



# CALIFORNIA WATER PLAN

# 2023

**UPDATE**

## Welcome to California Water Plan Update 2023!

*In the spirit of previous Water Plan updates, Update 2023 continues to broaden the community of interest that has fulfilled an integral role in developing and evolving the plan over decades. Reaching the hearts and minds of as many Californians as possible is key to the success of the Water Plan's vision and its recommendations; only by working together to meet current and future challenges will we achieve the sustainability and resilience vital for our water systems, natural and human-made. Further, Update 2023 considers diversity in California's economy, ecosystems, cultures, and ideas not only a strength but essential to collaboratively meeting those challenges. Update 2023 is written in clear, concise, and straightforward terms, with awareness of and respect for the histories of the state's diverse peoples who call California lands and waters home. As we continue to learn and act collaboratively, the equitable sharing of our knowledge, effort, and resources will ensure a prosperous future for all Californians.*

The development of [California Water Plan Update 2023](#) was informed by documents that provide methodology, assumptions, data, estimates, and other information. These supporting documents are listed among the back pages of this plan. The description and the full document can be found on the [Update 2023 webpage](#).

Titles and terms in **purple** correspond to links in the **Useful Web Links** section in the back matter of the plan. Key terms in Update 2023, appearing in **brown**, are listed in the front matter. The full *California Water Plan Glossary* is available as a supporting document.

# CALIFORNIA WATER PLAN

**UPDATE 2023**

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December 2023

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## California Water Plan Update 2023 Acknowledgments

The long lists of individuals show the magnitude of resources required to develop the California Water Plan. These individuals come from the Department of Water Resources and other State departments and agencies; federal, regional, and local agencies; California Tribes; private and public entities; and from universities and think tanks. We have drawn on many of California's best and brightest for technical, strategic, and policy insight.

The Water Plan team is grateful to the many who contributed to development of the plan by reviewing, commenting, and providing content for incorporation into Update 2023.

For a complete list of those who contributed to California Water Plan Update 2023, see *Contributors to California Water Plan Update 2023* on the Update 2023 webpage.

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The development of the California Water Plan could not take place without the expertise and knowledge of dozens of individuals that make up the different Project Work Teams. The full list of members will be available on the Contributors to California Water Plan Update 2023 on the Update 2023 webpage.

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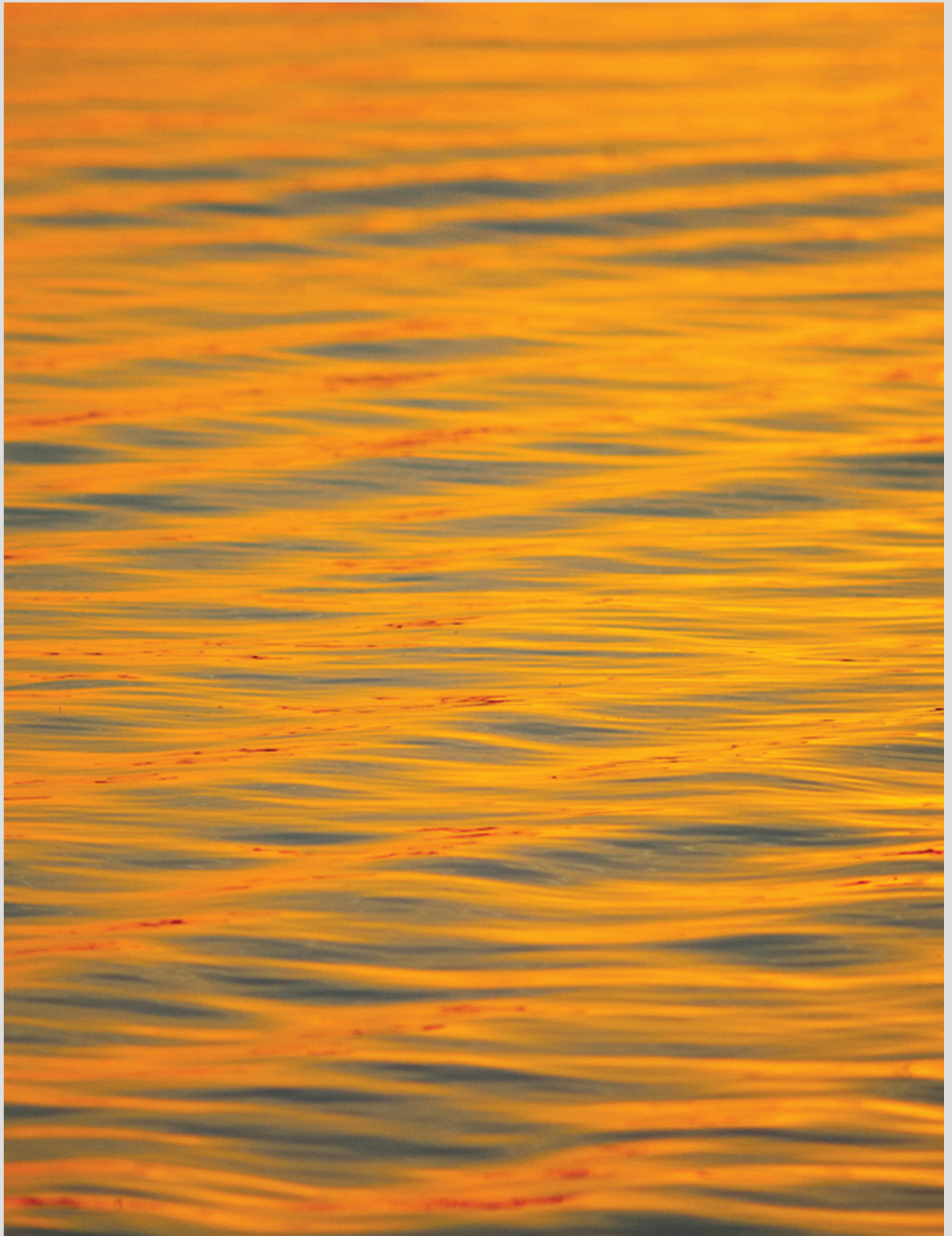
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## Acronyms and Abbreviations

|            |  |
|------------|--|
| AB         | Assembly Bill  |
| AR Program | Atmospheric Rivers Research, Mitigation, and Climate Forecasting Program |
| BCR        | benefit-to-cost ratio  |
| CAL FIRE   | California Department of Forestry and Fire Protection                    |
| CAP        | Climate Action Plan  |
| CARE       | Collective Benefit, Authority to Control, Responsibility, and Ethics     |
| CCC        | California Coastal Commission  |
| CCORE      | Capitol Collaborative on Race and Equity                                 |
| CDFW       | California Department of Fish and Wildlife                               |
| CEQA       | California Environmental Quality Act                                     |
| CNRA       | California Natural Resources Agency                                      |
| CVFPP      | Central Valley Flood Protection Plan                                     |
| DAC        | disadvantaged community  |
| DOC        | California Department of Conservation                                    |
| DWR        | California Department of Water Resources                                 |
| EO         | executive order  |
| FAIR       | Findability, Accessibility, Interoperability, and Reusability            |
| FEMA       | Federal Emergency Management Agency                                      |
| FIRO       | forecast-informed reservoir operations                                   |
| Flood-MAR  | flood-managed aquifer recharge   |
| FRWR       | federally reserved water rights  |
| GHG        | greenhouse gas   |
| GIS        | geographic information systems   |
| GSA        | groundwater sustainability agency  |
| GSP        | groundwater sustainability plan  |

|                          |  |
|--------------------------|--|
| HREA                     | Habitat Restoration and Enhancement Act  |
| ICARP                    | Integrated Climate Adaptation and Resiliency Program   |
| IRWM                     | integrated regional water management   |
| OPR                      | Governor’s Office of Planning and Research   |
| Portfolio                | Water Resilience Portfolio   |
| Racial Equity Resolution | State Water Board Resolution No. 2021-0050, “Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access, and Anti-Racism |
| RWMG                     | regional water management group  |
| SB                       | Senate Bill  |
| SGMA                     | Sustainable Groundwater Management Act   |
| State                    | Capitalized, refers to State government  |
| State Water Board        | State Water Resources Control Board  |
| Strategy                 | Water Supply Strategy: Adapting to a Hotter, Drier Future  |
| taf                      | thousand acre-feet   |
| TEK                      | Tribal Ecological Knowledge  |
| Tribes                   | California Tribes  |
| TWS                      | Tribal Water Summit  |
| Update 2018              | California Water Plan Update 2018  |
| Update 2023              | California Water Plan Update 2023  |
| USACE                    | U.S. Army Corps of Engineers   |
| Water Plan               | California Water Plan  |
| WEAP                     | Water Evaluation and Planning  |

## Key Terms

**acre-foot (af):** The volume of water that would cover 1 acre to a depth of 1 foot; equal to 43,560 cubic feet or 325,851 gallons. An acre-foot of water is considered enough water to meet the needs of two families of four for one year.

**adaptation (measures/strategies):** Adjustments to natural and human systems to moderate harm or to exploit beneficial opportunities in response to actual or expected effects of climate change.

**atmospheric river:** A weather pattern that forms a narrow corridor of concentrated moisture in the atmosphere that drops significant rain and snow as it passes over land.

**built backbone infrastructure:** Human-constructed infrastructure that provides water management benefits to communities, ecosystems, and economies across watershed boundaries. The California Aqueduct, Oroville Dam, and the Los Angeles Aqueduct are examples of built backbone infrastructure.

**California Tribes:** As stated in Executive Order (EO) B-10-11 and affirmed in EO N-15-19, "Tribe," "California Indian Tribe," and "Tribal" include all federally recognized Tribes and other California Native Americans.

**climate change:** Changes in long-term average temperature, precipitation, wind, or other variables in a specific region.

**climatic water deficit:** A value that represents evaporative demand that exceeds available surface water supplies.

**data sovereignty:** A Native American Tribe's right to "govern the collection, ownership, and application of data" regarding the Tribe, Tribal members, or information kept by the Tribe (Rainie 2017).

**environmental equity/justice:** Equal protection from environmental hazards for individuals, groups, or communities regardless of race, ethnicity, or economic status. The fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Government Code Section 65040.12[e]).

**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.

**floodplain:** The extent of the flood hazard for a 100-year (1 percent chance of exceedance in a given year) or 500-year (0.2 percent chance of exceedance in a given year) event, as determined by the Central Valley Flood Protection Plan, Federal Emergency Management Agency, or U.S. Army Corps of Engineers.

**frontline communities:** Communities that experience the “first and worst” of environmental consequences. In other words, frontline communities are already living with the negative impacts of inequities in water management and thus are most susceptible to future negative changes. Residents are more exposed to existing water sector vulnerabilities (e.g., water shortages, water quality issues, or affordability challenges) and future ones, such as the impacts of climate change.

**future scenarios:** Probable realizations of conditions that may occur in coming years. Future scenarios are typically built to examine the effects of specific stressors, such as climate change, on a system to understand the impacts of those stressors on system performance.

**future scenarios analysis:** An analytical approach to identifying future water vulnerabilities in specific water sectors (e.g., surface water, groundwater, water supply, flood risk) based on a suite of metrics developed by comparing average conditions likely to occur in a future year to average conditions of a recent past year.

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

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

**natural backbone infrastructure:** Natural watershed lands and processes that provide, collect, clean, store, and convey water across watersheds or within large hydrologic regions. The Feather River watershed above Lake Oroville, the Sacramento – San Joaquin Delta, and the Colorado River basin are examples of natural backbone infrastructure.

**racial equity:** A process of eliminating racial disparities and improving outcomes for everyone. It is the intentional and continual practice of changing policies, practices, systems, and structures by prioritizing measurable change in the lives of people of color.

**redlining:** A practice by which federal and local governments and financing entities systematically denied public and private financial services to Black and other people of color. This set of practices included race and environmental factors as criteria when assessing the perceived credit-worthiness of neighborhoods and led to many of the environmental disparities affecting communities of color across California today.

**resilience:** The capacity of any resource or entity – including an individual, a community, an organization, or a natural or constructed system – to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience.

**Rights of Nature:** A global movement to protect nature (rivers, mountains, and entire ecosystems and the life forms supported within them) by recognizing its legal rights. Just as humans and corporations are considered to “have rights,” this legal strategy grants rights to nature itself.



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

**Tribal Ecological Knowledge (TEK):** California Tribes’ traditional practices for land stewardship consider the need for sustainability and regeneration for future generations. As with many other first peoples, these traditional practices and knowledge have been maintained and passed down through generations and make up the basis of what is termed Traditional (or Tribal) Ecological Knowledge. TEK is also often referred to as Tribal Knowledge and/or Tribal Science.

**water balances:** Analyses of the total developed and dedicated supplies, uses, and operational characteristics for a region; the analyses show what water was applied to uses so that use equals supply.

**water budget:** An accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored (California Water Code Section 10721[y]).

**water equity:** The condition of all Californians having access to safe, clean, and affordable water fit for human consumption; being resilient in the face of climate extremes and their effects; and being active participants in the collaborative management of water resources for the benefit of human and natural systems.

**watershed:** A land area from which water drains into a stream, river, or reservoir. A watershed includes all natural and artificial (human-made) features, including its surface and subsurface features, climate and weather patterns, geologic and topographic history, soils and vegetation characteristics, and land use.

**watershed network:** A planned gathering of individuals and organizations focused on addressing one or more complex, shared challenges or opportunities, with the intention of collaboratively addressing each of its members’ concerns at a watershed scale while advancing shared interests.

**watershed resilience:** The capacity of any resource or entity – including an individual, a community, an organization, or a natural or constructed system – within or connected to a watershed to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience.

**weather whiplash:** Considered a consequence of climate change, swings from one extreme weather condition to an opposing extreme weather condition (e.g., an exceedingly wet year followed by an exceedingly dry year).

These terms are a subset of the full [Water Plan Glossary](#).



# Executive Summary

In the five-year period since the publication of *California Water Plan Update 2018 (Update 2018)*, climate change has put unprecedented stress on natural and human systems. During that time, Californians experienced increased wildfires, rising sea levels, and highly variable precipitation and runoff patterns that manifested as historic droughts and floods – all of which increased socio-economic uncertainty. Although climate change certainly is not the only water-related challenge disrupting natural and human systems, all water sectors are vulnerable to its interrelated impacts. Moreover, California’s frontline communities, those most vulnerable to climate-driven impacts, are anticipated to face them earlier and more severely.

