snow, hydrologic events become more extreme, more communities are situated in floodplains, and maintenance is deferred on existing infrastructure. Every county in California has been declared a federal disaster area for a flooding event at least once in the last 20 years (California Department of Water Resources and U.S. Army Corps of Engineers 2013). This alarming statistic underscores the need to invest in the state's aging flood management infrastructure and in measures to modernize the flood system to adapt to climate change and increased extreme weather events. Modernizing the flood system to adapt to future needs includes recognizing that managed flooding in certain areas can produce beneficial effects and support natural functions (e.g., replenishing ecosystems with sediment and nutrients and helping to recharge groundwater aquifers). Flooding and floodplains also can provide beneficial habitat conditions; but, as people and structures have moved into floodplains, the need for flood management that benefits people and the environment has increased greatly.

- **Reduced Access to Clean, Safe, Reliable, and Affordable Water Supplies:** During the recent drought, many vulnerable communities were unable to provide reliable and safe water to their residents. Nearly 700 communities have water systems that rely on contaminated groundwater (State Water Resources Control Board 2013). Of the 3,399 public water systems (community systems and schools) in the state, more than 300 are not in compliance with safe drinking water standards (State Water Resources Control Board 2018), and many more lack access to affordable

and reliable water supplies and sanitation. Many disadvantaged communities are dedicating an increased portion of their resources to providing human services, rather than to operating and maintaining infrastructure for safe drinking water and sanitation. Moreover, the recent rise in homelessness has created new challenges for water utilities to provide clean and safe water for drinking, bathing, and sanitation for 130,000 unhoused Californians. People living in encampments along riverbanks and stormwater management systems also pose additional water management issues, such as waterborne public health threats, damage to levees, and degraded river ecosystems and water quality (U.S. Department of Housing and Urban Development 2017; White 2013).

- **Declining Groundwater Levels:** Surface water and groundwater have largely been managed as separate resources when, in reality, they are a highly interdependent system of watersheds and groundwater basins. This historical separation in managing these resources has resulted in negative effects and missed opportunities to advance sustainability.

Water quality monitoring is a significant component of the Delta Stewardship Council's 2017–2021 Science Action Agenda, which prioritizes and aligns science actions to inform management decisions, fills gaps in knowledge, and promotes collaborative science across multiple State and federal agencies.

According to *California's Groundwater Update 2013*, the average annual groundwater withdrawal in California is approximately 16 million acre-feet (m.a.f.), which is almost 40 percent of all water used in the state. Most of the groundwater withdrawal occurs in the Central Valley, where available data indicate that during the five-year period from spring 2005 to spring 2010, the average annual depletion of groundwater in storage ranged from approximately 1.0 m.a.f. to 2.6 m.a.f. The total depletion in groundwater storage in the Central Valley aquifers during that period was approximately 13 m.a.f., which is nearly four times Lake Oroville's storage capacity (3.5 m.a.f.). The vast majority of the state's population and agricultural activity is dependent on stressed groundwater basins (California Department of Water Resources 2015). Driven by recent and extended drought, groundwater levels in some parts of the state are declining at unprecedented rates. These declines have led to land subsidence in some areas, resulting in costly damage to water supply, transportation, and flood infrastructure (Water Education Foundation 2017).

- **Declining Ecosystems:** Even with increasing awareness of the benefits of natural infrastructure, relative to water supply and other sectors, investment in restoration of terrestrial, wetland, and aquatic ecosystems has been insufficient. The same is true for forest and headwater management. The result is that many ecosystems and the services they provide continue to decline. More than 150 species are listed as Threatened or Endangered in California (California Department of Fish and Wildlife 2018).

- **Water Quality Degradation:** Changes in land use and water use have resulted in increased runoff of agricultural, industrial, and urban pollutants to surface water and groundwater. Increased agricultural and urban wastewater discharges, as well as changes in commercial and recreational activities, have negatively affected water quality. Higher temperatures, extreme hydrologic events, wildfire and forest management practices, and ecosystem degradation have further diminished water quality. As the quality diminishes, treatment costs increase.

- **Aging and Inadequate Built Infrastructure:** California's water systems are increasingly managed to provide benefits beyond their original purpose. Much of California's water-resource infrastructure is reaching the end of its design life, even as it comes under greater stress created by hydrologic extremes and increasing water demand. At the same time, costly maintenance and capital improvements have been deferred in some regions and water sectors because of lack of funding or regulatory challenges (Hanak et al. 2011).

- **Sacramento-San Joaquin Delta (Delta) Conflicts:** Competing demands for the Delta's resources have contributed to escalating conflicts among water, environmental, and local stakeholders. The Delta's future will be affected by increasing land subsidence; heightened seismic risk; and the effects of climate change, such as rising temperatures, changes in runoff timing, sea level rise, and changes in storm timing, intensity, and frequency (California Department of Water Resources and U.S. Bureau of Reclamation 2016; Delta Stewardship Council 2013).

- **Declining Forest and Headwater Health:** More extreme hydrologic events also directly affect forests through increased drought stress that makes trees more vulnerable to insect attack, with the resulting increased rates of tree mortality influencing wildfire frequency, size, and severity. California received record-breaking rains in the winter of 2016–2017, yet the previous five consecutive years of severe drought in California and rising temperatures led to a dramatic rise in bark beetle infestation and tree die-off. Since November 2016, 27 million trees have died throughout the state, bringing the total that have died because of drought and bark beetles to an historic 129 million (U.S. Forest Service 2017). The dead trees continue to pose a hazard to people and critical infrastructure.

Along with other environmental pressures, this historic die-off is affecting forest resiliency, stream flows, and water quality buffering. Many perennial streams will likely become intermittent, resulting in degraded meadows and the loss of riparian areas, wetlands, and other aquatic habitats.

- **Catastrophic Wildfires:** Californians increasingly face the disastrous consequences of catastrophic wildfires. In 2017, there were 46 fire-related deaths (and more from fire-induced landslides); 1,436,558 acres burned; 10,822 structures destroyed and another 1,238 damaged (McLean 2018); and tens of billions of dollars in losses and associated costs. As of December 2, 2018, approximately 1.7 million acres have been consumed by 7,510 wildfires (California Department of Forestry and Fire Protection

2018). California is primed for more frequent and more catastrophic wildfires as a result of extreme tree mortality, increased fuel loads, climate change leading to more extreme droughts and flooding, and continued urban development in and near wildlands.

- **Unstable Regional Economies:** As water supplies have become less reliable, local and regional economies are more volatile, especially in agricultural and rural communities. For example, direct agricultural costs statewide from the drought total more than $1.8 billion, with a loss of approximately 10,100 seasonal jobs (Howitt et al. 2015). Often these economic downturns disproportionately harm people who have the least capacity to respond to changes.
- **Changing Demands for Water:** Future water scenarios published in Update 2013 show an increase in urban water demand ranging from 1 m.a.f. to 7 m.a.f. per year by 2050 (depending on population growth). The high end of this range is equivalent to twice the storage capacity of Lake Oroville. Landmark water-use efficiency measures and mandates have been implemented since Update 2013; thus, the actual increase in urban water use could be lower than the 2013 estimates.

After several years of drought conditions, heavy storms brought unrelenting snow and rain to Central California mountains and valleys during the first two months of 2017, which resulted in significant flooding. Shown in January 2017, these inundated agricultural structures are located outside Elk Grove, south of Sacramento.

The scenarios show a decrease in agricultural water demand ranging from 2 m.a.f. to 6 m.a.f. for the same planning horizon. California's population is expected to increase from 39.4 million in 2016, to 51.1 million by 2060 (California Department of Finance 2018). Shifts in agriculture to permanent crops will also make it more difficult to reduce water use during droughts and periods of low supply (i.e., "demand hardening").

Systemic and Institutional Challenges

The following systemic and institutional challenges place significant risks on public safety, vulnerable ecosystems, and the state's economy. To some degree, all Californians are affected by these challenges. Careful consideration of the risks posed by these challenges is an important aspect of managing water resources for sustainability.

- **Fragmented and Non-Coordinated Initiatives and Governance:** The ability to efficiently, equitably, and sustainably manage water resources at a watershed scale is often impaired by lack of shared intent and alignment. Holistically managing California natural resources will require collaboration among State agencies, federal agencies, California Native American Tribes, water districts, land-use entities, flood districts, resource conservation districts, and community-based organizations, especially when

they share jurisdictional areas, watersheds, ecoregions, and groundwater basins. For example, groundwater sustainability agencies and regional water management groups, through integrated regional water management planning, provide effective collaborative forums to establish shared intent and alignment of initiatives.