***Frontline communities** are those that experience the “first and worst” of environmental consequences. In other words, frontline communities are already living with the negative impacts of inequities in water management and thus are most susceptible to future negative changes. Residents are more exposed to existing water sector vulnerabilities (e.g., water shortages, water quality issues, or affordability challenges) and future ones, such as the impacts of climate change.*

## Update 2023 Builds on Administrative and Legislative Water Initiatives

The California Water Plan (Water Plan), in tackling issues of concern such as climate change, naturally reflect the priorities of the administration and Legislature current when a given update is developed. *California Water Plan Update 2023 (Update 2023)* is no exception. It builds on existing water policies, laws and regulations, and initiatives and investments of the Newsom administration’s *Water Resilience Portfolio (Portfolio)*, *Water Supply Strategy (Strategy)*, and recent legislation. These State initiatives establish cornerstone policies and investments, targets and actions, at a time when significant systemic and institutional challenges are increasing risks to public safety, frontline communities, ecosystems, and the state’s economy. Update 2023 folds the Portfolio’s and the Strategy’s themes and actions

## Executive Summary

**Update 2023 Vision:** *All Californians benefit from water resources that are sustainable, resilient to climate change, and managed to achieve shared values and connections to our communities and the environment.*

into a durable, legislatively mandated planning and policy roadmap that spans legislative and executive political cycles.

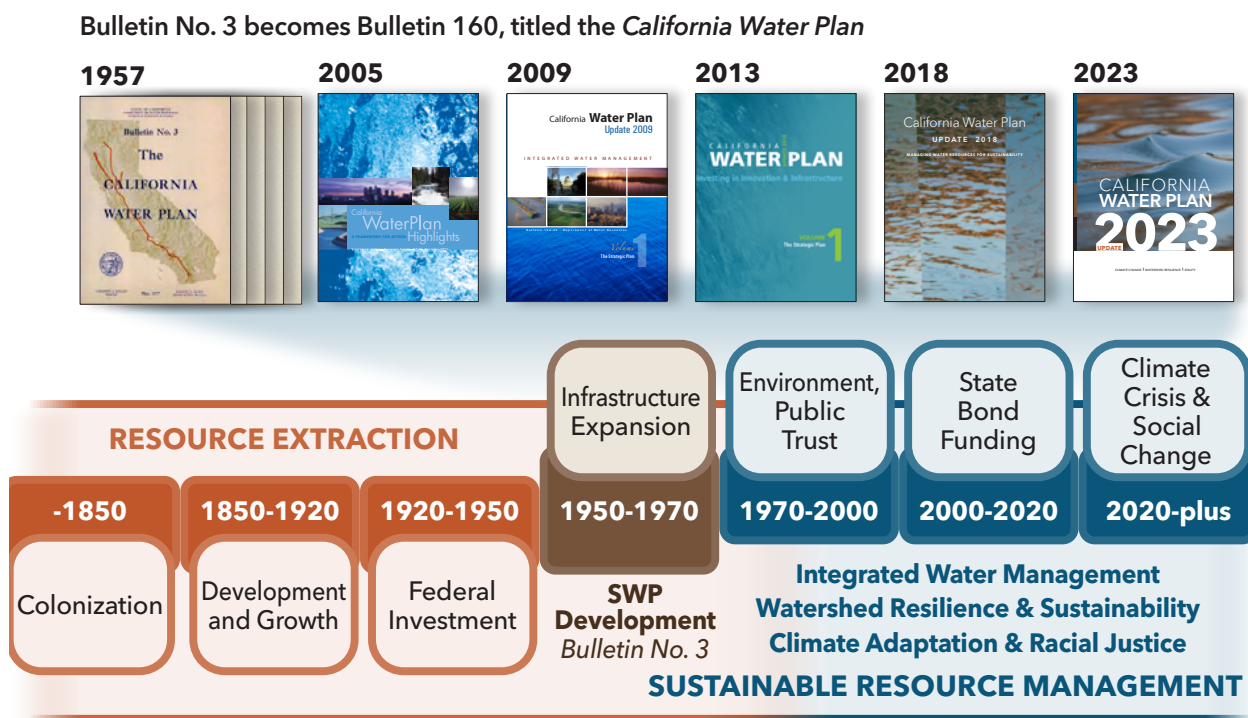
Updated every five years, the Water Plan is the State’s strategic plan for sustainably and equitably managing, developing, and stewarding water resources. Required by Water Code Section 10005, the plan presents the status and trends of California’s water-dependent natural resources; water supplies; and agricultural, urban, and environmental water demands for a range of plausible future scenarios.

Figure ES-1 illustrates the evolution of the plan over time, from the first “State Water Plan,” published in 1931 and outlining utilization of water resources on a statewide basis, to the present. The first modern Water Plan, published in 1957, emphasized the need for developing and conveying water supply, thereby promoting what became the State Water Project. By the turn of the century, the plan’s focus had evolved toward environmental protection; integrated watershed management; and the importance of inclusion, transparency, and sustainable resource management.

Now with climate change an urgent threat, Update 2023 is focusing on the innovation and investments in California’s watersheds, water systems, and communities needed for a resilient and equitable future.

Update 2023’s three intersecting and interdependent themes – Addressing Climate Urgency, Strengthening Watershed Resilience, and Achieving Equity – builds upon State administrative and legislative policies, priorities, and oversight necessary to create more equitable and climate-resilient water systems to benefit all Californians (see Chapter 1).

Figure ES-1 The California Water Plan Has Evolved to Meet California’s Needs and Challenges



**Addressing Climate Urgency:** Update 2023 focuses on understanding the challenges and bolstering the adaptive capacity of California’s water systems. Although California alone cannot stop the cascading consequences of global climate change, transitioning the state to net-zero carbon emissions will help stabilize rising temperatures globally and safeguard California residents and water resources. Water resource planning that expands on lessons learned and past successes is necessary to safeguard water supply and quality and food security; protect vulnerable populations from drought, flooding, and extreme heat; prepare for sea level rise; and protect and enhance critical natural and built infrastructure for water storage, treatment, distribution, reuse, and stormwater capture within and among regions and watersheds.

**Strengthening Watershed Resilience:** Watersheds throughout the state, including their associated aquifers and groundwater basins, provide water supply, flood management, ecosystem, hydropower, recreation, and other benefits to those within and connected to them. They allow California’s communities, economies, and ecosystems to thrive. These same watersheds are also at the forefront of the impacts of climate change, each experiencing effects of climate change unique to its geography, hydrology, socioeconomics, land use patterns, and built infrastructure. Because effective climate adaptation strategies will vary between watersheds, Update 2023 underscores the importance of incentivizing and

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supporting robust watershed-specific climate vulnerability analyses and adaptation plans, followed by investments in multi-sector collaborations and solutions at the watershed and regional scale. Complementing ongoing regulatory frameworks and programs, this expanded watershed-scale focus is intended to empower communities with the data, technical expertise, and financial resources to build water solutions resilient to climate change and other uncertainties that lie ahead.

**Achieving Equity:** The recent spotlight on social justice has accelerated overdue equity assessments in many public spheres of activity, including the water community. In 2012, California became the first state in the nation to recognize that every human being has the right to safe, clean, affordable, and accessible water (Human Right to Water, Assembly Bill 685). Then, with the passage of the Safe and Affordable Drinking Water Fund (Senate Bill 200, 2019), California deepened its commitment to resolving a crisis that affects more than 1 million people across the state. Since Update 2018, there have been many new State actions, including executive orders, legislation, and financial and technical assistance, designed to mitigate the impacts of droughts, floods, wildfires, and legacy impacts on frontline communities. (See Chapter 6 for equity-related challenges, including affordability, outreach and engagement, and representation and participation). Despite these remarkable efforts, climate change continues to exacerbate long-standing inequities in California water management.

**Resilience:** *The capacity of a resource, natural system, or constructed system to adapt to and recover from changed conditions after a disturbance.*

**Watershed:** *A watershed is the land area from which water drains into a stream, river, or reservoir. A watershed includes all natural and artificial (human-made) features, including its surface and subsurface features, climate and weather patterns, geologic and topographic history, soils and vegetation characteristics, and land use.*

**Built backbone infrastructure:** *Human-constructed infrastructure that provides water management benefits to communities, ecosystems, and economies across regional and watershed boundaries. The California Aqueduct, Oroville Dam, and Los Angeles Aqueduct are examples of built backbone infrastructure.*

**Natural backbone infrastructure:** *Watershed lands, aquifers, and processes that provide, collect, clean, store, and convey water within and among watersheds or hydrologic regions. The Feather River watershed above Lake Oroville, the Sacramento–San Joaquin Delta, the Colorado River basin, and the state’s 515 groundwater basins are examples of natural backbone infrastructure.*

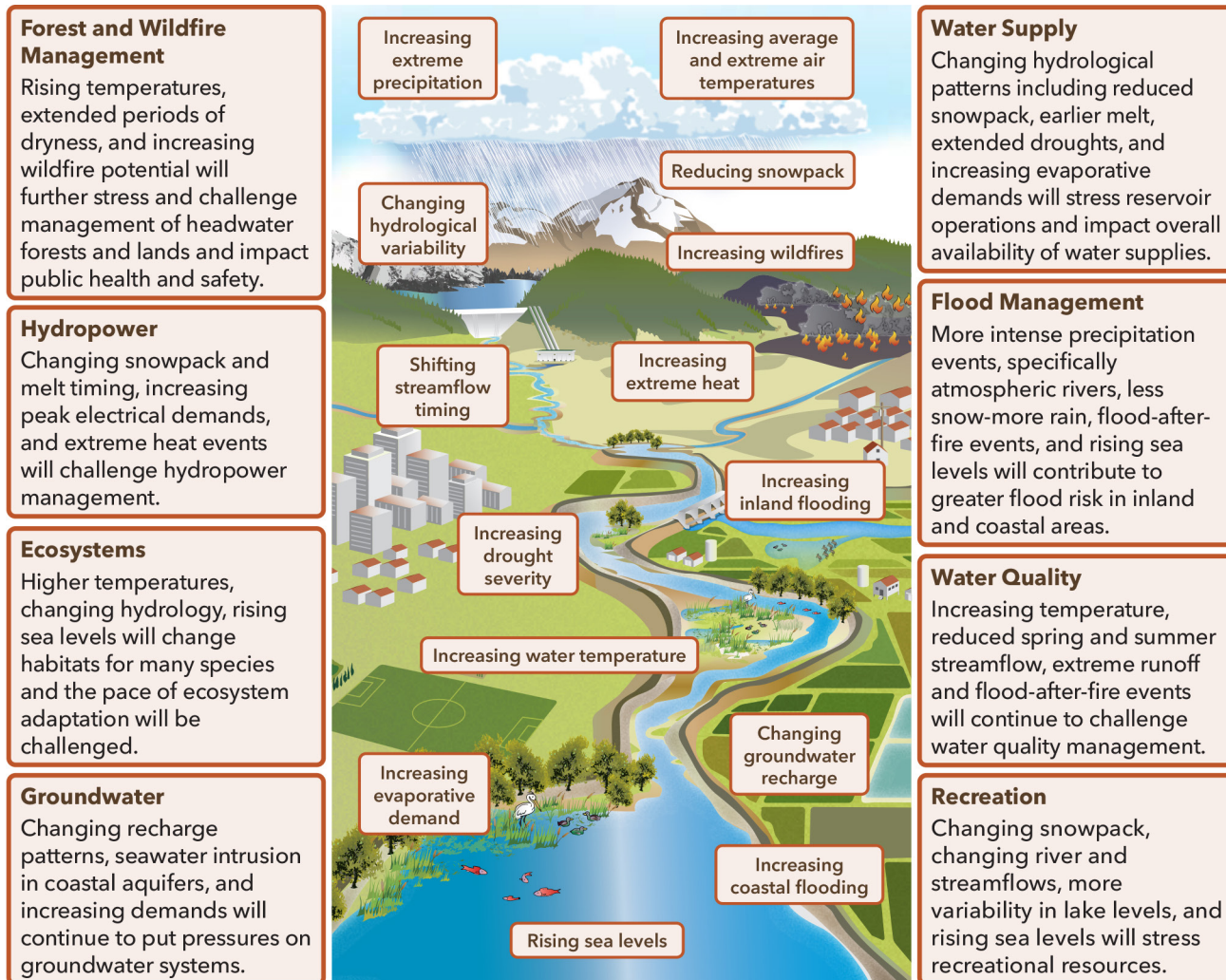
## California's Water Systems and Sectors are More Vulnerable Because of Climate Change

In recent years, drought conditions in California have been increasing in intensity and duration, punctuated by more intense atmospheric river-driven storms and higher flood flows (weather whiplash). Given recent and future anticipated variability and intensity in precipitation and temperature with climate change, it is expected that California's existing flood, water, and wastewater management and treatment systems will be unable to deliver adequate, much less the same level of, quality and service as in the past (see Chapter 2).

California's ability to adapt is not keeping pace with climate change impacts. As depicted in Figure ES-2, higher average and extreme temperatures, more frequent and intense precipitation events, and changing runoff patterns are causing cascading impacts.

- California's 20th century water-infrastructure design and operations are not adequate for managing climate change impacts.
- Water-related sectors often operate in siloes, resulting in unintended or secondary consequences, inefficiencies, and unrealized opportunities.
- Many regional and local agencies currently lack the funding, data, tools, or institutional capacity to understand climate change vulnerabilities and adaptation opportunities unique to their watershed.
- Insufficient alignment among State agency mandates, policies, plans, programs, regulatory frameworks, funding opportunities, and datasets impede the State's ability to provide coordinated, agile, and flexible guidance, assistance, and oversight to regions and watersheds.
- Climate change impacts are disproportionately affecting frontline communities in California because they have fewer resources and less institutional capacity to adapt to impacts resulting from physical (built and natural), social, political, and economic factor(s).
- Tribal resources are significantly threatened by climate change impacts.
- Legacy forecasting data and models are unable to accurately predict future conditions.

Figure ES-2 Climate Impacts are Affecting All Water Sectors across California



**Forest and Wildfire Management**  
Rising temperatures, extended periods of dryness, and increasing wildfire potential will further stress and challenge management of headwater forests and lands and impact public health and safety.

**Hydropower**  
Changing snowpack and melt timing, increasing peak electrical demands, and extreme heat events will challenge hydropower management.

**Ecosystems**  
Higher temperatures, changing hydrology, rising sea levels will change habitats for many species and the pace of ecosystem adaptation will be challenged.

**Groundwater**  
Changing recharge patterns, seawater intrusion in coastal aquifers, and increasing demands will continue to put pressures on groundwater systems.

**Water Supply**  
Changing hydrological patterns including reduced snowpack, earlier melt, extended droughts, and increasing evaporative demands will stress reservoir operations and impact overall availability of water supplies.

**Flood Management**  
More intense precipitation events, specifically atmospheric rivers, less snow-more rain, flood-after-fire events, and rising sea levels will contribute to greater flood risk in inland and coastal areas.

**Water Quality**  
Increasing temperature, reduced spring and summer streamflow, extreme runoff and flood-after-fire events will continue to challenge water quality management.

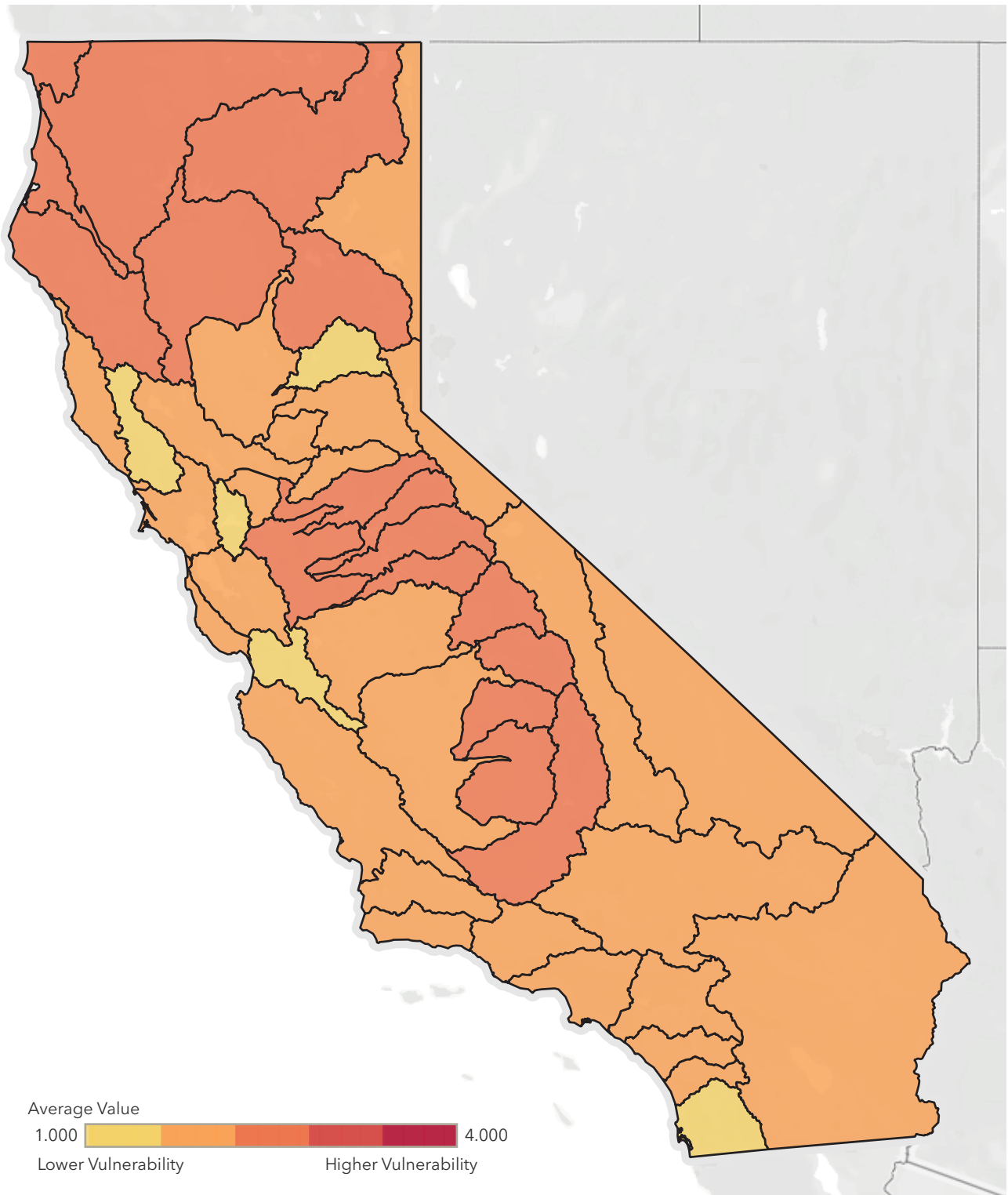
**Recreation**  
Changing snowpack, changing river and streamflows, more variability in lake levels, and rising sea levels will stress recreational resources.

Climate vulnerabilities exist in all regions of the state, yet they vary considerably from watershed to watershed. Larger storms, more severe droughts, hotter temperatures, and earlier snowmelt runoff are changing the operating conditions for water infrastructure. Much of California’s built “backbone” infrastructure was designed for historical climate conditions and must be modernized and adapted to provide necessary levels of service.

Figure ES-3 shows the results of a high-level assessment of future climate vulnerabilities by watershed, with a consistent, combined set of metrics related to water supply, flood management, water quality, ecosystems, hydropower, and recreation. This statewide perspective of relative vulnerability by watershed and region can inform where additional analysis, investments, and technical support are needed.



Figure ES-3 Projected Climate Vulnerabilities Vary across California



### California's Watersheds Depend on the Natural and Built Backbone Infrastructure that Supports and Connects Them

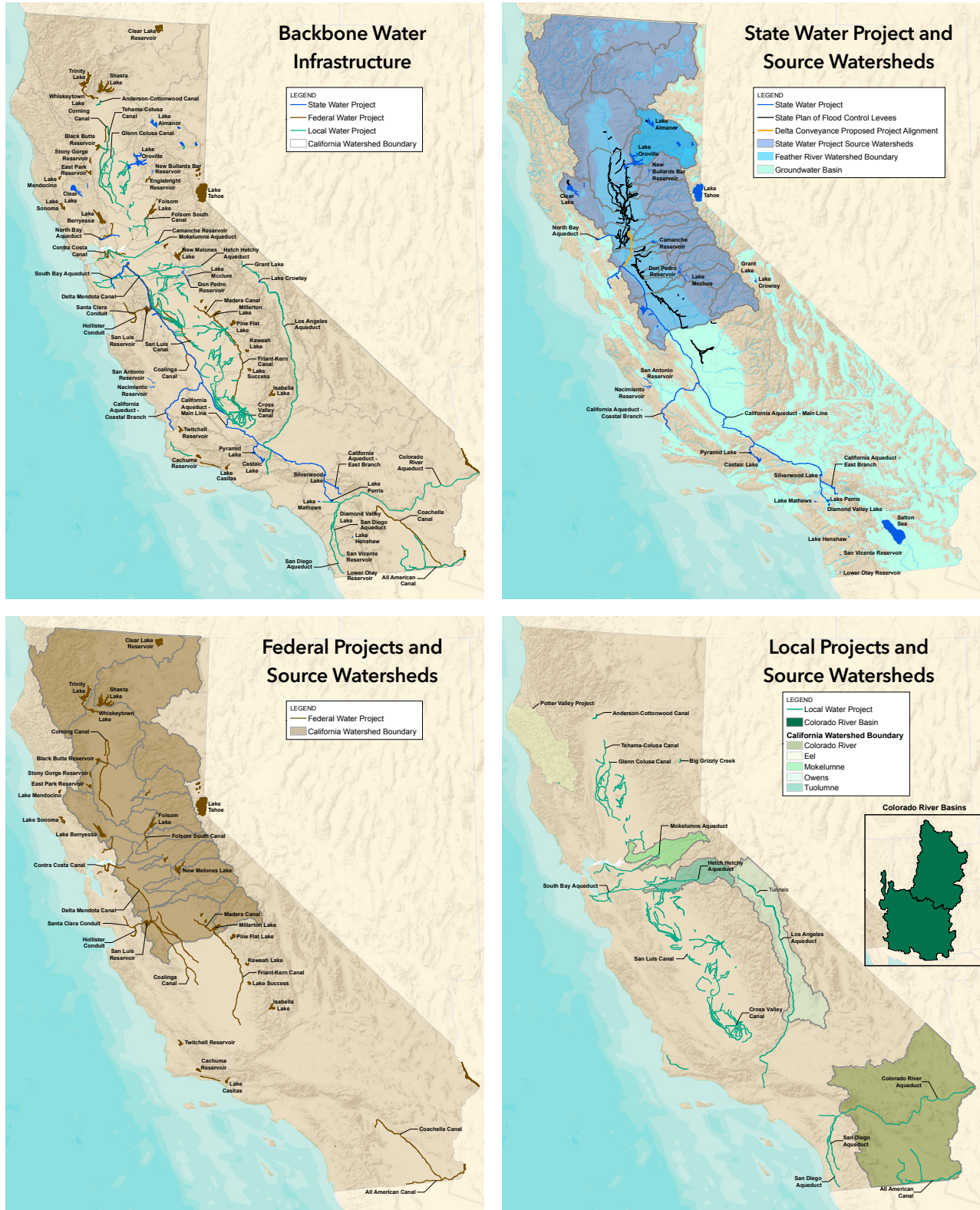
Connecting watersheds and regions throughout the state, California's backbone water infrastructure includes major built systems and natural systems within and among watersheds. Built infrastructure refers to major State, federal, regional, and local water projects. More than two-thirds of Californians receive water from backbone systems, which consist of major dams and reservoirs with more than 40 million acre-feet of storage, more than 1,000 miles of canals and aqueducts, and hundreds of pump stations to deliver water from the source watersheds to areas of need (see Chapter 3).

Natural infrastructure is an equally important part of backbone water systems. Source watersheds and their associated groundwater basins provide natural storage, high-quality supply, regulation of water supply across seasons and years, attenuation of peak flood flows, and thermal regulation. Rivers and floodplains help convey water from source to diversion, deliver flood benefits, and support ecosystems. They also provide for healthy riverine and delta ecosystems, while aquifers help regulate and retain infiltrated water for annual and drought-year supply. The resiliency of built water-infrastructure systems is intrinsically linked to the resilience of the natural systems. Chapter 8, "Roadmap to Resilience," affirms the interdependent relationship between the built and natural aspects of the state's complex water system and recommends actions that result in investments and stewardship for both.

Figure ES-4 illustrates four examples of backbone infrastructure. The upper left corner panel shows built backbone infrastructure throughout the state, including the State Water Project, federal water projects, and local water projects. The following three panels show the connection between backbone infrastructure and source watersheds. (Although thousands of production groundwater wells throughout the state are considered built backbone infrastructure, they are not depicted in Figure ES-4.)

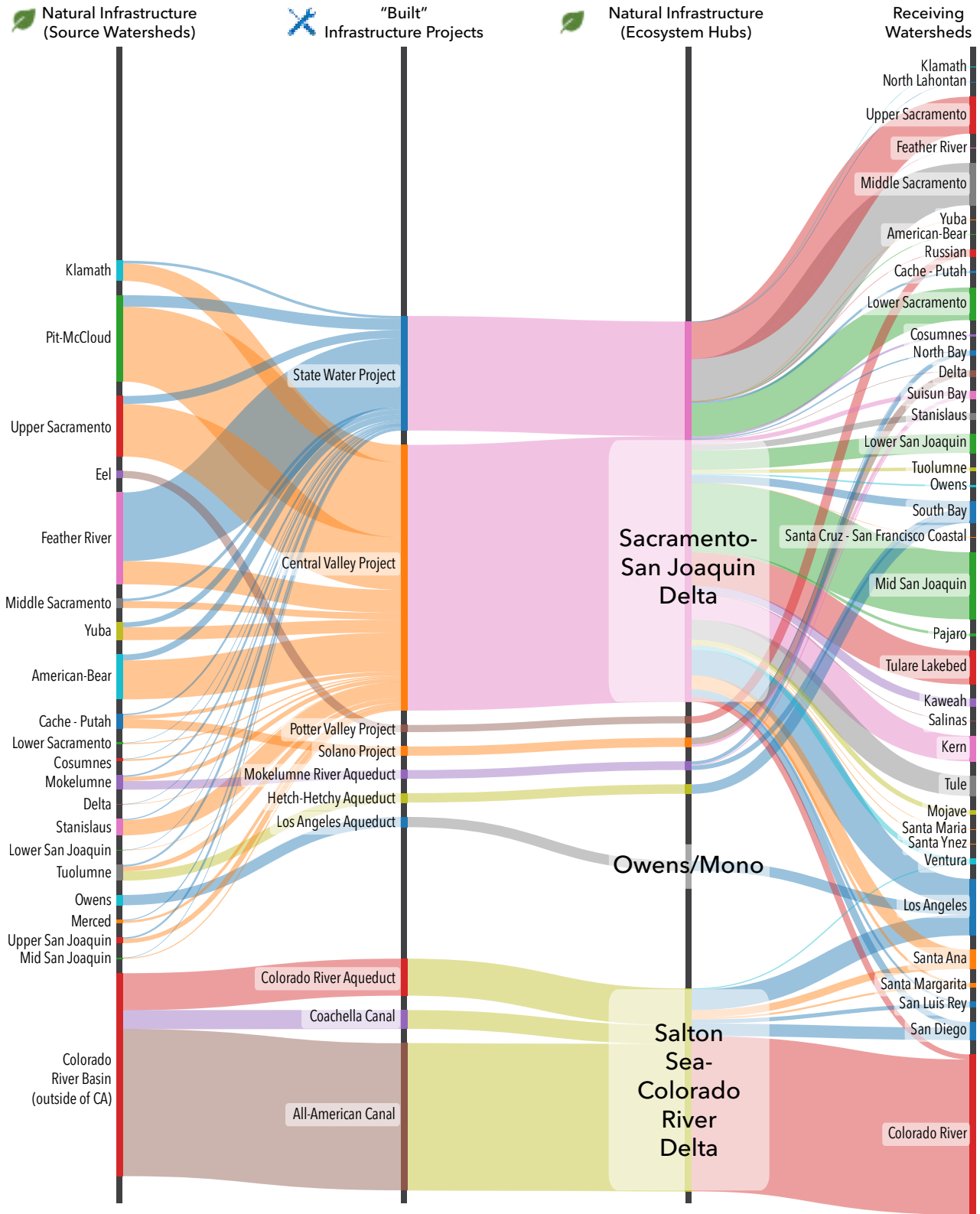
Figure ES-5 illustrates the movement of water across watersheds in the state, starting with each of the source watersheds on the left, through major built infrastructure projects and to the receiving watersheds. The width of the lines is proportional to the quantity of water moving through these systems. The figure also identifies major natural infrastructure system hubs, such as the Bay-Delta, Owens and Mono lakes, the Salton Sea, and Colorado River Delta. The resilience of each of these natural system hubs is integral to the resilience of the built infrastructure systems. To achieve statewide water resilience, the interdependence of these systems calls for investments in the resilience of built and natural systems.