- **Inconsistent and Conflicting Regulations:** Regulations, including constitutional provisions and laws, are an integral part of public health and safety and of environmental protection. Yet at times, some regulations, particularly those developed in institutional silos, do not achieve their intended outcomes, much less balance environmental needs and human activities. For the most part, existing regulations focus on avoiding, minimizing, or mitigating environmental impacts caused by discrete projects or protecting a single species. But what is beneficial for one project or species is not necessarily beneficial for another. Also, existing laws largely lack the discretion needed to manage adaptively on a watershed or ecoregion scale – including managing for ecosystem restoration and the services it provides.
- **Insufficient Capacity for Data-Driven Decision-Making:** Information, data, and tools are essential for ensuring that decisions and actions result in intended outcomes, as well as measure progress toward accomplishing those outcomes. Yet, water resource planners and managers often do not have access to the technical information, tools, and facilitation services needed to support regional efforts toward sustainable integrated water management (Canto et al. 2018). Data may be abundant statewide but are collected, used, and stored by numerous agencies and are not coordinated or shared. Although this is a statewide challenge, the consequences of inadequately informed decisions are experienced to a much greater degree in under-represented and economically disadvantaged communities. These communities also lack the resources to gather and provide information regarding local conditions to inform policy.

Data management, planning, policy-making, and regulation must occur in a collaborative, regionally based manner. Data must be accessible, sufficient, quality controlled, and usable. Effective decisions must also be based on the appropriate use and interpretation of data. The ultimate data-sharing and management system needs to utilize an authoritative, open-access platform that informs the decisions of elected officials, opinion leaders, stakeholders, scientists, and subject experts. Subject expertise (e.g., hydrology, climatology, environmental sciences) and stakeholder perspectives woven together into comprehensive, regionally appropriate policies and implementation decisions are necessary to manage for sustainability.

- **Insufficient and Unstable Funding:** Current mechanisms and how they are used to fund State government are often inadequate, unpredictable, and inflexible. As a result, they do not fully fund water-related State responsibilities (including local assistance and cost-sharing). Many other factors, such as changing public priorities, deferred maintenance, and responses to declining ecosystems and catastrophic events, have compounded today's State funding needs. Other challenges to sufficient

and stable funding occur at all levels of government. These include competition with other public services for available resources, reduced revenue collection during periods of required water conservation, legal constraints related to assessment increases (e.g., Proposition 218), and geographical or jurisdictional limitations on generation and use of funds (California Department of Water Resources 2014). For example, many local agencies have funding restrictions based on their charters and missions that preclude implementing multi-benefit projects.

Flood management and ecosystem management face additional funding challenges because they rely heavily on State general obligation bond funding and federal funding. State funding for protecting public trust assets, as well as for ensuring that communities with limited resources have clean and reliable water supplies, is also frequently inadequate and unstable. For example, only 6 percent of total water resource funding is allocated to flood management and ecosystem functions (Hanak et al. 2012). Sporadic funding in response to floods or droughts lacks the predictability and reliability required for effective long-term change. At the same time, levels of State general obligation bond debt are near an all-time high (California Department of Water Resources 2019a).

- **Inadequate Performance Tracking of State and Local Investment:** One basic long-standing challenge to water resource resilience and reliability in California is the lack of a consistent and practical method for assessing current and future sustainability (California Department of Water Resources, in prep.). Decision-makers often set critical and long-term water management priorities with insufficient data and information about the performance of past actions and the effectiveness of existing opportunities.

Chapter 3 describes recommended actions for infrastructure and ecosystem improvements, as well as actions to overcome institutional, statutory, and data deficiencies and other root causes of the state's water challenges.

The Sustainability Outlook

The Sustainability Outlook was developed to provide a well-organized and consistent approach for tracking local, regional, and State actions and investments. It is an evolving method of informing the strategic planning and prioritization of water management actions. This method, or tool, involves evaluating status and trends of conditions within a watershed or region, setting intended outcomes consistent with societal values, and determining whether actual outcomes are consistent with intended outcomes. Through progressive application of the Sustainability Outlook, decision-makers should be able to evaluate return on investments, identify needed analytical tools and data gaps, build capacity to make decisions and set priorities, and describe how individual and collective actions have affected the management of water resources for sustainability. The Sustainability Outlook was informed by stakeholder input and initial pilot projects, as described in *The Sustainability Outlook: A Summary* (California Department of Water Resources 2019b).

Chapter 3. Actions for Sustainability

Managing water resource systems for sustainability requires changing the status quo, addressing challenges, and strategically planning for long-term resiliency. State government must address challenges related to aging infrastructure, ecosystem decline, decision-making, and public funding.

This chapter describes recommended actions needed to meet the goals of *California Water Plan Update 2018* (Update 2018). The actions, if implemented, would result in multiple benefits across water management sectors. They would involve assisting and empowering local and regional communities to plan, fund, implement, and report on their accomplishments and lessons learned.

State and regional entities play unique roles in water management. To accomplish Update 2018's six goals, listed below, the State should partner with federal, Tribal, regional, and local entities to implement the recommended actions described in this chapter.

Recommended Actions to Accomplish Update 2018 Goals

The following six goals and actions support the larger State initiatives referenced in Chapter 1 and the Newsom Administration's water resilience portfolio. Many of the actions are intended to work together by leveraging value from one action to augment the value of another. As suggested above, each recommended action is intended to be implemented in a collaborative way across State agencies to leverage funding and staffing resources, programs, initiatives, and statutes. The actions will help overcome challenges and enable the management of water resources for sustainability.

Goal 1 – Improve Integrated Watershed Management

California's vision of sustainable water management relies on the continued support of innovative and inclusive integrated water management strategies. Healthy watersheds, headwaters, aquifers, and working landscapes provide critical water supply and ecosystem services.

Recommended Action 1.1 – Strengthen State Support for Integrated Regional Water Management and Vulnerable Communities.
The State should provide base-level support to help long-term stability of key operations of integrated regional water management and sustainable groundwater programs. This should include support for disadvantaged communities, California Native American Tribes, and other vulnerable communities. The California Department of Water Resources (DWR), in coordination with the Water Plan advisory committees, Water Plan State Agency Steering Committee (SASC), Roundtable of Regions, and groundwater sustainability agencies will prepare recommendations to strengthen timely and meaningful communication with vulnerable communities and inform water resource management.

Recommended Action 1.2 – Support the Role of Working Landscapes.
Given the importance of well-managed public and private lands in a changing climate, the State should support and consider expansion of existing working landscape stewardship programs.

Recommended Action 1.3 – Promote Flood-Managed Aquifer Recharge (Flood-MAR) and Sustainable Groundwater Management Practices.
DWR will provide technical, planning, and facilitation assistance for local and regional entities to evaluate opportunities and implement projects using flood flows and alternative water supplies for managed aquifer recharge.

This bird's-eye view of the upper chute of Lake Oroville's main spillway shows Phase 2 of DWR's reconstruction effort, with placement of concrete slabs and walls, in October 2018.

Goal 2 – Strengthen Resiliency and Operational Flexibility of Existing and Future Infrastructure

Water managers must make plans to address aging infrastructure and impacts associated with climate change, population growth, ecosystem stressors, and funding constraints.

Recommended Action 2.1 – Improve Infrastructure and Promote Long-Term Management.
The State should continue and build upon recent efforts to evaluate and maintain State-owned and State-regulated water supply infrastructure and *State Plan of Flood Control* infrastructure. It also should assist local agencies with the implementation of long-

term solutions for infrastructure management. This would include identifying and evaluating opportunities to implement resource management strategies, such as those related to water supply reliability, flood risk reduction, aquifer replenishment and remediation, and surface and groundwater storage.

Goal 3 – Restore Critical Ecosystem Functions

California is one of the world's great biodiversity hotspots. Anthropogenic influence – water management included – has impacts on natural resources; and environmental protections for many species has impacts on water management.

Recommended Action 3.1 – Address Legacy Impacts.
The State is committed to directly addressing – and aiding local agency actions to address – legacy water management impacts (legacy impacts), as well as current conflicts between water management and natural resources. Integration of ecological principles into infrastructure planning and project design is critical. It complements the incorporation of climate change mitigation and adaptation strategies.

Recommended Action 3.2 – Facilitate Multi-Benefit Water Management Projects.
State and local projects that involve more than one water management sector (e.g., flood, ecosystem, water supply) should be pursued to address multiple public needs. An example would be a project that reduces flood risk while benefiting fish and wildlife populations and replenishing depleted aquifers.

Recommended Action 3.3 – Quantify Natural Capital.
The State should work with non-governmental organizations, private-sector businesses, regional and local entities, and academia to quantify the societal and economic values of functional ecosystems. This action will assist with the development of innovative restoration efforts and the measurement of progress toward restoration goals.

Goal 4 – Empower California's Under-Represented or Vulnerable Communities

Equitable water management means reliable, affordable, and safe water supplies and management for all Californians.

Recommended Action 4.1 – Expand Tribal Involvement in Regional Planning Efforts.
Consistent with Recommended Action 1.1, and in coordination with the Tribal Advisory Committee and SASC, DWR will expand engagement and consultation with California Native American Tribes to better inform water resource management decisions, increase funding opportunities, and protect cultural resources and landscapes. Better understanding and use of Tribal Ecological Knowledge, in particular, will inform decisions regarding traditional

The April 2018 Tribal Water Summit addressed indigenous water rights, reviewed previous summit accomplishments, and explored further partnerships to meet Tribal water policy needs. The summit also strengthened shared understanding of policy impacts and built partner capacity to continue addressing Tribal interests.

and current water uses, watershed management, and cultural resource preservation.

Recommended Action 4.2 – Engage Proactively with Disadvantaged Community Liaisons. In coordination with Recommended Action 1.1, State agencies should identify opportunities to leverage existing disadvantaged community liaisons and watershed coordinators, and support additional liaisons, as needed. The liaisons would engage proactively and consistently with local, regional, State, and federal agencies and Tribes to promote more effective integration and collaboration. Liaisons would provide technical, managerial, and financial expertise and services; prepare proposals for infrastructure and operations and maintenance improvement programs; and facilitate involvement of disadvantaged communities in regional water management efforts (e.g., regional water management groups and groundwater sustainability agencies).

Goal 5 – Improve Inter-Agency Alignment and Address Persistent Regulatory Challenges

Improved alignment and communication will more effectively deliver public benefits. Strengthening links between regulation and strategic planning, as well as utilizing restoration management on an ecosystem scale, will help balance environmental needs and human activities over the long term.

Recommended Action 5.1 – Incorporate Ecosystem Needs into Water Management Infrastructure Planning and Implementation. The State should continue to implement Assembly Bill (A.B.) 2087 (Levine, 2016) by developing regional conservation assessments, regional conservation investment strategies, and associated mitigation credit agreements to assist infrastructure development and ecosystem restoration program outcomes. The State also should explore additional opportunities to pursue public-private partnerships that result in innovative mechanisms for the delivery of ecosystem outcomes.

Recommended Action 5.2 – Streamline Ecosystem Restoration Project Permitting. DWR and other State agencies should continue to support stakeholder efforts to develop and implement programmatic approaches to restoration project permitting. This work is intended to simplify and accelerate the completion of critically needed habitat restoration projects across the state.

Recommended Action 5.3 – Address Regulatory Challenges.
In conjunction with Recommended Actions 5.1 and 5.2, DWR will work with other State agencies and stakeholders to identify and address additional watershed management regulatory challenges.

This Atmospheric River Observatory was installed at Bodega Bay Marine Laboratory by DWR, in partnership with Scripps Institution of Oceanography and National Oceanic and Atmospheric Administration, to allow forecasters and others to predict extreme precipitation and flooding.

Goal 6 – Support Real-Time Decision-Making, Adaptive Management, and Long-Term Planning

Effective water management requires access to data and information necessary to understand current conditions, historic challenges, and future challenges. It also requires stable funding sufficient to support State and local sustainability goals.

Recommended Action 6.1 – Facilitate Comprehensive Water Resource Data Collection and Management.
As required by A.B. 1755 (Dodd, 2016), State agencies will publish and update State water and ecological datasets on an easily accessible federated open-water-data platform. State agencies should also maintain data management best practices and work with local agencies to improve data gathering, accessibility, quality, and related decision-support tools.

Recommended Action 6.2 – Coordinate Climate Science and Monitoring Efforts.
State agencies should consider further coordination of critical climate science and monitoring efforts. The effort would support and expand ongoing research collaborations designed to track atmospheric rivers, rain-to-snow percentage trends, high-elevation snow water content, upland watershed monitoring, paleohydrology, sea level rise, seasonal winter outlooks, and changes in streamflow and stream temperatures. This action includes implementation of *Safeguarding California Plan: 2018 Update* (California Natural Resources Agency 2018) and the development of the *Indicators of Climate Change in California* report.

Recommended Action 6.3 – Improve Performance Tracking.
DWR will consider assessing State progress toward Update 2018's goals by applying the Sustainability Outlook, a method to uniformly track the outcomes and the value of water system investments (California Department of Water Resources 2019b). DWR will also consider assisting regional and local water agencies with implementing the Sustainability Outlook to inform future decision-making and help measure local progress and return on investment.

Recommended Action 6.4 – Develop Regional Water Management Atlas.
DWR will implement the Regional Water Management Atlas, a new interactive statewide tool that will provide users with access to critical water management data, including needed, ongoing, and completed water-resource management projects. Not only will this data management system promote tracking of progress on regional projects and communication of the value of past investments, it will provide a platform for building partnerships on multi-benefit projects. It will enable the sorting of information by region, county, legislative district, and other geographic units, and will allow local government entities seeking State assistance to report on future projects that provide multiple benefits and help advance State policies and priorities.

Recommended Action 6.5 – Report on Outcomes of Projects Receiving State Financial Assistance.
State agencies should build on existing tracking efforts by requiring articulation of intended outcomes for all local water projects funded or partially funded by the State. This action would require tracking and reporting on project outcomes and providing information as may be required by State grant programs and funding source requirements.

Recommended Action 6.6 – Expand Water Resource Education.
State agencies should work with school districts, universities, and foundations to attract a larger and more diverse group of students to the field of water resource management. Efforts should also be made to expand related curricula and programs to increase public awareness of surface water and groundwater as a single resource, impacts of climate change, and the need to invest in water infrastructure and ecosystems.

Recommended Action 6.7 – Explore Ways to Develop Stable and Sufficient Funding.
Water stakeholders are encouraged to explore new funding mechanisms to support managing water resources for sustainability. Foundations, academia, public agencies, the Legislature, non-governmental organizations, and others should take into consideration opportunities to expand on existing funding mechanisms, as well as opportunities to develop new funding mechanisms.

To implement these 19 recommended actions, investment will need to be increased over historical levels. Chapter 4 describes the additional funding, as well as potential new funding mechanisms and funding scenarios, needed to implement the recommended actions.

Chapter 4. Investing in Water Resource Sustainability

In light of the critical, systemic, and institutional challenges to water resource sustainability, annual historical funding will not support the level of investment needed to implement the recommended actions of *California Water Plan Update 2018* (Update 2018). This chapter describes the additional funding needed to implement the recommended actions in Chapter 3. It also describes an analysis of funding scenarios.

Scope and Setting

Although local, federal, and other stakeholders play a crucial role in funding water management actions, Update 2018 focuses on State government obligations, roles, responsibilities, incentives, and local assistance for sustaining California's water resources. Comprehensive in its scope, Update 2018 supports the 10 actions of Governor Brown's *California Water Action Plan 2016 Update* and is informing the Newsom Administration's water resilience portfolio.

Some types of water resource management activities, such as water supply and wastewater treatment, are predominately funded by ratepayer revenues, as well as through local revenue bonds for larger capital investments. On the other hand, many other activities are neither sufficiently nor stably funded, such as flood and stormwater management, statewide water resource planning, data collection and management, statewide infrastructure operation and maintenance, legacy impact remediation, and ecosystem restoration (Hanak et al. 2012).

State government has an important role in performing and funding these other activities, and even more so in disadvantaged communities. In many cases, historical

funding has been insufficient to sustain the benefits of past investments (e.g., operation and maintenance) and secure benefits from future investments (e.g., data, knowledge, skills, tools). State government has been spending approximately $2 billion per year from the State General Fund and general obligation (G.O.) bonds on water management (California Department of Water Resources 2018b). In comparison, this is approximately 10 percent of the total local, State, and federal annual expenditures on water resource management (California Department of Water Resources 2018b). Although State cost-shares will vary among water sectors, Update 2018 proposes maintaining this approximate proportion of State costshare.