Figure ES-4 California's Resilience Depends on Natural and Built Backbone Infrastructure



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## Figure ES-5 California's Water Management System is Inherently Integrated



## A Regional Perspective Reveals Varied Conditions Across the State

The diversity of bioregions and hydrologic systems in California gives rise to diverse challenges that underscore the importance of taking a regional approach to water resilience. California's 10 hydrologic regions have their own water management tools, water-related assets, and challenges. The same is true of two overlay areas, the western slope of the Sierra Nevada and the Sacramento-San Joaquin Delta. Because climate change impacts vary among watersheds, unique characteristics of hydrology, topography, land use, and groundwater are factors when characterizing a region's climate vulnerabilities and adaptation opportunities.

In Chapter 3, regional summaries describe existing and future climate vulnerabilities and water management challenges, and activities currently underway to reduce risks. The vulnerability of each hydrologic region was assessed for 15 different factors, including water supply risk, flood risk, drinking water threats, and affordability challenges. This information was derived from a statewide climate-change risk and preparedness assessment conducted by the California Department of Water Resources (DWR); the Portfolio; and, for the Central Valley regions, the Water Plan's future scenarios analysis.

## State Agencies and Partners are Responding to Climate Change to Shape a Resilient and Equitable Future

The scale of climate-related challenges demands a timely, thorough, and coordinated response from all levels of California government. Visionary policies, immediate actions, long-term resilience planning, and substantial ongoing investments are essential. To be effective, these actions must be coordinated closely among State agencies; federal, Tribal, regional, and local partners; and regulated parties.

State government serves an important role in water resources management, coordinating regulatory development and oversight; setting policies and rules; providing technical, data, and financial support; overseeing critical statewide interjurisdictional backbone infrastructure; and facilitating resolutions to long-standing environmental conflicts. The Newsom administration and Legislature have adopted policies to guide State and local responses to the increasing intensity of climate change, including the Portfolio and the Strategy. Alongside these policies, State agencies, departments, boards, and commissions are planning and implementing actions funded by billions of dollars of State investment in climate resilience-related strategies and programs.

The State also plays an essential leadership role in the research, development, and sharing of climate science and related data to advance understanding of how the climate emergency is affecting all environmental and economic resource sectors. In support of science and technology, DWR and other State agencies are leading collaborative open data initiatives, technical studies, and planning efforts with local, regional, Tribal, and federal partners. The shared goals are:

- Improve water data monitoring, reporting, and access.
- Modernize observation and forecasting techniques.

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- Develop water accounting system, models, and decision-support tools.
- Strengthen alignment of open data and analytical tools used by DWR, State agencies, and regional water programs.
- Improve understanding of climate vulnerabilities and risks across the state.
- Identify appropriate adaptation strategies.

As shown in Figure ES-6, multiple State agencies, departments, commissions, councils, and boards are acting on efforts focused on achieving resilience in the water sector. These planning, regulatory, and incentive-based actions include developing new water supplies, improving water use efficiency, protecting water quality, improving soil health for food security, improving biodiversity and ecosystems, conserving landscapes, treating source watersheds to reduce fire risk, protecting coastal areas from sea level rise, decarbonizing the energy sector, and other actions (see Chapter 4).

Federal partners actively working alongside State agencies to improve overall water resources resilience include the Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Department of Agriculture Forest Service, U.S. Geological Survey, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration Fisheries.

Many efforts are in response to policy directives in the Portfolio, the Strategy, and related executive orders. Others are ongoing, legislatively mandated activities central to each agency's mission. All reflect the administration's and Legislature's commitment to respond to climate change with mitigation actions and adaptation strategies to secure a more resilient and equitable water future.

Figure ES-6 State Initiatives for a Resilient and Equitable Water Future



### A Focus on Watershed Resilience Complements Existing State Initiatives

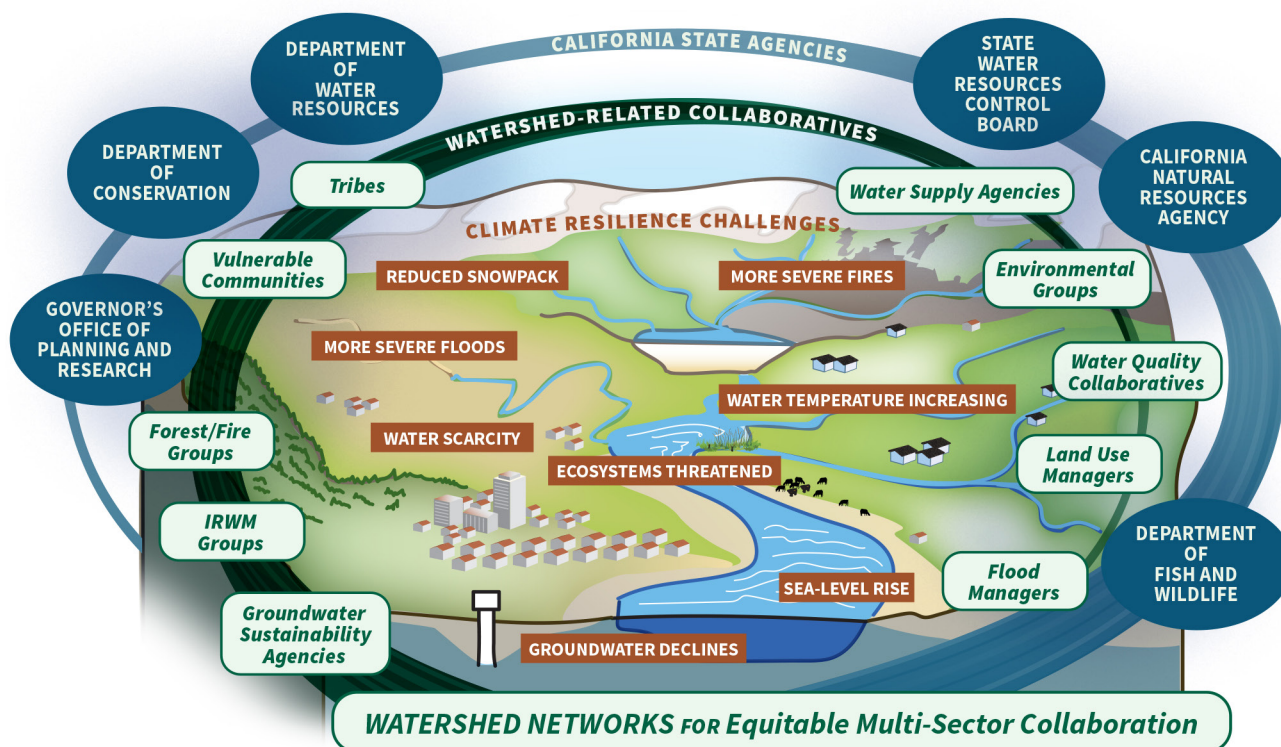
Water management in California occurs at many different scales, from individual residences and communities (e.g., water use efficiency standards and drinking water regulations) to interregional infrastructure, such as the State Water Project and the Los Angeles Aqueduct. While there are critically important, ongoing efforts and new opportunities to address these challenges at each scale – as shown through various regulatory, planning, and local assistance actions (see Chapter 4) – the watershed continues to emerge as a vital, holistic scale for water resilience planning.

As previously enumerated, watersheds provide many essential benefits to those within and connected to them. Past Water Plan updates, as well as the Portfolio and the Strategy, acknowledge this diversity, highlighting the importance of State incentives for local, collaborative water resources management at regional and watershed scales. Update 2023 emphasizes the importance of robust watershed-specific climate vulnerability analyses and adaptation plans, followed by investments in multi-sector collaborations and solutions at the regional and watershed scale. The goal is to empower communities with the data, technical expertise, and financial resources to build water solutions resilient to climate change and other uncertainties that lie ahead.

Accordingly, Update 2023 recommends an expanded role for regional and watershed-scale initiatives, especially those that incentivize the establishment of networks of local agencies, Tribal governments, community leaders, and non-profit organizations. These networks (Figure ES-7) would represent an inclusive cross-section of local voices and perspectives contributing to water plans and projects that would be naturally integrated across such sectors as stormwater, sanitation, recycling, and groundwater management. For example, Tribal government representation on decision-making bodies would facilitate incorporation of Indigenous knowledge and practices of holistic watershed management.



Figure ES-7 Networks Promote Equitable Multi-Sector Collaboration



Chapters 4 and 5 highlight several examples of existing State programs that explicitly require or otherwise incentivize regional or watershed-scale collaborative actions.

- Integrated Regional Water Management Program (DWR).
- Regional Resilience Planning and Implementation Grant Program (Governor's Office of Planning and Research).
- Community Resilience Centers Program (California Strategic Growth Council).
- Sustainable Groundwater Management Program (DWR and State Water Resources Control Board).
- Multi-benefit Land Repurposing Program (California Department of Conservation).
- Regional Forest and Fire Capacity (California Department of Conservation).

State agencies administering regional- or watershed-scale programs should incorporate the Update 2023 watershed resilience principles to help guide consistent and equitable approaches to climate vulnerability and adaptation planning and project implementation.

## Executive Summary

These principles will:

- Facilitate more equitable water management outcomes by requiring inclusive regional governance and decision-making.
- Promote scientifically driven climate vulnerability analyses by standardizing requirements for best available science and analytical approaches.
- Incentivize regional planning with watershed hydrology as a key factor in determining planning-area scale, scope, and measurable outcomes.
- Incorporate a robust and consistent approach for tracking outcomes by using metrics and indicators of resilience at the watershed scale.

## California Requires Continued and Amplified Efforts for Equity in Water Management

In 2022, Governor Newsom committed to creating a “California for all” by signing Executive Order N-16-22, directing State agencies to take critical actions and address equity in all strategic plans and updates. This deepening commitment to equity is an acknowledgment that current institutional systems and programs are not serving all Californians. Additionally, insufficient community engagement, representation, and financial and technical capacity impede collective solutions and progress. With the deeper understanding that inclusive collaboration brings to the process of developing recommendations and thus solutions, equitable outcomes become increasingly possible.

In the context of existing systemic and institutional challenges and inequities, Update 2023 advances a roadmap with recommendations to accelerate, strengthen, and broaden an essential and important collective dialogue within the water community to address pivotal findings (see Chapter 6).

- Many Californians do not have access to safe, clean, and affordable drinking water.
- Frontline communities are vulnerable in the face of floods, drought, and other climate risks.
- Economic, social, and environmental barriers exist that prevent equitable outcomes within water systems.

California’s water is managed through a complex governance system, with overlapping and interdependent jurisdictions at the local, regional, State, federal, and Tribal levels. Considerable variation in how each local authority allocates water, assesses rates, and mitigates risks makes navigating governance systems difficult for frontline communities and curtails their ability to participate in the decision-making process.

Building authentic and meaningful relationships with communities is critical to advancing water management planning and actions. Yet, communities and non-governmental organizations report that often many State outreach strategies are not accessible to diverse populations.

A major vulnerability of frontline communities has resulted from their drinking water needs not being made a priority. This is largely because frontline communities have not been incorporated in decision-making processes or other forms of participation based on land tenure, well permitting, property size, race, language, economic status, and other factors. Nearly 1.5 million Californians rely on domestic wells – even as one-third of community water systems rely on only a single well – for drinking water and other potable uses. As climate change impacts continue to accelerate, these Californians may experience greater frequency or intensity of water shortages and water quality degradation, along with more limited options for alternative water sources.

What's more, future climate conditions are anticipated to directly increase the cost of living for frontline communities. In 2022, the State Water Resources Control Board conducted a drinking water affordability assessment, concluding that 39 percent of disadvantaged or severely disadvantaged community water systems exceed affordability thresholds. Other recent estimates report that 1 in 10 California households are falling into arrears on their water payments. These affordability challenges are exacerbated by periods of extended drought, during which domestic water supply costs can rise because of unexpected infrastructure costs (e.g., well drilling) and alternative supply importation costs.

Implementing climate adaptation strategies provides new opportunities and approaches to modernizing aging infrastructure and ensuring that water systems work better for all Californians, especially those most vulnerable to the effects of climate. Investing in natural infrastructure also offers opportunities to further uplift frontline communities by improving environmental health, a key indicator of a thriving and resilient community.

Understanding existing inequities and systemic challenges within and beyond the water management sector supports and informs ongoing and future efforts to advance equity throughout the state. For frontline communities, addressing these challenges and barriers is essential for ensuring sufficient adaptation and community resilience.

### **California Tribes Describe How Tribal Knowledge and Practices Enhance Water Resilience**

Colonization, relocation, and termination have perpetuated a practice of leaving Tribes out of the discussion involved in developing State legislation and have made it more difficult for Tribes to practice their cultural, spiritual, and sustainability practices. California's water planning processes also have historically not included California Tribes. California Tribes reside throughout the state and have deep spiritual connections to water and water-related resources. Past State policies and practices have limited the ability of Tribes to control and access water and constrained their cultural, spiritual, and sustainability practices.

As California promotes understanding of Tribal perspectives and lessons learned from the historical treatment of Tribes, it paves the way for decisions and policies to support Tribal sovereignty, culture, practices, and socio-economic stability.

## Executive Summary

To understand and report viewpoints of California Tribes, the California Water Plan team worked with members of the Update 2023 Tribal Advisory Committee to collaboratively promote Tribal water concerns, needs, and opportunities. Tribal members and their representatives contributed their time and expertise to describe water management challenges they face within their watersheds and ancestral homelands. This was done with a clear understanding that, although Tribal communities may have common concerns, interests, and priorities, each Tribe has unique needs that must be taken into consideration. Understanding these unique differences will help create effective partnerships with the State of California.

Chapter 7, “Strengths and Resources of California Tribes,” a first for the California Water Plan, amplifies California Native American Tribal voices and perspectives. A primary purpose of the chapter is to increase the quality of Tribal participation in the preparation of this and future Water Plan updates. The chapter highlights water management challenges faced by Tribal governments and Tribal communities, and it provides strategies and recommendations to begin addressing these challenges. Tribal voices convey the experience and priorities of Tribes and an overview of Tribal history, as well as a Tribal vision for California water management; Tribal sovereignty; Tribal water rights; and Tribal efforts to improve watershed health, adapt to climate change, strengthen equity, and increase available funding.