On average, from 2006 to 2015, less than 2 percent of annual State budget (including State General Fund, G.O. bonds, and G.O. bond debt service) was allocated for water resource management (California Department of Water Resources 2018b). Because the State General Fund serves a vast array of critical needs, and G.O. bonds are subject to voter approval and debt service limitations (Fiscal Year 2017–2018 debt service on water G.O. bonds was more than $1 billion — approximately $680 million in interest and $380 million on principal repayment), water resource funding is subject to competing and shifting priorities. These constraints make funding for sustainably managed water resources variable and uncertain.

By providing local and regional financial assistance, State government continues to invest in statewide sustainability. Local and regional entities can determine the best way to accomplish State goals based on local/regional priorities, conditions, and available solutions. Integrated regional water management, as a program and a practice, has delivered significant value and continues to be an effective way for the State to fund local and regional activities. Regional water management groups are well-positioned in many areas to interact with the State to explore planning and funding innovations.

Although the total local, State, and federal funding needed for water management actions currently planned in California is more than $350 billion over the next 50 years, the State investment needed to implement the actions in Chapter 3 (approximately $90 billion) is a small portion of this total estimated need (California Department of Water Resources 2018b).

Funding to Implement Recommended Actions

Identifying and analyzing ways to implement and fund the recommended actions described in Chapter 3 is essential to putting California on a more sustainable path. Table 4-1 shows total State funding needed to implement Update 2018's recommended actions, as represented by the goals for the near term and the long term. The total projected 50-year capital and ongoing cost is approximately $90.2 billion, of which $77.8 billion (more than 85 percent) is for financial and technical assistance to regional and local entities, $9.7 billion is for State-managed water infrastructure, and approximately $2.7 billion (less than 3 percent) is for resolving the systemic and institutional challenges listed in Chapter 2 (California Department of Water Resources 2019a).

Funding Mechanisms

A mix of funding mechanisms would provide stable and sufficient funding for capital (large magnitude, short duration) and ongoing (small magnitude, long duration) management actions. Stable funding helps increase efficiency and return on investment. Specifically, it reduces deferred maintenance; avoids costs associated with disruptions to planning, research, and implementation; and minimizes stranded investment from data inaccessibility and gaps.

Each funding mechanism has a unique set of characteristics, including applicability to capital and ongoing investments, feasibility, inter-annual reliability, and limitations and applications related to different water management sectors. These characteristics were used to analyze the feasibility and trade-offs of funding mixes, or scenarios. Each scenario is comprised of a mix of funding mechanisms and levels.

Table 4-1 State Funds Needed to Implement the Recommended Actions, Organized by Goals (2016 Dollars)

Goals ($ millions)	Years 1–5 2019–2023	Years 6–10 2024–2028	Years 11–30 2029–2048	Years 31–50 2049–2068	50-Year Total
Goal 1[a] Improve Integrated Watershed Management	86	235	960	960	2,241
Goal 2[b, c] Strengthen Resiliency and Operational Flexibility of Existing and Future Infrastructure	2,200	4,400	24,800	27,600	59,000
Goal 3[b, c] Restore Critical Ecosystem Functions	142	815	11,565	14,000	26,522
Goal 4[a] Empower California's Under-Represented or Vulnerable Communities	9	10	40	40	99
Goal 5[a] Improve Inter-Agency Alignment and Address Persistent Regulatory Challenges	8	13	50	50	121
Goal 6[a] Support Real-Time Decision-Making, Adaptive Management, and Long-Term Planning	188	231	895	895	2,209
Totals	**$2,633**	**$5,704**	**$38,310**	**$43,545**	**$90,192**[d]

Table 4-1 Notes:

[a] All costs are expected to be ongoing (e.g., planning, data, improvement of State operations).

[b] Approximately 75 percent of the costs are capital expenditures, while 25 percent are for operations and maintenance.

[c] State investment depends on the level of local participation in voluntary State cost-sharing programs.

[d] A sizeable portion (more than 85 percent) of the additional State funding is intended for use by local and regional water management entities to implement local activities and projects.

Table summarized from information in Funding Assumptions for Approximating Costs of Recommended Actions (California Department of Water Resources 2019a).

Current Funding Mechanisms

This list of current funding mechanisms describes their respective characteristics.

- **State General Fund:** A fund used for the daily and long-term operations of State agencies. The State General Fund is typically supported with revenues, primarily income and sales taxes, collected on a regular basis with few restrictions on the use of those funds. The State General Fund can be used for capital, operations and maintenance, and ongoing actions. Increases in State General Fund expenditures for infrastructure investments are more feasible during periods of economic growth.
- **General Obligation Bond:** A common type of municipal bond in the United States that is secured by a state or local government's pledge to use legally available resources, including tax revenues, to repay bond holders. The G.O. bond is generally used to fund capital actions. A State G.O. bond requires a statewide vote. Time is required to prepare language for the bond measure for the statewide vote, and there is a time lag before funds are available after passage. The State must pay back the principal (amount raised), plus bond issuance cost and interest over the life of the bond. Fiscal Year 2016–2017 interest on debt for State G.O. bonds was more than $678 million.
- **Greenhouse Gas Reduction Fund:** The State's portion of the cap-and-trade auction proceeds are deposited in the Greenhouse Gas Reduction Fund (GGRF) and used to further the objectives of the California Global Warming Solutions Act of 2006 (Assembly Bill 32; Núñez, Chapter 488, Statutes of 2006). Programs and projects funded by GGRF are collectively referred to as California Climate Investments. GGRF supports a wide range of programs and projects that reduce greenhouse gas (GHG) emissions and deliver other economic, environmental, and public health benefits for Californians, including meaningful benefits to the most disadvantaged communities, low-income communities, and low-income households (California Air Resources Board 2019).
- **Public-Private Partnerships:** Long-term contractual agreements between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility. Repayment is linked to performance.
- **User Fees:** A fee based on the principal of either a beneficiary paying for a service or good, or a polluter paying for costs associated with damages to the environment. Examples include State Water Resources Control Board drinking water, water quality, and water rights fees; local development fees; and water rates. A user fee requires legislation that stipulates the types of benefits that can be assessed.

Table 4-2 shows the historical maximum and average funding from the State General Fund and G.O. bonds. Table 4-3 lists the attributes of current funding mechanisms for State investments.

Table 4-2 Historical Funding Levels of Current Funding Mechanisms
(Based on Average and Maximum Historical Expenditures 2006–2015) ($ millions)

Funding Mechanism	Historical Annual Average	Historical Annual Maximum	2015 Actual Expenditures
State General Fund	254	405	247
State G.O. Bond	1,603	2,289	1,862
State Interest on G.O. Bond Debt[a]	491	695	667
State Designated Special Fund[b]	4,980	7,122	3,366
Local Agency[c]	27,823	33,382	33,382
Federal Government[d]	788	1,074	616

Table 4-2 Notes:

G.O. = general obligation

Estimating historical expenditures for integrated water management activities and levels of government requires numerous assumptions and characterizations (as described in supporting documents), and no standard method is applied to make estimates. While various methods may share some characteristics, using different assumptions and characterizations can produce dissimilar numerical estimates of historical expenditures.

[a] Interest on water related general obligation bonds debt from the California Department of Finance (http://www.ebudget.ca.gov/2015-16/pdf/GovernorsBudget/8000/9600.pdf).

[b] Designated special fund mechanism includes fees, assessments, taxes, and other revenue sources with a designated purpose.

[c] Local agency funding is from city, county, and special district general funds; user fees; and G.O. bonds for water resources associated capital and some ongoing actions (excludes administrative and local agency operation and maintenance activities).

[d] Federal government funding is from congressional appropriation for capital associated with water resources management and some ongoing actions, as provided to the Bureau of Land Management, Federal Emergency Management Agency, National Oceanic and Atmospheric Administration, U.S. National Park Service, Natural Resources Conservation Service, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and U.S. Forest Service. These appropriations exclude administrative and federal operation and maintenance activities.

Table 4-3 Attributes of Current Funding Mechanisms for State Investments

Funding Mechanism	Inter-Annual Reliability (High, Moderate, Low)	Capital Applicability (High, Moderate, Low)	Ongoing Applicability (High, Moderate, Low)	Cost-Share Range (Minimum – Maximum)	Revenue Sources
General Fund	Moderate: dependent on State budgeting	Low	High	20% to 100% for capital, data, tools, and planning actions Up to 100% for ongoing and policy actions	Income taxes, corporate taxes, sales and use taxes, other State General Fund revenue sources
General Obligation Bond	Low	High	Low	20% to 100% for capital, data, tools, and planning actions Cost shares for qualified ongoing actions depends on bond language.	Income taxes, corporate taxes, sales and use taxes, other State General Fund revenue sources.
Greenhouse Gas (GHG) Reduction Fund	Moderate: dependent on market factors	High: ecosystem and other actions that reduce GHGs N/A: capital, OMRR&R, ongoing actions unrelated to GHG reduction	High: ecosystem and other actions that reduce GHGs N/A: capital, OMRR&R, ongoing actions unrelated to GHG reduction	Up to 80% of capital and planning actions that show nexus to GHG reductions	Qualified bidders in California's Cap-and-Trade Program

Funding Mechanism	Inter-Annual Reliability (High, Moderate, Low)	Capital Applicability (High, Moderate, Low)	Ongoing Applicability (High, Moderate, Low)	Cost-Share Range (Minimum – Maximum)	Revenue Sources
Public-Private Partnership (P3)	High	High	High	Depends on the agreement that establishes P3	Depends on establishment of P3 but could include private entity(s), ratepayers, property owners, other identified beneficiaries
User Fees	High	High: actions related to benefit N/A: capital, OMRR&R, ongoing actions unrelated to identified fee benefit	High: actions related to benefit N/A: capital, OMRR&R, ongoing actions unrelated to identified fee benefit	Up to 80% of capital and planning actions related to benefit	Water use ratepayers (urban and/or agricultural)

Table 4-3 Notes:

N/A = not applicable; OMRR&R = operations, maintenance, repair, rehabilitation, and replacement.

Historically, different water management sectors have relied on different funding mechanisms.

Table summarized from information in *Funding Mechanism Inventory and Evaluation* (California Department of Water Resources 2018c).

Novel Funding Mechanisms

Recommended Action 6.7 encourages the broader water stakeholder community to individually or collectively consider additional financing mechanisms to support sustainability. Novel funding mechanisms could provide the State with additional options for funding water resource management. They would generate revenues outside of the current State funding mechanisms and could be applied individually or in various combinations. Combined with current funding mechanisms, novel mechanisms could augment funding levels, provide more stability, and more directly link revenues and expenditures to the beneficiaries of water management activities.

This discussion of novel mechanisms is intended to help balance funding decisions with prevailing policy considerations, such as the amount of debt the State will tolerate, the feasibility of novel mechanisms in any given legislative session, and the urgency of infrastructure needs relative to the multitude of other State government roles and responsibilities.

Integral to the authorization and administration of any novel mechanism would be consideration and application of shared funding tenets, as described in *California Water Plan Update 2013*. For example, a novel mechanism must improve cost effectiveness and administrative efficiency for it to be considered. In applying any novel mechanism, the ability and willingness of the public, or local agencies, to pay must be considered. That willingness can increase when those entrusted with public funding are seen as good stewards who provide transparency, accountability, and clarity of purpose in their novel mechanism decisions.

Novel mechanisms can be administered by local, regional, or State government. State-administered novel mechanisms should be designed to minimize the effect on the ability of local agencies to generate revenue.
Table 4-4 lists the attributes of these novel funding mechanisms.

The novel mechanisms, as summarized from *Funding Mechanism Inventory and Evaluation* (California Department of Water Resources 2018c), include the following:

- **Enhanced Infrastructure Finance Districts (EIFDs)**: EIFDs were established in 2014 to enable local governments (counties, cities, and special districts) to jointly use a variety of funding and financing powers that they may not possess individually. The new authority is applicable to watershed-wide project financing because the boundaries of the EIFD may include the watershed. These funding and financing authorities include capturing a portion of the growth in the property tax and/or sales tax, use of benefit assessments for specifically benefited property, and the levy of special taxes through the Mello-Roos authority. The EIFD can fund and finance a wide variety of public infrastructure and private facilities that benefit the watershed.

Table 4-4 Attributes of Novel Funding Mechanisms for State Investments

Funding Mechanism	Inter-Annual Reliability (High, Moderate, Low)	Capital Applicability (High, Moderate, Low)	Ongoing Applicability (High, Moderate, Low)	Cost-Share Range (Minimum – Maximum)	Revenue Sources
Enhanced Infrastructure Finance Districts (EIFDs)	High	High	High	Depends on EIFD establishment language; up to 100% of capital and ongoing	Water use ratepayers (urban and/or agricultural), property owners, other identified beneficiaries
Local Municipal Bond Financing for Local Systems	High	High	Low	Depends on State financing mechanism (e.g., State Revolving Fund)	Local municipal bonds, combined with State funding
Water Markets	Variable/ Moderate: dependent on market factors	Moderate: dependent on nexus to resource benefit	Moderate: dependent on nexus to resource benefit	Up to 80% of capital, ongoing, and policy actions	Water transfer participants (urban and/or agricultural agencies, individuals)
Risk Reduction Insurance	Moderate: dependent on number of insurance policies purchased	Moderate: dependent on linkage to risk reduction actions	Moderate: dependent on linkage to risk reduction actions	Up to 100% of risk reduction related capital, ongoing, and policy actions	Risk reduction insurance participants

Funding Mechanism	Inter-Annual Reliability (High, Moderate, Low)	Capital Applicability (High, Moderate, Low)	Ongoing Applicability (High, Moderate, Low)	Cost-Share Range (Minimum – Maximum)	Revenue Sources
Watershed Assessment	High	High	High	Up to 100% for State services and policy actions Up to 80% of infrastructure and planning actions Cost shares for qualified ongoing actions depends on bond language.	Water use ratepayers (urban and/or agricultural), property owners, other identified beneficiaries
Water Surcharge Fee	Moderate: dependent on resource usage	Moderate: dependent on nexus to fee	Moderate: dependent on nexus to fee	Up to 80% of capital, ongoing, and policy actions related to benefit	Water use ratepayers (urban and/or agricultural)

Table 4-4 Notes:

Historically, different water management sectors have relied on different funding mechanisms.

[a] Inter-annual reliability refers to the degree to which a funding approach lasts for multiple decades.

Table summarized from information in *Funding Mechanism Inventory and Evaluation* (California Department of Water Resources 2018c).

Water is released from Lake Natoma at Nimbus Dam in Sacramento County, while storm clouds build in the distant eastern sky toward the foothills of the Sierra Nevada. The water was released as a precaution against flooding after an atmospheric river dumped heavy rain and snow across Northern California. March 3, 2019.

- **Local Municipal Bond Financing for Local Systems**: This novel mechanism would enhance opportunities for local governments and water agencies to maximize their access to State-administered water infrastructure funding. Governmental Accounting Standards Board Statement 62 allows public agencies to book the cost of "business-type activities" as assets instead of annual expenses. These are called "regulatory assets" and can be capitalized by public water resource entities. The regulated assets approach is a complete alternative to traditional public agency accounting for capital assets. To meet the regulated assets approach and access debt-financing for localized infrastructure, local water providers need to have a governing board that meets these three criteria: The board (1) is empowered to set rates, (2) can set those rates at levels to cover the cost of the specific programs to be financed, and (3) can commit to setting rates in the future to pay for the cost of these programs. Virtually all public water providers in California are positioned to meet these criteria.
- **Water Markets:** Water markets allow willing buyers and sellers to shift the use of water through exchanges, one-time purchases, short-term leases, long-term leases, or permanent sale of water rights or contract quantities. Revenue could be generated from water markets by assessing a fee or per unit charge for each transfer, which could be used to implement management actions.
- **Risk Reduction Insurance:** Risk reduction insurance could be used to support funding of management actions to reduce risks from flooding. Implementation could involve the State partnering with private insurers and underwriters to effectively develop a State insurance program that would either replace or augment existing traditional flood insurance programs. The State would use a portion of the insurance premiums to implement risk-reduction management actions. The remaining revenue would support policy holders in the event of a flood (California Department of Water Resources 2017).
- **Watershed Assessment:** An assessment at a watershed or similar scale on water ratepayers, property owners, and other beneficiaries could be used to fund water management actions within the assessment area.

- **Water Surcharge Fee:** A water use surcharge on retail water sales could be used to generate revenue for water projects. The fee could support actions, including integrated water resource management. Revenue generated by a water use surcharge would require actions funded to demonstrate a nexus to the fee.