## Update 2023 Recommendations Chart a Roadmap to Resilience

In Chapter 8, the State’s recommendations are organized around seven objectives that provide a roadmap to resilience. California has the capacity and resolve to meet its water and climate challenges, create economic opportunity, and improve public and environmental health and safety. These goals can be reached through the strong alignment of State, federal, Tribal, and local leadership; public-private-partnerships; collaborative, multi-sector actions and co-management; research and technology; and community engagement.

Carrying out the Water Plan’s recommendations will require time, effort, and funding. The pace of implementation will depend on the availability and feasibility of acquiring needed resources and balancing this effort with competing priorities.

### Objective 1. Support Watershed Resilience Planning and Implementation.

California’s watersheds are currently experiencing major climate change challenges that will be magnified in the future. Improving and accelerating climate resilience planning and implementation at the watershed scale will improve water resilience where impacts are most acutely experienced. Recommendations under this objective seek to support and accelerate watershed resilience through priority State actions.

### **Objective 2. Improve Resiliency of “Backbone” State, Federal, and Regional Built Water Infrastructure.**

Recognizing that most watersheds in California are interconnected and dependent on State, federal, and regional built water infrastructure, statewide water resilience can only be achieved with improvements to the resiliency of these backbone systems. The recommendations under this objective seek to improve existing built backbone infrastructure systems, adapt operations for climate change, increase integration of these systems, and improve information sharing.

### **Objective 3. Improve Resiliency of Natural “Backbone” Infrastructure.**

The resilience of built infrastructure is intrinsically linked to the resilience of natural infrastructure. Recognizing this interdependence, the recommendations under this objective seek to improve the resilience of natural infrastructure through accelerated ecosystem restoration and identifying critically important ecosystem hubs and groundwater basins.

### **Objective 4. Advance Equitable Outcomes in Water Management.**

Recognizing that current inequities exist in California’s institutional systems and that resilience for California must include resilience for all, the recommendations under this objective emphasize improving community outreach and engagement, local capacity building efforts, and access to State assistance programs.

### **Objective 5. Support and Learn from Tribal Water and Resource Management Practices.**

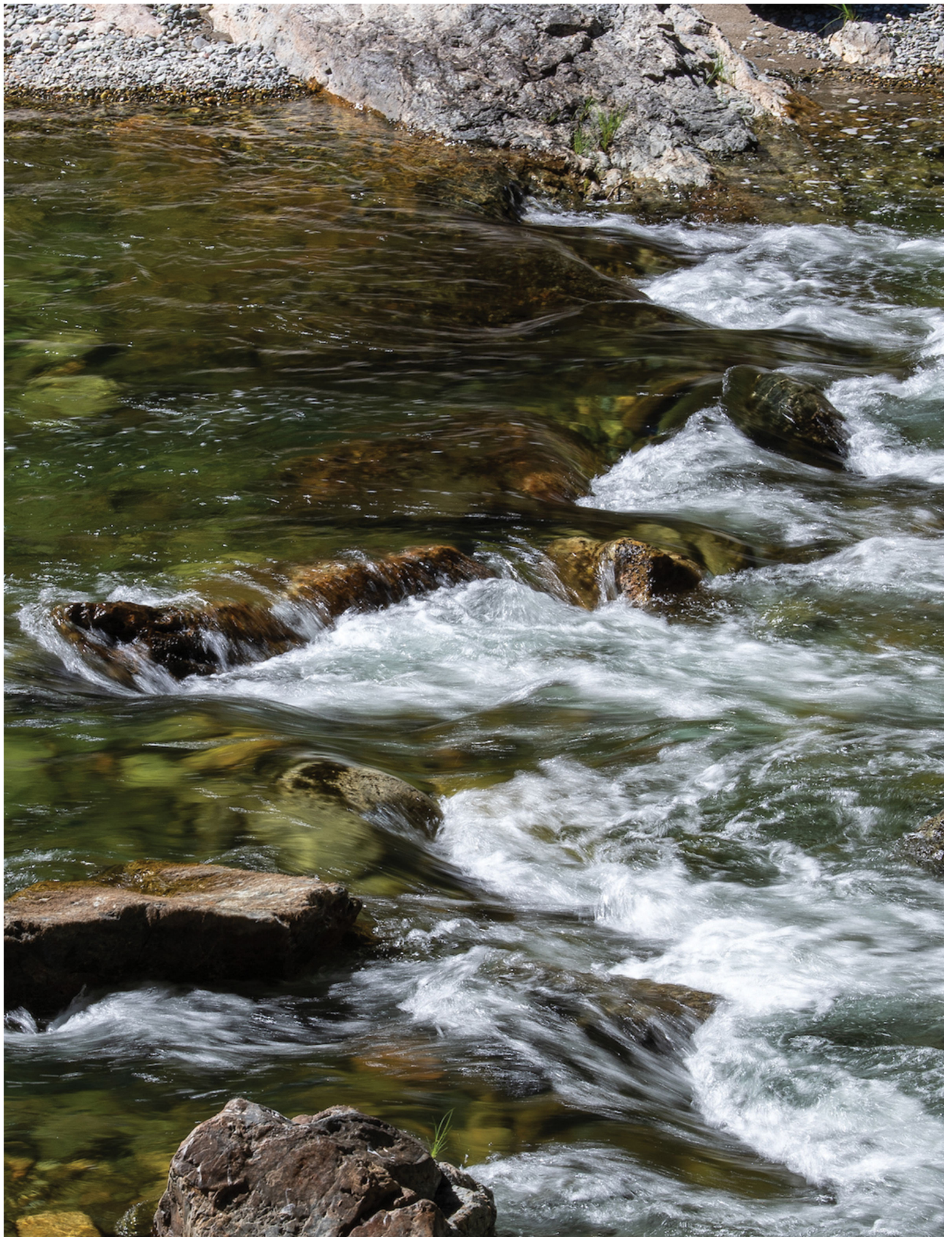
California Tribes have a long history of sustainable water and resource management practices. But Tribal communities also face a growing number of water management challenges related to water rights, infrastructure development, engagement, and funding. The recommendations under this objective seek to support strategies to address these challenges and support and learn from Tribal water management practices.

### **Objective 6. Support and Increase Flexibility of Regulatory Systems.**

Update 2023 details how climate change is driving a need for planning and projects capable of addressing future uncertainties. It also discusses the need to fully support regulatory programs and to ensure that they are flexible and adaptive enough to meet the challenges of a changing hydrology. The recommendations under this objective seek to support that and other related outcomes.

### **Objective 7: Provide Guidance and Support Continued Resources for Implementation of Actions toward Water Resilience.**

Sustainable resources are essential for creating more resilient water-resource management systems, which are foundational to adapting to an increasingly variable hydroclimatic regime of swings between drought and flood. Developing statewide and watershed resilience requires local, State, and federal investments and unique approaches to sustainable funding. The recommendations under this objective seek to align resources with the needs of California water management.



# 1

## Context and Vision for a Resilient and Equitable Water Future

Water is essential to all aspects of life in California – from the state’s stunning natural landscapes and biodiverse ecosystems to the many leading global industries that comprise its robust economy. Yet, California’s **watersheds** are being adversely affected by **climate change**. In the five-year period since the publication of *California Water Plan Update 2018* (Update 2018), climate change has put unprecedented stress on natural and human systems. During that time, Californians experienced increased wildfires, rising sea levels, and highly variable precipitation and runoff patterns that manifested as historic droughts and floods – all of which increased socio-economic uncertainty. Indeed, as *California Water Plan Update 2023* (Update 2023) is being published, the year is on pace to become the warmest on record.

Although climate change certainly is not the only water-related challenge disrupting natural and human systems, all water systems are vulnerable to its interrelated impacts. Droughts and extreme heat exacerbate fires and threaten ecosystems, fires threaten water supply and water quality, changes in hydrology simultaneously increase risks of flooding and reduce groundwater and surface water supplies, intense flood events overwhelm stormwater and wastewater systems, and on it goes. Additionally, most, if not all, of the anticipated climate change impacts are on a trajectory to continue to disproportionately affect California’s **frontline communities**, those that experience the “first and worst” of environmental consequences, in part, owing to inequities in water management and thus greater susceptibility to future negative changes. (For a full definition of frontline communities, see the “Key Terms” section or Chapter 6, “Understanding and Addressing Equity in the Management of California’s Water Resources.”) All these effects and vulnerabilities require a fundamental shift in approaches to redesigning, modernizing, reoperating, and investing in the state’s water resource systems to ensure they are resilient to the ongoing and worsening effects of climate change.

California has been at the forefront of climate action since the passage of Assembly Bill (AB) 32 (Nunez 2006), which established the groundbreaking regulatory and market

## Context and Vision for a Resilient and Equitable Water Future

mechanisms to achieve quantifiable, cost-effective reductions in greenhouse gases. More recently, the State has committed to a net-zero carbon future by 2045 – a future made possible through strong policies and investments focused on decarbonizing our energy grid and transportation sector. While California is on its way to meeting these ambitious emission reduction targets, global emissions are still on pace for continued rise in global temperature and significant climate change effects on the environment, economy, and social equity.

Mitigation (i.e., reducing greenhouse gas emissions) is not sufficient and needs to be coupled with aggressive climate **adaptation** that involves lessening climate change impacts. As the ravages of heat, drought, fires, and floods are felt across water sectors and across the state, the concerted focus on adaptation must continue and accelerate. California has the capacity and resolve to meet these water and climate challenges, create economic opportunity, and improve public and environmental health and safety with the strong alignment of State, federal, Tribal, and local leadership; public-private-partnerships; collaborative, multi-sector actions and co-management; research and technology; and community engagement.

## State Vision for California's Water Resources

Update 2023 lays out a vision for a resilient and equitable water future and discusses the water, climate, and system challenges to that future, as well as initiatives already underway.

***Update 2023 Vision:** All Californians benefit from water resources that are sustainable, resilient to climate change, and managed to achieve shared values and connections to our communities and the environment.*

Update 2023 is a call to action, an all-hands-on-deck endeavor, in which everyone has a role – State agencies and departments with water, regulatory, and climate responsibilities; regional water and resource managers and stewards at every scale across water sectors; and individual Californians. Achieving a resilient future requires alignment of purpose, leadership, action, and a clearly defined path with collaborative understanding of the many interrelated sectors, institutions, and roles. Taken together, this update's themes, findings, and recommendations illuminate a roadmap to **resilience** with social equity as a guiding principle to achieve the following objectives:

- Support **watershed resilience** planning and implementation.
- Improve resilience of State, federal, and regional built “backbone” water infrastructure.
- Improve resilience of natural backbone infrastructure.
- Advance equitable outcomes in water management.



## Context and Vision for a Resilient and Equitable Water Future

- Support and learn from Tribal water and resource management practices.
- Increase flexibility of regulatory systems.
- Provide guidance and support continued resources for implementing actions toward water resilience.

### Purpose of the California Water Plan

The California Water Plan (Water Plan), updated every five years, is the State's strategic plan for sustainably and equitably managing, developing, and stewarding water resources. Required by Water Code Section 10005(a), the plan presents the status and trends of California's water-dependent natural resources; water supplies; and agricultural, urban, and environmental water demands for a range of plausible **future scenarios**.

Update 2023 promotes climate resilience across regions, water sectors, and natural and built infrastructure with a statewide vision, clear goals, watershed-based climate resilience planning framework, and regional and interregional infrastructure modernization strategies. Update 2023 includes updated resource management strategies, regional planning and performance tracking tools, **water balances**, future scenarios, and other technical and policy-related actions and recommendations related to water resilience and **sustainability**.

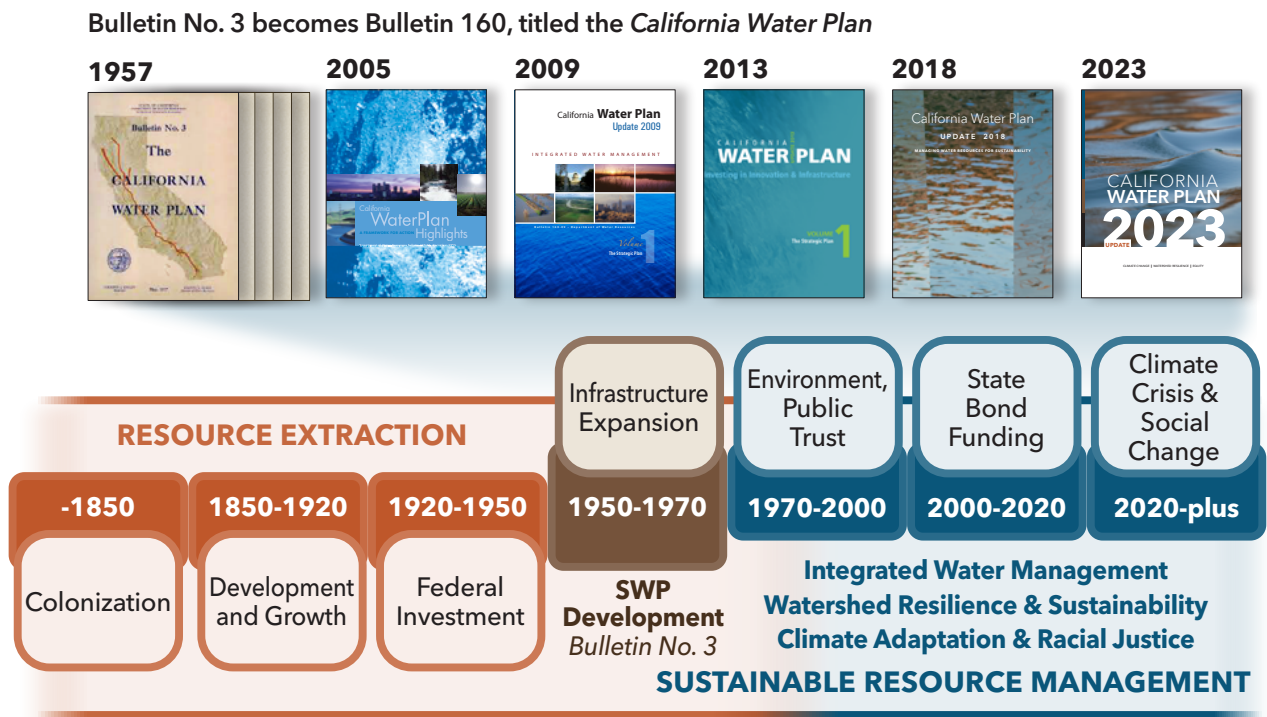
Since 2000, DWR has prepared plan updates in collaboration with multiple State, federal, Tribal, and local governments and agencies responsible for the stewardship and management of California's water and water-related resources, as well as with communities of interest and place.

Figure 1-1 shows the evolution of the plan over time, from the 1930s through the 1960s, the decades of major infrastructure expansion that included the Central Valley Project. The plan originally focused on water supply, addressing the need for what became known as the State Water Project, and by the late 20th century the focus included environmental values, integrated watershed management, and increased emphasis on sustainability and resilience.

Now, with climate change an urgent threat, Update 2023 is focusing on the innovation and investments in California's watersheds, water systems, and communities which are needed for a resilient and equitable future.

## Context and Vision for a Resilient and Equitable Water Future

**Figure 1-1 The California Water Plan Has Evolved to Meet California’s Needs and Challenges**



## Relationship of Update 2023 to the Water Resilience Portfolio and the Water Supply Strategy

The Water Plan, in tackling issues of concern such as climate change, naturally reflects the priorities of the administration and Legislature current when a given update is developed. Update 2023 is no exception as it builds on existing water policies, laws and regulations, and initiatives and investments of the Newsom administration’s [Water Resilience Portfolio](#) (Portfolio), [Water Supply Strategy](#) (Strategy), and recent legislation. These State initiatives are cornerstone policies and investments, targets, and actions, necessary to create more equitable and climate-resilient water systems to benefit all Californians. Update 2023 folds Portfolio and Strategy themes and actions into a durable, legislatively mandated planning and policy roadmap that can uniquely span legislative and executive political cycles. The recommendations presented in Chapter 8, “Roadmap to Resilience,” will serve to facilitate the actions and policies discussed in the governor’s directives.

Chapter 4, “State’s Role in Creating a Resilient and Equitable Future,” includes a detailed summary of the Portfolio and the Strategy and the role of multiple State agencies, departments, and commissions in successful implementation of the governor’s policies.

### Update 2023 Water Plan Themes

Update 2023 is organized around the three intersecting themes – climate urgency, watershed resilience, and achieving equity – which together characterize today’s most significant pressures on California water resources and systems, as well as the strategies and tools needed to address them.

#### Addressing Climate Urgency

Update 2023 focuses on understanding the challenges ahead and bolstering the adaptive capacity of California’s water systems. Although California alone cannot stop the cascading consequences of global climate change, transitioning the state to net-zero carbon emissions will help stabilize rising temperatures globally and safeguard California residents and water resources. Water resource planning that expands on lessons learned and past successes is necessary to safeguard water supply and quality and food security; protect vulnerable populations from drought, flooding, and extreme heat; prepare for sea level rise; and protect and enhance critical natural and built infrastructure for water storage, treatment, distribution, reuse, and stormwater capture within and among regions and watersheds.

California water management also faces significant systemic and institutional challenges that increase risks to public safety, frontline communities and ecosystems, and the state’s economy. These challenges described in Chapter 2 are impeding implementation of programs and projects intended to reverse and recover from legacy community and environmental impacts and to aggressively adapt to climate change vulnerabilities affecting all water sectors.

#### Strengthening Watershed Resilience

A watershed is the land area from which water drains into a stream, river, or reservoir. A watershed includes all natural and artificial (human-made) features, including its surface and subsurface features, climate and weather patterns, geologic and topographic history, soils and vegetation characteristics, and land use. Watersheds throughout the state, including their associated aquifers and groundwater basins, provide water supply, flood management, ecosystem, hydropower, recreation, and other benefits to those within and connected to them. They allow California’s communities, economies, and ecosystems to thrive. These same watersheds are also at the forefront of the impacts of climate change, each experiencing effects of climate change unique to its geography, hydrology, socioeconomics, land use patterns, and built infrastructure. As such, effective climate adaptation strategies will vary among watersheds.

Update 2023 underscores the importance of supporting programs to incentivize robust watershed-specific climate vulnerability analyses and adaptation plans, followed by investments in multi-sector collaborations and solutions at the watershed- and regional-scale. Complementing ongoing regulatory frameworks and program approaches, this expanded watershed-scale focus is intended to empower communities with the data, technical expertise, and financial resources to build water solutions resilient to climate change and other uncertainties that lie ahead.

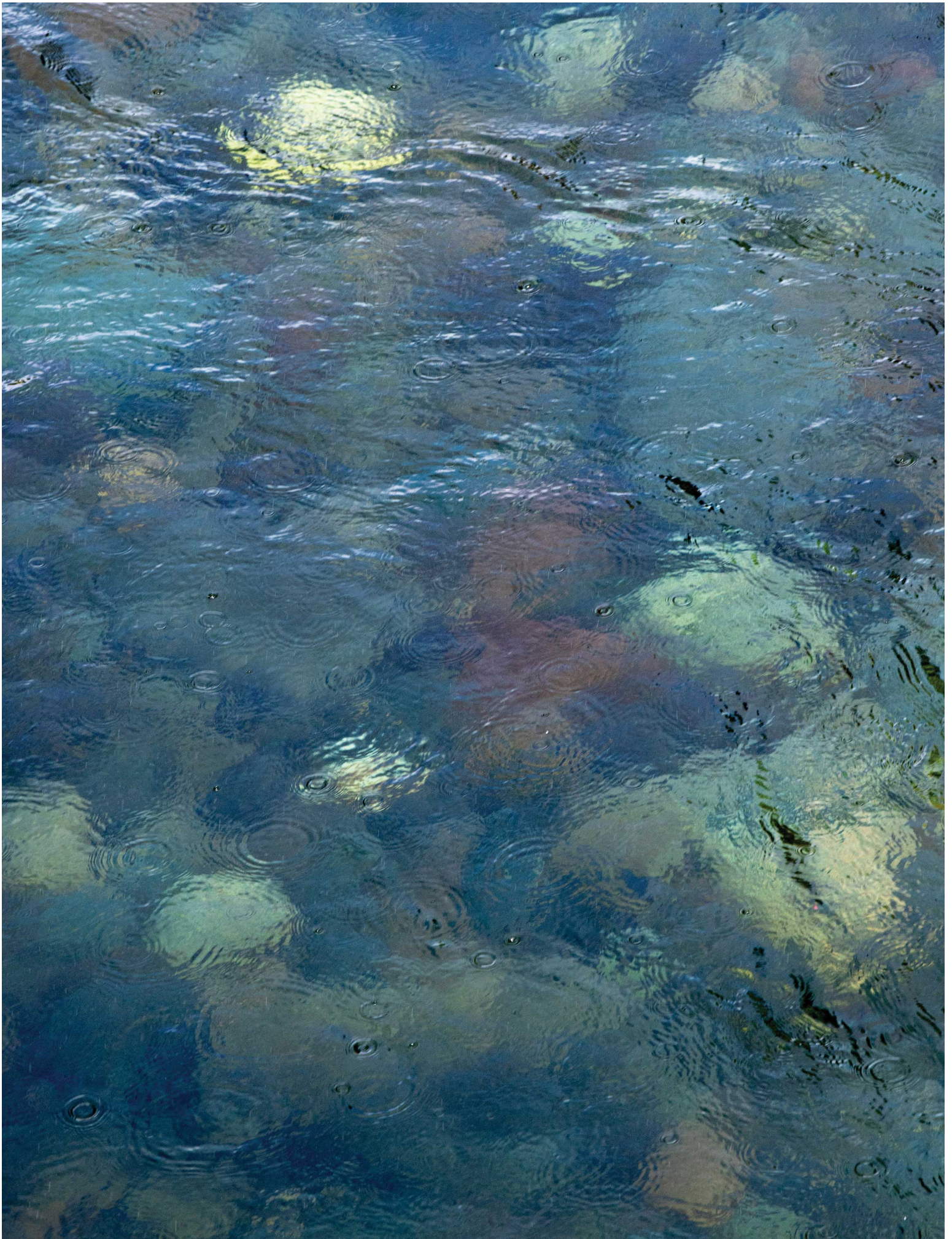
## Context and Vision for a Resilient and Equitable Water Future

### Equity

The recent spotlight on social justice has accelerated overdue equity assessments in many public spheres of activity, including the water community. In 2012, California became the first state in the nation to recognize that every human being has the right to safe, clean, affordable, and accessible water with the passage of AB 685 (Reyes 2020), the Human Right to Water Law. Then, with the passage of the Safe and Affordable Drinking Water Fund (Senate Bill [SB] 200, [Monning 2019]), California deepened its commitment to resolving a crisis that affects more than 1 million people across the state. Since Update 2018, there have been many new State actions, including executive orders, legislation, and financial and technical assistance, designed to mitigate vulnerabilities experienced by frontline communities from droughts, floods, wildfires, and legacy impacts. (See Chapter 6, “Understanding and Addressing Equity in the Management of California’s Water Resources,” for equity-related challenges, including affordability, outreach and engagement, and representation and participation.)

Despite these remarkable efforts, climate change continues to exacerbate long-standing inequities in California water management. Implementing climate adaptation strategies provides new opportunities and approaches to modernize aging infrastructure and ensure that our systems work better for all Californians, especially those most vulnerable to the effects of climate change. Investing in natural infrastructure also offers opportunities to further uplift frontline communities by improving environmental health, a key indicator of a thriving and resilient community. Update 2023 discusses how insufficient community engagement, representation, and financial and technical capacity impede collective solutions and progress. With that deeper understanding, collaboratively developed recommendations are provided to achieve more equitable outcomes (see Chapters 6 and 8).

## Context and Vision for a Resilient and Equitable Water Future



# 2

## Statewide and Water Sector Challenges and Conditions

This chapter describes water challenges and considerations and broadly organizes them by statewide conditions (i.e., **climate change**, systemic institutional challenges, and challenges for **California Tribes**) and water sector-specific conditions (i.e., water supply, water quality, wastewater, flood management, natural ecosystems, forest and fire management, land use, seismic risks, and water-energy nexus). Regional summaries and the importance and challenges of California’s natural and **built backbone infrastructure** that connect and support its regions are described in Chapter 3, “Natural and Built Backbone Water Infrastructure and Regional Summaries.”

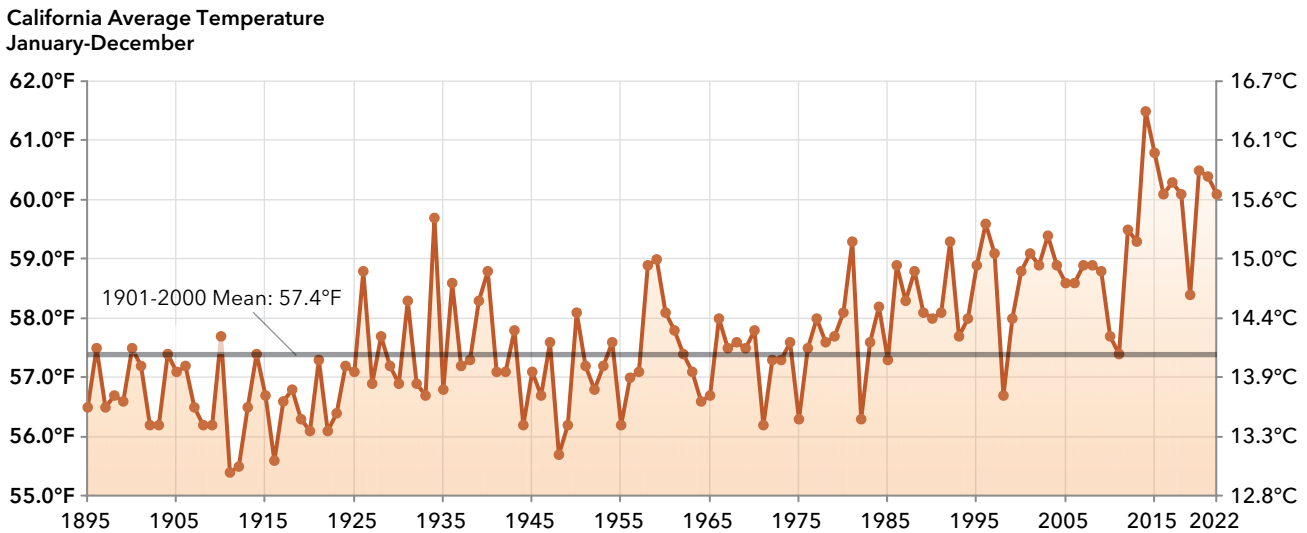
### Statewide Conditions

Key statewide conditions summarized below include climate change challenges, systemwide institutional challenges, and challenges facing California Tribes.

### Climate Change Challenges Related to Water Management

California’s annual average temperatures have been rising since 1895 and at an accelerated pace since the 1980s (Figure 2-1) (National Oceanic and Atmospheric Administration 2023). Climate change is causing unprecedented stress to natural and human systems with increased wildfires, extreme heat events, rising sea levels, and highly variable precipitation and runoff patterns, which are resulting in more extreme floods, droughts, public health, and infrastructure impacts, as well as social and economic uncertainty. California is experiencing higher temperatures; less snowpack; increasing evaporation; and greater consumptive use by vegetation and humans. Even with the same amount of precipitation, these effects leave less water for runoff.

Figure 2-1 California Average Temperature Have Been Rising at an Accelerated Pace

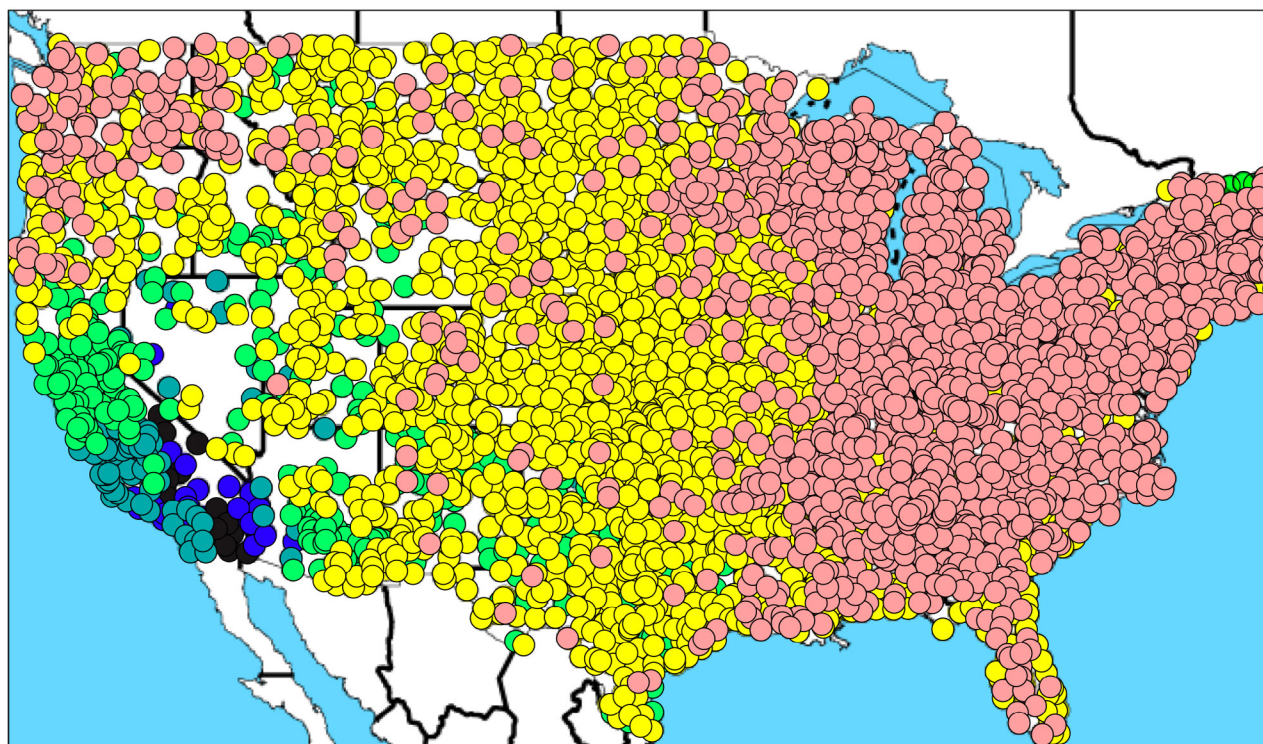


California’s water systems were designed and have been operated for a winter snowpack and spring snowmelt from the Sierra Nevada that has contributed on average, one-third of the state’s water supply. Historically, the snowpack released runoff over an extended period, through the spring and early summer; but, with increased temperatures and more precipitation falling as rain instead of snow, there is higher risk of early runoff, flooding, and less water available during the arid summer months.