Funding Scenarios

Several funding scenarios were developed to evaluate the plausibility and trade-offs of different combinations of current funding mechanisms. Each scenario represents a different contribution of mechanisms to provide the additional funding called for in Chapter 3. These scenarios were compared with current funding trends, under the assumption that average annual local, State, and federal funding levels remain unchanged (Table 4-2). By comparing the scenarios with current trends, a common frame of reference is established to examine how benefits and impacts vary among the scenarios.

These scenarios are focused on State funding and, for the purposes of identifying trade-offs, do not consider variations in local or federal funding. Table 4-5 summarizes the funding level assumed for each mechanism under each scenario.

Table 4-5 Funding Mechanisms Utilized by Each Scenario

Funding Scenario	Assumed Funding Level by Mechanism: State General Fund	Assumed Funding Level by Mechanism: General Obligation Bonds
Scenario A – Emphasis on General Obligation Bonds	Average Historical	Significant Increase
Scenario B – Emphasis on State General Fund	Significant Increase	Average Historical
Scenario C – Increase in Both General Obligation Bonds and State General Fund	Significant Increase	Maximum Historical

Scenario A: Emphasis on General Obligation Bonds – This scenario depicts the debt, and interest on the debt, throughout the 50-year planning horizon, accompanied by increased borrowing. State general funding remains at the historical average level. State G.O. bonds increase to pay for Update 2018's recommended actions. Local funding and federal funding remain at historical annual averages.

Scenario B: Emphasis on State General Fund – This scenario explores increasing appropriations from the State General Fund without additional borrowing. State general funding increases to implement the recommended actions. State G.O. bonds remain at the historical average level. Local funding and federal funding remain at historical annual averages.

Scenario C: Increase in Both General Obligation Bonds and State General Fund – This scenario uses G.O. bonds at maximum historical levels and increases State general funding as needed to fund the recommended actions. Local funding and federal funding remain at historical annual averages.

Funding Scenario Findings

There are many complexities, considerations, and uncertainties in determining appropriate, feasible, equitable, and cost-effective mechanisms to fund Update 2018 implementation. The funding scenario metrics and findings described in this section provide a common basis for evaluating trade-offs among the different scenarios. For every scenario, total annual local and federal funding is assumed to remain at current levels of approximately $28 billion and $800 million, respectively.

Scenario A: Emphasis on General Obligation Bonds – Historical average funding from State G.O. bonds would need to be more than doubled to fully fund Update 2018's recommended actions. Relative to current trends, this would significantly increase interest accrued on debt, for a total of more than $64 billion in interest over the 50-year planning horizon. Because G.O. bonds are intermittent and unpredictable, they are not appropriate for funding ongoing activities. Moreover, borrowing to pay for ongoing State activities is inconsistent with several shared funding tenets, including good stewardship of State government monies, recognition of the cost of borrowing, and the risks of indebtedness.

Scenario B: Emphasis on State General Fund – This scenario would require a considerable increase (more than eight times the historical average) in State General Fund appropriations to fund the recommended actions. State General Fund appropriations have a lower inter-annual reliability because they must compete with other State services for funding. Because it is highly unlikely the State would increase State General Fund appropriations by more than eight times, this scenario is inconsistent with the shared funding tenet that calls for reasonable assumptions about future revenues.

Scenario C: Increase in Both General Obligation Bonds and State General Fund – This would require an increase of more than five times the historical average of State General Fund appropriations, while sustaining the historical maximum funding from G.O. bonds, to fund the recommended actions. There are several shared funding tenets that would be integral to the authorization and administration of such a large increase in State General Fund appropriations. They include no redirection of G.O. bond or other existing mechanisms, nor do they include assurances regarding value, cost effectiveness, and efficiency.

A Shared Vision for California's Water Future

The State investment called for in Update 2018 will lead directly to public benefits and leverage local investment. Funding invested in Update 2018 actions would result in:

- Clearly articulated intended outcomes of investments and policies.
- Increased infrastructure and ecosystem integrity and resiliency.
- More accurate, comprehensive information to estimate the full cost of implementing all recommended actions over 50 years.
- Increased likelihood that investments will produce intended outcomes.
- Greater efficiency and capacity in the administration of programs.
- More accountability for expenditures of public monies.

Update 2018 envisions a future where all Californians benefit from reduced flood risk, more reliable water supplies, reduced groundwater depletion, and greater habitat and species resiliency. It recommends actions to help align decision-making processes, track outcomes, and adaptively manage programs and investments to make the state's water resource systems more resilient and achieve the sustainability goals.

Chapter 5. References

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Supporting Documents

California Water Plan Update 2018 (Update 2018) draws from, and builds on, reference documents related to water resources to enhance the content and produce a better plan with each succeeding update. These documents provide the methodology, assumptions, data, estimates, and other information used in the development of Update 2018. The chapter or chapters each document helped to inform are included in the document's description; if the document has "global" or "general" applicability, that is stated.

Note: Some of the following documents contain the views of their authors and do not necessary reflect the views of the California Department of Water Resources.

2018 California Tribal Water Summit Proceedings

The summit proceedings provide a summary of the summit speakers, panels, and discussions that occurred during the two-day summit in April 2018. *Chapters 2, 3*

California Must Enhance Groundwater Recharge and Storage

This summary describes the University of California Agriculture and Natural Resources' and the California Economic Summit's proposed actions to increase implementation of groundwater recharge projects in California. The information was compiled during a stakeholder meeting in September 2018. *Chapters 2, 3*

California Water Action Plan Implementation Report: 2014–2018 Summary of Accomplishments

The implementation report highlights the accomplishments during the implementation of the *California Water Action Plan* from 2014 to 2018. *Global*

California Water Plan Glossary

The glossary contains terms used in the text of Update 2018 and additional terms related to water resources. *Global*

Contributors to California Water Plan Update 2018

Developing the water plan requires the knowledge, work, expertise, research, and technical advice of scores of individuals and groups – governmental, private, and nonprofit – representing multiple disciplines and many State agencies; federal, Tribal, regional, and local interests; and environmental, agricultural, and urban stakeholders. This list acknowledges their work in the preparation of Update 2018. *General*

Corporate Water Stewardship and the Case for Green Infrastructure

This report presents how private sector investment in green infrastructure can reduce water-related risks and provide multiple co-benefits while helping companies achieve water-stewardship goals. *Chapter 4*

Disadvantaged Communities Visioning Workshop Recommendations

This report presents recommendations that support a more effective, equitable, and accessible roadmap to meeting the water needs of disadvantaged communities. *Chapters 2, 3*

Ecosystem Services and California's Working Landscapes: Market Mechanisms to Revitalize Rural Economies

This report explores current and potential markets for water provision, agricultural production, climate stability, outdoor recreation, and biodiversity to identify ways of mapping, valuing, and investing in ecosystem services to help protect California's natural capital and narrow the economic divide between its urban and rural regions. *Chapters 3, 4*

Engaging the Business Community on Watershed Sustainability Assessments: Opportunities, Challenges, and Recommendations

Engagement between the public and private sectors can be a powerful tool for assessing, addressing, and reducing shared water risks. This report provides an overview of opportunities, challenges, and recommendations for achieving this engagement. *Chapter 4*

Flood-MAR: Using Flood Water for Managed Aquifer Recharge to Support Sustainable Water Resources

This white paper explores opportunities to use flood-managed aquifer recharge (Flood-MAR). It demonstrates the need for Flood-MAR to become an important part of California's portfolio of water resource management strategies to help significantly improve water resource sustainability and climate resiliency throughout the state. *Chapters 2, 3*

Funding Mechanism Inventory and Evaluation

This document provides a description of the current and novel funding mechanisms, as well as assumptions used in the funding analysis in Update 2018. *Chapter 4*

Funding Scenario Analysis

This document provides a description of the funding analysis as well as the scenarios evaluated by the funding analysis in Update 2018. *Chapter 4*

Future Water Scenarios

This document covers future water supply and demand scenarios developed by the California Water Plan to analyze long-term future climate, urban growth, and land use conditions and their effect on long-term water demand conditions. *Chapter 2*

Historical Expenditures and Current and Future Funding Needs

This document provides a description of California's water resources management historical expenditures and the current and future funding needs in the state.