Climate change is increasing the frequency and magnitude of extreme weather in California. Figure 2-2 shows the year-to-year variability in precipitation for the continental U.S. from 1951 to 2008. A higher coefficient of variation represents greater year-to-year variability in precipitation. The data illustrate that, among the states, California has had the largest annual precipitation variability depicted by the green and blue circles (Dettinger et al. 2011). Climate change is further increasing variability in precipitation in California, leading to more frequent and severe droughts and floods. Drought conditions in California have been increasing in intensity and duration, punctuated by more intense **atmospheric river**-driven storms and higher flood flows (**weather whiplash**).



**Figure 2-2 California Has High Precipitation Variability When Compared with Rest of Continental U.S.**



Coefficient of Variation, Water Year 1951-2008

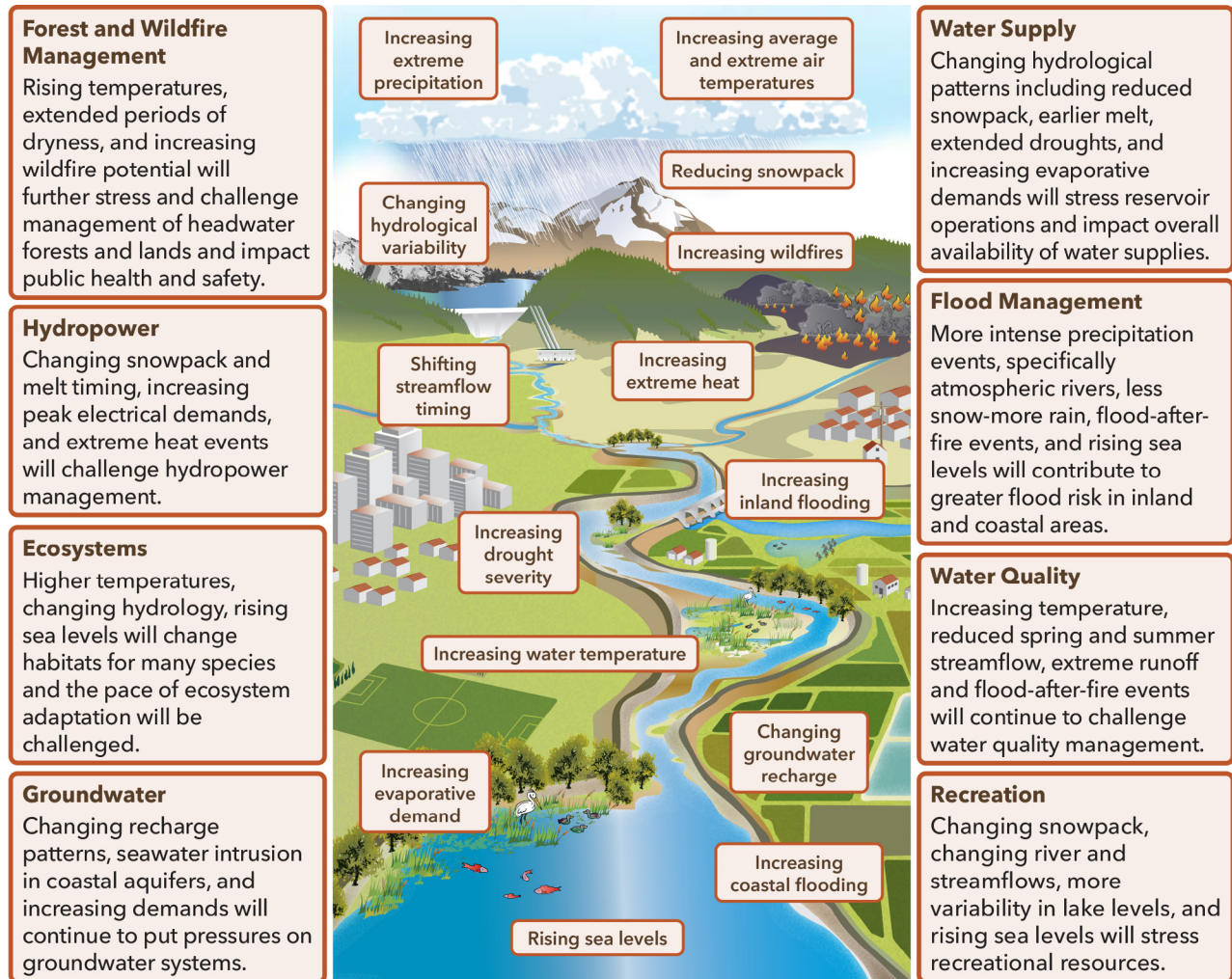


Figure credit: Mike Dettinger, U.S. Geological Survey

Climate change is reducing cold-water habitat and water supply for aquatic species, forest vegetation, and hydroelectricity generation. Less runoff and snowpack in forests are also heightening wildfire risk and diminishing long-term forest health. Wildfires lead to increased sedimentation of rivers, lakes, and reservoirs, and higher flood risk. Concurrently, sea levels are rising, threatening infrastructure along California’s coastline.

As shown in Figure 2-3, those climate change effects are making all water-related sectors – water supply, flood management, groundwater, ecosystem, water quality, forest and fire management, hydropower, and recreation – more vulnerable and less resilient across the state, with potential cascading effects among sectors.

Figure 2-3 Climate Change Challenges Can Create Cascading Effects Among Sectors



California’s ability to adapt is not keeping pace with climate change impacts.

- California’s 20th century water-infrastructure design and operations are not adequate for managing climate change impacts (Figure 2-3).
- Water sectors, such as water supply, flood management, forests, and groundwater, are often managed independently, resulting in unintended or secondary consequences, inefficiencies, and unrealized opportunities.
- Many regional and local agencies currently lack the funding, data, tools, or institutional capacity to understand the climate change vulnerabilities and **adaptation** opportunities unique to their **watershed**.

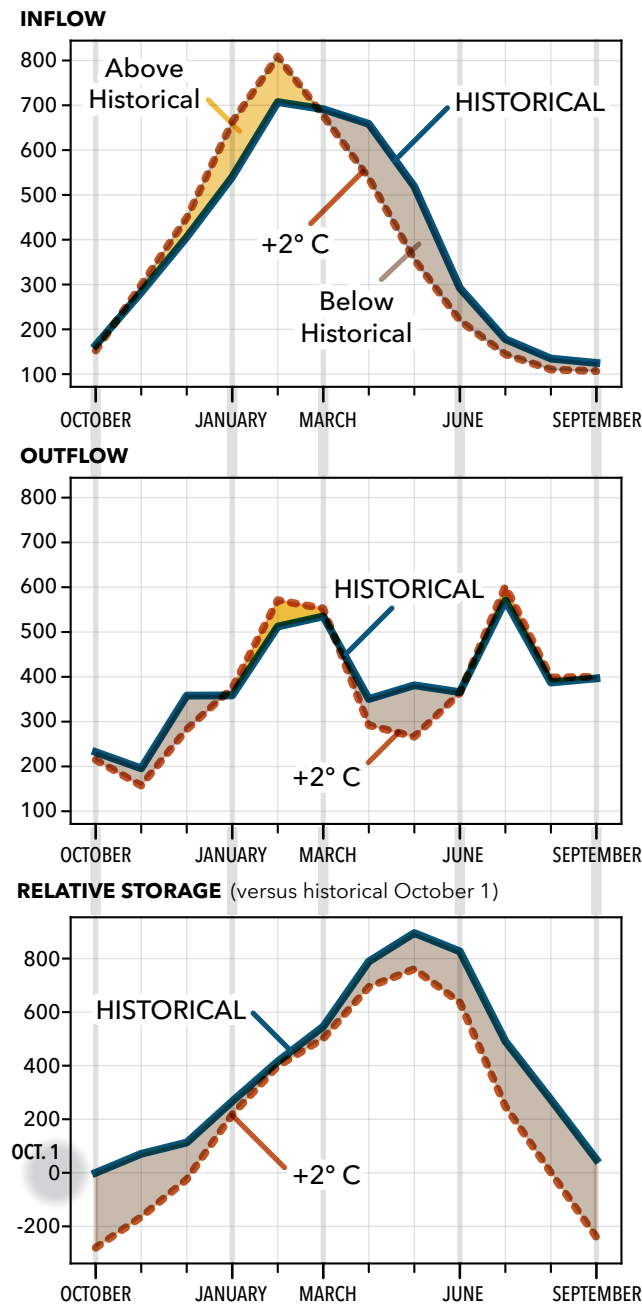
## Statewide and Water Sector Challenges and Conditions

- Insufficient alignment among State agency mandates, policies, plans, programs, regulatory frameworks, funding opportunities, and datasets impede the State’s ability to provide coordinated, agile, and flexible guidance, assistance, and oversight.
- Climate change impacts are disproportionately affecting **frontline communities** in California because they have fewer resources and less institutional capacity to adapt to impacts resulting from physical (built and natural), social, political, or economic factors.
- Tribal communities and resources are significantly threatened by climate change impacts.
- Legacy forecasting data and models are unable to accurately predict future conditions.

As an example of how water-infrastructure design and operations are not adequate for managing climate change impacts, Figure 2-4 depicts the simulated changes to reservoir storage resulting from the climate impacts that occur at different times in the water year, for a rain-dominated reservoir and one that is mixed rain and snow (or snowpack vulnerable). Carryover storage is low to start the water year in October, and, owing to earlier snowmelt and flood-risk reduction releases, a deficit in inflow and outflow occur again in the spring, compared with current conditions. This leaves less water available for the environment and urban and agricultural water uses later in the year. The overall implications are that storage will be lower on average in both types of reservoirs, rain-dominated, and mixed rain and snow, throughout the year, relative to current October 1 conditions.

Figure 2-4 Climate Change Creates Challenges to Future Reservoir Operations

OROVILLE (Mixed rain-snow )



NEW HOGAN (Rain-dominated)

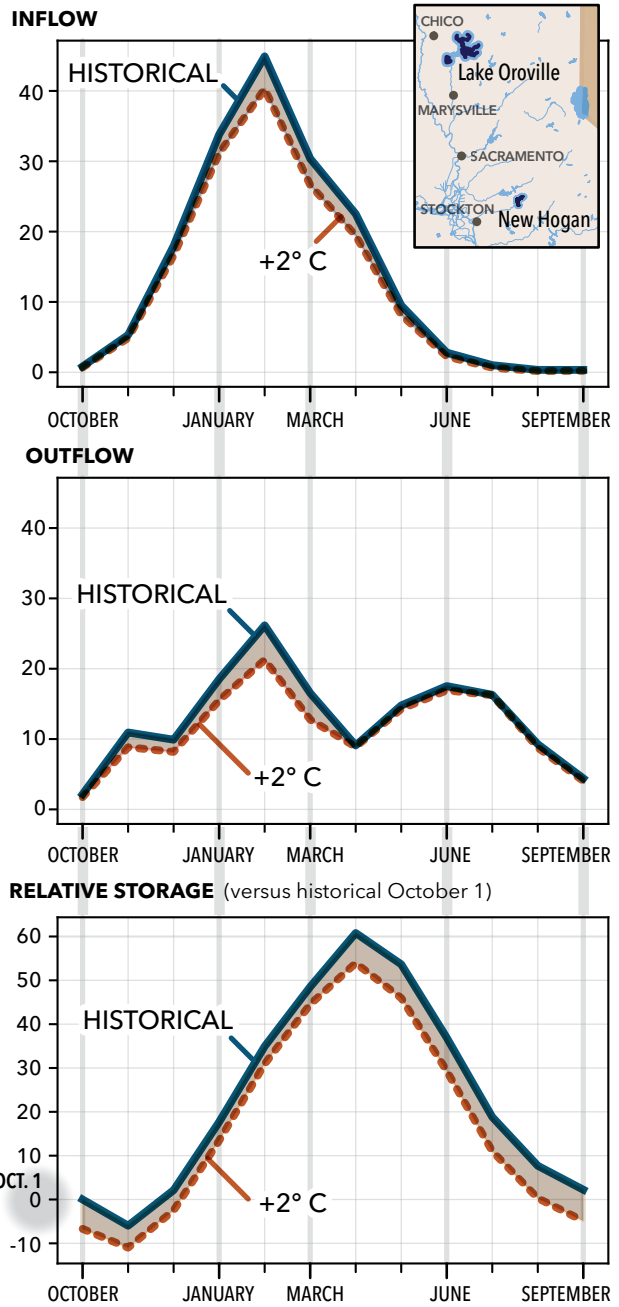


Figure 2-4 Source: California Department of Water Resources 2019

Figure 2-4 Notes: All units are in thousand acre-feet (taf).