Chapters 1, 4

Integrated Regional Water Management Panel Discussion Summaries: California Water Plan Update 2018: 2017 and 2018 Plenary Meetings

A compendium of panel discussions and session activities, this report provides a summary of the integrated water management sessions DWR hosted in conjunction with the Integrated Regional Water Management (IRWM) Roundtable of Regions, during the Water Plan plenary meetings in support of Update 2018. *Chapter 3*

Process Guide for Update 2018

This article summarizes the elements of the Update 2018 development process, while highlighting the organizational structure and methods used to facilitate a robust, iterative collaboration among agencies, California Native American Tribes, stakeholders, and the technical team. *Global*

Progress Report for Implementation of Assembly Bill 1755, the Open and Transparent Water Data Act

This report includes the background, accomplishments, and next steps for implementing A.B. 1755. It describes the strategic plan, initial protocols, use case development, long-term governance and funding options, the implementation planning by eight partner State agencies, and stakeholder engagement. *Chapter 3*

Recharge Roundtable Call to Action: Key Steps for Replenishing California Groundwater

This report summarizes results of a Groundwater Resources Association of California and the University of California Water Security and Sustainability Research Initiative workshop to identify key actions needed to significantly increase recharge to California groundwater systems. *Chapters 2, 3*

Report on the Water Sustainability Atlas Pilot Project with Recommendations

This report provides the accomplishments and recommendations for full-scale implementation on the prototype Sustainability Atlas successfully used in three pilot projects for the American River Basin IRWM region, the San Diego IRWM region, and the Mojave IRWM region. *Chapter 3*

Stakeholder Perspectives: Recommendations for Sustaining and Strengthening Integrated Regional Water Management

This report provides stakeholder recommendations on actions needed to sustain and strengthen the practice of IRWM with the goal of achieving regional sustainability. *Chapter 3*

State Board of Food and Agriculture Letter to Governor Brown – Recommendations for Groundwater Managed Recharge

This letter delivers the recommendations related to groundwater recharge from the board to the governor in support of achieving the goals of the Sustainable Groundwater Management Act (SGMA) and the *California Water Action Plan*. *Chapters 2, 3*

Strategic Data Framework

The Strategic Data Framework aims to connect the California Department of Water Resources programs to support achieving the sustainable water management goals of the Water Plan, the *California Water Action Plan*, and SGMA. *General*

The Sustainability Outlook: A Summary

The Sustainability Outlook establishes a comprehensive method, or tool, for tracking and reporting the progress and the effectiveness of implementing water management actions and policies, as well as return on investment. By doing so, the Sustainability Outlook provides shared agreement and consistency across State government and local governments throughout California. *Chapters 2, 3*

Sustainability Outlook Indicator Descriptions and Methodology

The Sustainability Outlook relies on identified indicators to track status and progress toward sustainability, including the effectiveness of State water policies and return on investments. This document details the process for developing the indicators as defined within the California Water Plan (Water Plan).

Note: There are many approaches to identifying sustainability indicators. Sustainability indicators provided in the Water Plan inform users about the relationship of water system conditions to ecosystems, social systems, and economic systems. Water managers and users should not confuse Water Plan sustainability indicators with those defined under the SGMA Groundwater Sustainability Plan regulations. Sustainability indicators under SGMA refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in California Water Code Section 10021. *Chapters 2, 3*

Sustainability Outlook Pilot Project: Russian River Watershed

The Russian River watershed was selected as a pilot area because of established relationships in the watershed. In addition, the innovative and participatory local entities involved have fewer distinctive jurisdictions or agencies, compared with other watersheds in the state. As planned, this pilot is applying the outcome-based planning concepts advanced by Update 2018 at a watershed scale. *Chapters 2, 3*

Sustainability Outlook Pilot Project: Santa Ana River Watershed

The Santa Ana River watershed was selected as a pilot area because of established relationships in the watershed, as well as the innovative sustainability planning of the One Water One Watershed plans coordinated by the Santa Ana Watershed Project Authority. The *One Water One Watershed 2.0 Plan* (2014) created an indicators-based tool for assessing integrated regional water management plan performance, based on earlier California Department of Water Resources grant-supported work at the Council for Watershed Health, and *California Water Plan Update 2013* work at the University of California, Davis. This pilot draws from the earlier work and the experience in the region with application of the Water Foundation's Sustainability Water Management Profile.

Chapters 2, 3

Water Budget Development Practitioner's Handbook

The Water Budget Handbook will provide a tool that uses data and models to develop water budgets for any geographic area and time period. This will allow local agencies to develop their own water budgets. *General*

Water Budget Pilot Projects

As proof of concept for the Water Budget Handbook, pilot projects for the Tulare Lake and Central Coast hydrologic regions demonstrate the value of water budgets to achieve and manage water resources sustainability. *General*

Water Portfolios and Balances

Water portfolios and balances describe the distribution of water throughout the hydrologic cycle, water use by the urban and agricultural sectors, water in the environment, and water supply sources used to meet these uses at the statewide and regional levels. *Chapter 1*

Featured Companion State Plans

These State government plans, related to water resources, were used to inform policy recommendations and recommended actions in *California Water Plan Update 2018*.

2015 Statewide Comprehensive Outdoor Recreation Plan (California Department of Parks and Recreation) (2015)

2016–19 Strategic Action Plan (Sierra Nevada Conservancy) (2015)

2017–2022 Delta Conservancy Strategic Plan (Sacramento-San Joaquin Delta Conservancy Board) (2017)

2018 Energy Policy Report Update (California Energy Commission) (2018)

2018 State Hazard Mitigation Plan (Governor's Office of Emergency Services) (Public Review Draft, 2018)

2018 Strategic Fire Plan for California (California Department of Forestry and Fire Protection) (2018)

Bulletin 118 – Interim Update 2016 (California Department of Water Resources) (2016)

California 2030 Natural and Working Lands Climate Change Implementation Plan (January 2019 Draft) (California Environmental Protection Agency, California Natural Resources Agency, California Department of Food and Agriculture, California Air Resources Board, California Strategic Growth Council)

California Agricultural Vision Update (California Department of Food and Agriculture, State Board of Food and Agriculture) (2017)

California Biodiversity Initiative: A Roadmap for Protecting the State's Natural Heritage (California Natural Resources Agency, California Department of Food and Agriculture, Governor's Office of Planning and Research) (2018)

California Drought of 2012–2016 (California Department of Water Resources) (in preparation)

California EcoRestore (California Natural Resources Agency)

California Native American Tribal Engagement in the California Water Plan Update 2013 – Tribal Engagement Plan (California Water Plan, Tribal Communication Committee) (2010)

California Ocean Protection Council Five-Year Strategic Plan 2012–2017 (California Ocean Protection Council)

California State Wildlife Action Plan (California Department of Fish and Wildlife) (2015)

California Strategic Growth Council Strategic Plan 2012–2014 (Strategic Growth Council) (2012)

California Transportation Plan 2040 (California Department of Transportation) (2016)

California Water Action Plan (California Natural Resources Agency, California Department of Food and Agriculture, California Environmental Protection Agency) (2016)

California Water Commission Strategic Plan 2012 (California Water Commission) (2012)

California's 2017 Climate Change Scoping Plan Update (California Air Resources Board) (2017)

California's Forests and Rangelands: 2010 Strategy Report (California Department of Forestry and Fire Protection) (2010)

California's Forests and Rangelands: 2017 Assessment (California Department of Forestry and Fire Protection) (2017)

Central Valley Flood Protection Plan 2017 Update (California Department of Water Resources) (2017)

The Delta Plan (Delta Stewardship Council) (2017)

Department of Toxic Substances Control 2014–2018 Strategic Plan (California Department of Toxic Substances Control) (2014)

Division of Safety of Dams: Strategic Plan (California Department of Water Resources) (2018)

Environmental Goals and Policy Report (Governor's Office of Planning and Research) (Draft, 2015)

General Plan Guidelines (Governor's Office of Planning and Research) (2017)

Investing in California's Flood Future (California Department of Water Resources) (in preparation)

Making Water Conservation a California Way of Life: Implementing Executive Order B-37-16 (California Department of Water Resources, California State Water Resources Control Board, California Public Utilities Commission, California Department of Food and Agriculture, California Energy Commission) (2017)

Making Water Conservation a California Way of Life: Primer of 2018 Legislation on Water Conservation and Drought Planning Senate Bill 606 (Hertzberg) **and Assembly Bill 1668** (Friedman) (California Department of Water Resources, California State Water Resources Control Board) (2018)

Recycled Water Policy (State Water Resources Control Board) (2013)

Regional Water Quality Control Plans (Basin Plans) (State Water Resources Control Board) (various)

Rising Seas in California: An Update on Sea-Level Science (California Ocean Protection Council) (2017)

Safe Drinking Water Plan for California (State Water Resources Control Board) (2015)

Safeguarding California: Implementation Action Plans (California Natural Resources Agency) (2016)

Safeguarding California Plan: 2018 Update — California's Climate Adaptation Strategy (California Natural Resources Agency) (2018)

San Francisco Bay/Sacramento — San Joaquin Delta Estuary Water Quality Control Plan (State Water Resources Control Board) (in preparation)

Stakeholder Perspectives — Recommendations for Sustaining and Strengthening IRWM (California Department of Water Resources) (2017)

State Coastal Conservancy Strategic Plan 2018–2022 (California State Coastal Conservancy) (2017)

State of California Emergency Plan (Governor's Office of Emergency Services) (2017)

Stormwater Targets for Groundwater Recharge and Direct Use in Urban California (California Department of Water Resources) (2019)

Strategic Plan for A.B. 1755, the Open and Transparent Water Data Act (California Department of Water Resources, State Water Resources Control Board, California Department of Fish and Wildlife, Water Quality Monitoring Council, Governor's Office of Planning and Research, California Government Operations Agency, Delta Stewardship Council, California Natural Resources Agency) (2018)

Strategic Plan Update 2008–2012 (State Water Resources Control Board) (2008)

Strategy to Optimize Resource Management of Storm Water (State Water Resources Control Board) (2016)

Threat, Hazard Identification and Risk Assessment 2018 (Governor's Office of Emergency Services) (2018)

Vision 2030 Strategic Plan (Delta Protection Commission) (2015)

Water Action Plan (California Public Utilities Commission) (2010)

Useful Web Links

The items listed here appear in red font within the Executive Summary and Chapters 1–4 of *California Water Plan Update 2018*, where they are linked to their respective documents or webpages.

California Biodiversity Initiative: A Roadmap for Protecting the State's Natural Heritage
http://opr.ca.gov/docs/20180907-CaliforniaBiodiversityActionPlan.pdf

California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018
https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB5

California EcoRestore
http://resources.ca.gov/ecorestore/

California's Groundwater Update 2013
https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/Water-Basics/GroundWater/Files/Resources-And-Reports/Californias--Groundwater-Update-2013.pdf

California Water Action Plan 2016 Update
http://resources.ca.gov/docs/california_water_action_plan/Final_California_Water_Action_Plan.pdf

California Water Action Plan Implementation Report: 2014–2018 Summary of Accomplishments
http://resources.ca.gov/wp-content/uploads/2019/01/CWAP_Implementation_Report_Finalpdf.pdf

California Water Plan Update 2013
https://www.water.ca.gov/Programs/California-Water-Plan/Water-Plan-Updates

California Water Plan Update 2018
https://tinyurl.com/y3c6lwm9

California Water Plan Update 2018 (digitally accessible version)
https://tinyurl.com/y2q94r5w

California Water Plan Update 2018 Webpage
https://water.ca.gov/Programs/California-Water-Plan/Update-2018

California Water Plan Water Portfolios
https://www.water.ca.gov/Programs/California-Water-Plan/Water-Portfolios

Central Valley Flood Protection Plan
https://water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan

Central Valley Flood Protection Plan 2017 Update
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan/Files/2017-Central-Valley-Flood-Protection-Plan-Update.pdf

The Delta Plan
http://www.deltacouncil.ca.gov/delta-plan-0

The Delta Reform Act
http://www.deltacouncil.ca.gov/sites/default/files/documents/files/dsc_legislative_booklet_0.pdf

Featured Companion State Plans
https://water.ca.gov/Programs/California-Water-Plan/Update-2018

Flood-Managed Aquifer Recharge (Flood-MAR)
https://www.water.ca.gov/Programs/All-Programs/Flood-MAR

Four-Point Plan to Bolster Dam Safety and Flood Protection (fact sheet)
https://www.ca.gov/archive/gov39/2017/02/24/news19696/index.html

Funding Mechanism Inventory and Evaluation
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2018/Final/SupportingDocs/Funding-Mechanism-Inventory-and-Evaluation.pdf

Healthy Soils Program
https://www.cdfa.ca.gov/oefi/healthysoils/

Indicators of Climate Change in California
https://oehha.ca.gov/climate-change/report/2018-report-indicators-climate-change-california

One Water One Watershed Plan 2.0
https://sawpa.org/owow/owow-irwm-plans/owow-2-0-plan/

Regional Conservation Investment Strategies Program
https://www.wildlife.ca.gov/conservation/planning/regional-conservation

Resource Management Strategies (California Water Plan)
https://water.ca.gov/Programs/California-Water-Plan/Water-Resource-Management-Strategies

Safeguarding California Plan: 2018 Update
http://resources.ca.gov/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

Salton Sea Management Program
http://resources.ca.gov/salton-sea/

Salton Sea Management Program Phase I: 10-Year Plan
http://resources.ca.gov/salton-sea/salton-sea-management-program/

State Plan of Flood Control
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan/Files/SPFC-MapBook-Report-201708.pdf

The Sustainability Outlook: A Summary
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2018/Final/SupportingDocs/The-Sustainability-Outlook-A-Summary.pdf

Sustainable Groundwater Management Act (SGMA) of 2014
https://www.water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management

Update 2018 Supporting Documents
https://water.ca.gov/Programs/California-Water-Plan/Update-2018

Water Portfolios and Balances
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2018/Final/SupportingDocs/Water-Portfolios-and-Balances.pdf

Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary
https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/docs/2006_plan_final.pdf

Water Quality, Supply, and Infrastructure Improvement Act of 2014
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1471

Water resilience portfolio
http://resources.ca.gov/initiatives/water-resilience/

Water Supply & Balance Data Interface tool
https://water.ca.gov/Programs/California-Water-Plan/Water-Portfolios

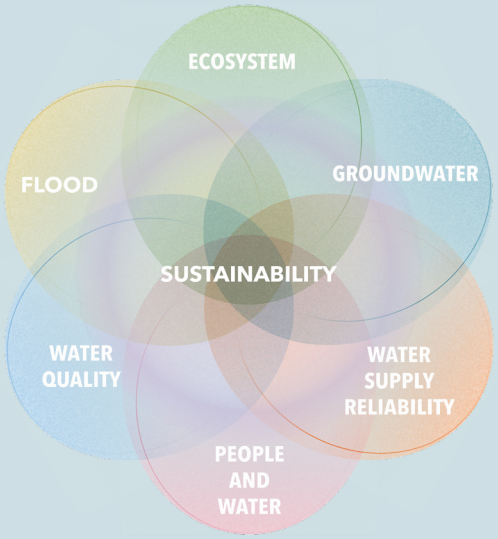
Water Year Hydrologic Classification Indices
http://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST

Guide to Update 2018 Webpage

California Water Plan Update 2018 is available on the Update 2018 webpage – the plan, its supporting documents, and supplementary resources.

- **Factsheet**
- **News Release**
- **Executive Summary**
- **Update 2013 Regional Reports**
- **Resource Management Strategies**
- **Update 2018 Technical Guide**

  Includes and updates information from the draft *Assumptions & Estimates Report* and summarizes California Water Code requirements.



Managing water resources for sustainability requires alignment and integration among water sectors.

+ Supporting Documents

Documents providing methodology, assumptions, data, estimates, and other information used in the development of this update.

+ Featured Companion State Plans

State government plans used to inform and align policy recommendations.

+ Public Review Draft and Comments

Draft of Update 2018 issued in December 2018 for public comment, per California Water Code requirements, plus all public comments received on the draft and DWR's responses to them.

The final draft of Update 2018 is available here: https://tinyurl.com/y3c6lwm9

Water Plan eNews: Subscribe to receive news and updates on upcoming events and document releases. Send questions or comments regarding Update 2018 to cwpcom@water.ca.gov.

Update 2018 is available in a digitally accessible version here: https://tinyurl.com/y2q94r5w. Supporting documents not yet available in accessible form are undergoing remediation and will soon be available on the webpage. To obtain Update 2018 or supporting documents in another alternate form, contact the Public Affairs Office, Graphic Services Branch, at (916) 653-1074.

California Water Plan Update 2018 envisions a future where all Californians benefit from reduced flood risk, more reliable water supplies, reduced groundwater depletion, and greater habitat and species resiliency. It recommends actions to help align decision-making processes, track outcomes and adaptively manage programs and investments to achieve the sustainability goals.

Gavin Newsom
Governor
State of California

Wade Crowfoot
Secretary for Natural Resources
Natural Resources Agency

Karla Nemeth
Director
Department of Water Resources