This figure depicts projected effects on inflow, outflow, and reservoir storage under a 2 °C warmer climate for a rain-dominated reservoir (i.e., New Hogan on the Calaveras River) and one that is partially driven by spring snowmelt (i.e., Oroville on the Feather River). On average, both reservoirs would begin the water year with less storage resulting from lower average inflow. Oroville storage is further affected owing to reduced snowmelt and

higher winter storm runoff, which leads to higher flood-control spills in February. For both reservoirs, the change in inflow and storage means less water released in certain months compared with historical records, with New Hogan outflows being affected mostly in December through March, and Oroville outflows in December through January and April through May. The figure demonstrates that water managers will need to reevaluate and adaptively manage how major infrastructure systems are operated in the future to ensure reliable water supply, flood management, water quality, and equity while safeguarding the environment.

### Systemic Institutional Challenges

California water management faces significant systemic and institutional challenges, including:

- Fragmented water initiatives, data, and governance.
- Inadequate and unstable funding.
- Lack of prioritization in watersheds that serve as source watersheds for most Californians.
- Insufficient capacity for data-driven decision-making.
- Barriers to public participation.
- Inequitable representation in governing bodies.
- Inadequate performance tracking of public investments.
- Limited financial and human resources to address scale of needs.

These systemic and institutional challenges increase risks to public safety, frontline communities and ecosystems, and the state's economy. These challenges are impeding implementation of programs and projects intended to reverse and recover from legacy impacts and to aggressively adapt to climate change vulnerabilities affecting all water sectors. Equity-related challenges, including affordability, outreach and engagement, and representation and participation, are discussed in Chapter 6, "Understanding and Addressing Equity in the Management of California's Water Resources."

### Challenges Faced by California Tribes

The State acknowledges its history of violence, exploitation, discrimination, and attempted destruction of California Tribes and the dispossession of lands and environments they depend on (Executive Order N-15-19).

Historically, California's water planning and associated funding programs have not included California Tribes. The legacy of colonization, relocation, and termination of California Tribes has perpetuated a practice of excluding Tribes from discussions and decisions for developing State legislation and water policies. Tribes reported that their exclusion from State policies, plans, and investments has limited their ability to access and manage water in accordance with their asserted Indigenous and aboriginal rights, as well as contribute **Tribal Ecological Knowledge** to strengthen policies, plans, and investments. It has made it more difficult for Tribes practice their cultural, religious, and **sustainability** practices.

## Statewide and Water Sector Challenges and Conditions

State assistance is needed to ensure Tribal participation in watershed planning and resource management, including in groundwater sustainability agencies and groundwater sustainability planning. Tribal issues, strengths, and resources are the focus of Chapter 7, “Strengths and Resources of California Tribes.”

### Water Sector Conditions

In this section, current and future water sector conditions are described for water supply, water quality, wastewater, flood management, natural ecosystems, forest and fire management, land use, seismic risks, and water-energy nexus. All water sectors are at risk and are expected to become more vulnerable with climate change.

### Water Supplies and Uses

The Water Plan water supply and use balance analysis provides the only consistent statewide method of aggregating local water-supply data. Comparing regional water uses and supplies with statewide amounts underscores the diversity among the state’s regions. Table 2-1 summarizes California’s statewide applied water uses, and Table 2-2 summarizes dedicated and developed water supplies, for Water Years 2016–2020. Figure 2-5 shows average statewide and regional water uses and supplies for Water Years 1998–2020. Figures 2-6 and 2-7 depict California water uses and water supply sources in a representative wet (2019) and dry (2020) year. Water use and supply volumes and sources, and their relative percentages, vary significantly from year to year and regionally. For more information about California’s water uses and water supplies, refer to the [Water Data Portfolios webpage, California Water Plan Update 2023 Supporting Documents](#), and the regional summaries in Chapter 3.

**Table 2-1** Statewide Applied Water Uses is Shown by Sector for Water Years 2016-2020 (in million acre-feet)

| <b>Sector</b>                      | <b>2016</b> | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>2020</b> |
|------------------------------------|-------------|-------------|-------------|-------------|-------------|
| % Average Rainfall                 | 103%        | 161%        | 73%         | 130%        | 71%         |
| Precipitation                      | 198.1       | 309.4       | 140.6       | 249.2       | 136.3       |
| <b>Urban</b>                       | <b>7.2</b>  | -           | <b>8.2</b>  | <b>7.9</b>  | <b>8.0</b>  |
| Large Landscape                    | 0.6         | -           | 0.8         | 0.6         | 0.8         |
| Commercial                         | 1.2         | -           | 1.1         | 1.1         | 1.1         |
| Industrial                         | 0.4         | -           | 0.4         | 0.4         | 0.4         |
| Energy Production                  | 0.1         | -           | 0.1         | 0.1         | 0.1         |
| Residential - Interior             | 2.8         | -           | 3.0         | 2.8         | 3.0         |
| Residential - Exterior             | 1.4         | -           | 1.9         | 1.9         | 1.9         |
| Conveyance Applied Water           | 0.3         | -           | 0.3         | 0.3         | 0.3         |
| Groundwater Recharge Applied Water | 0.4         | -           | 0.6         | 0.7         | 0.4         |
| <b>Irrigated Agriculture</b>       | <b>33.2</b> | -           | <b>33.7</b> | <b>31.6</b> | <b>32.4</b> |
| Applied Water-Crop Production      | 30.8        | -           | 30.3        | 27.5        | 29.2        |
| Conveyance Applied Water           | 2.3         | -           | 2.7         | 2.9         | 2.7         |
| Groundwater Recharge Applied Water | 0.1         | -           | 0.7         | 1.2         | 0.5         |
| <b>Environmental Water</b>         | <b>41.2</b> | -           | <b>31.5</b> | <b>51.0</b> | <b>23.9</b> |
| Managed Wetlands                   | 1.5         | -           | 1.6         | 1.5         | 1.7         |
| Minimum Required Delta Outflow     | 4.8         | -           | 5.3         | 8.4         | 4.4         |
| Instream Flow Requirements         | 6.3         | -           | 6.5         | 7.7         | 6.4         |
| Wild and Scenic Rivers             | 28.6        | -           | 18.2        | 33.4        | 11.4        |
| <b>Total Uses</b>                  | <b>81.6</b> | -           | <b>73.4</b> | <b>90.6</b> | <b>64.4</b> |

Table 2-1 Note: Data are not available for Water Year 2017.

## Statewide and Water Sector Challenges and Conditions

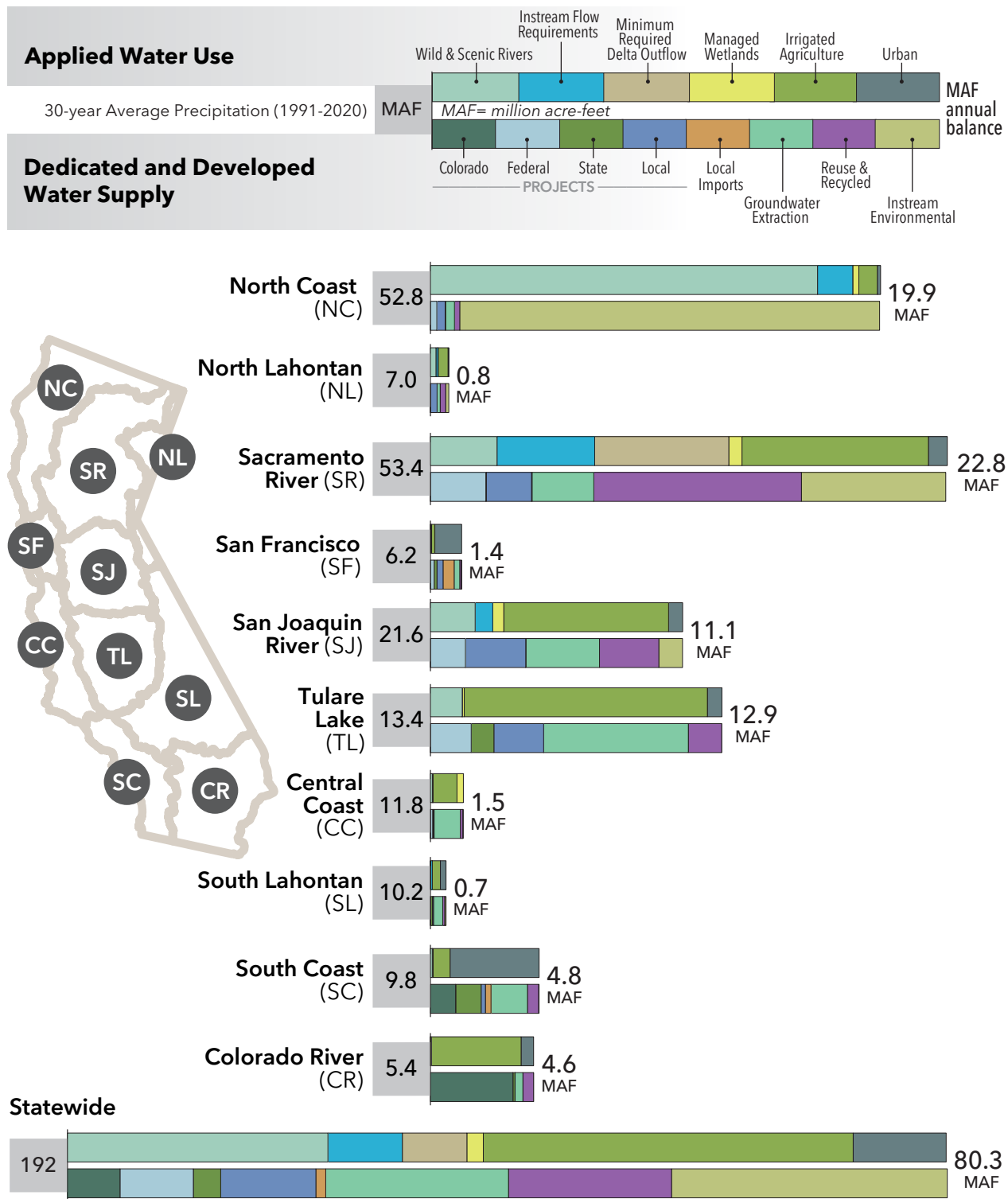
**Table 2-2** Statewide Dedicated and Developed Water Supplies by Supply or Place of Origin for Water Years 2016-2020 (in million acre-feet)

| <b>Supply or Place of Origin</b>             | <b>2016</b> | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>2020</b> |
|--|-------------|-------------|-------------|-------------|-------------|
| % Average Rainfall                           | 103%        | 161%        | 73%         | 130%        | 71%         |
| Precipitation                                | 198.1       | 309.4       | 140.6       | 249.2       | 136.3       |
| Instream Environmental Supply                | 28.1        |             | 18.2        | 30.3        | 12.0        |
| Local Projects                               | 5.4         |             | 6.9         | 8.3         | 6.5         |
| Local Imported Deliveries                    | 0.6         |             | 0.7         | 0.9         | 0.9         |
| Colorado River Project                       | 4.7         |             | 4.4         | 4.0         | 4.1         |
| Federal Projects                             | 7.0         |             | 8.7         | 8.9         | 7.8         |
| State Project                                | 1.8         |             | 2.5         | 2.4         | 1.9         |
| Groundwater Extraction                       | 17.9        |             | 16.2        | 12.2        | 16.4        |
| Inflow and Return Flow for Carryover Storage | 0.1         |             | 0.1         | 0.1         | 0.1         |
| Reuse and Recycled Water                     | 15.9        |             | 15.7        | 23.5        | 14.5        |
| <b>Total Supplies</b>                        | <b>81.6</b> |             | <b>73.4</b> | <b>90.6</b> | <b>64.4</b> |

*Table 2-2 Note: Data are not available for Water Year 2017.*

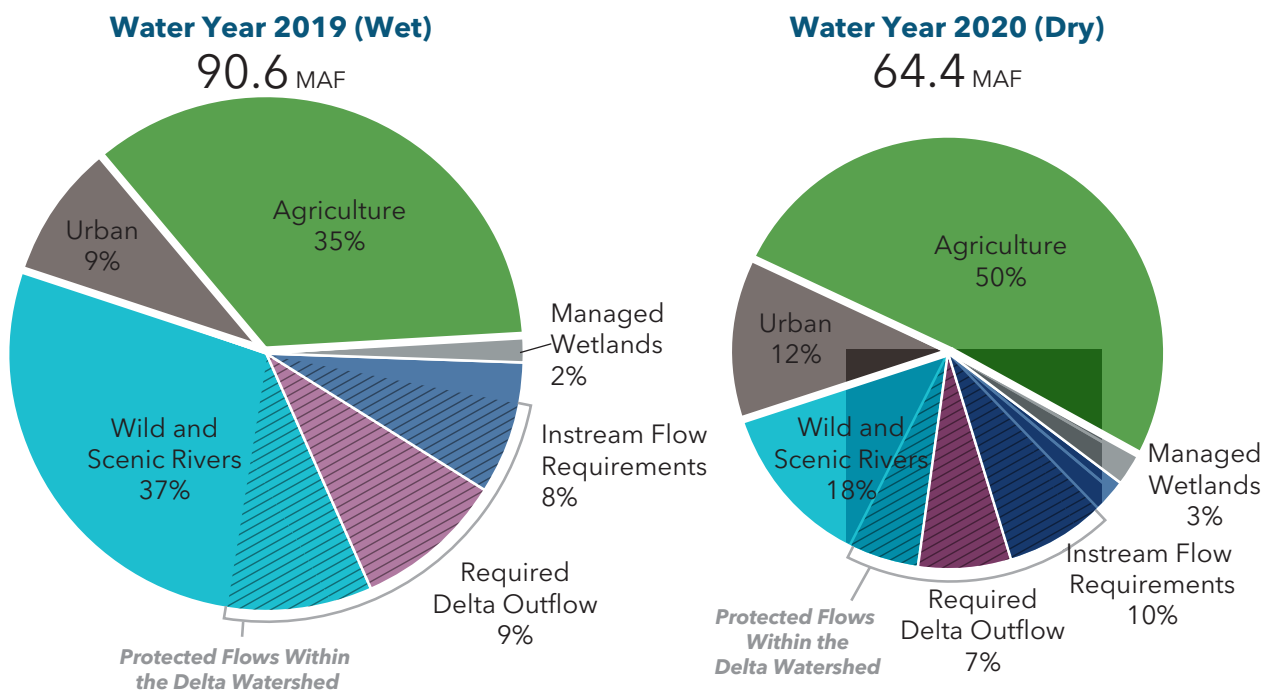


Figure 2-5 Applied Water Uses and Water Supplies Vary by Region for Water Years 1998-2020 Average



## Statewide and Water Sector Challenges and Conditions

Figure 2-6 California Water Uses Can Vary Significantly in Wet and Dry Years



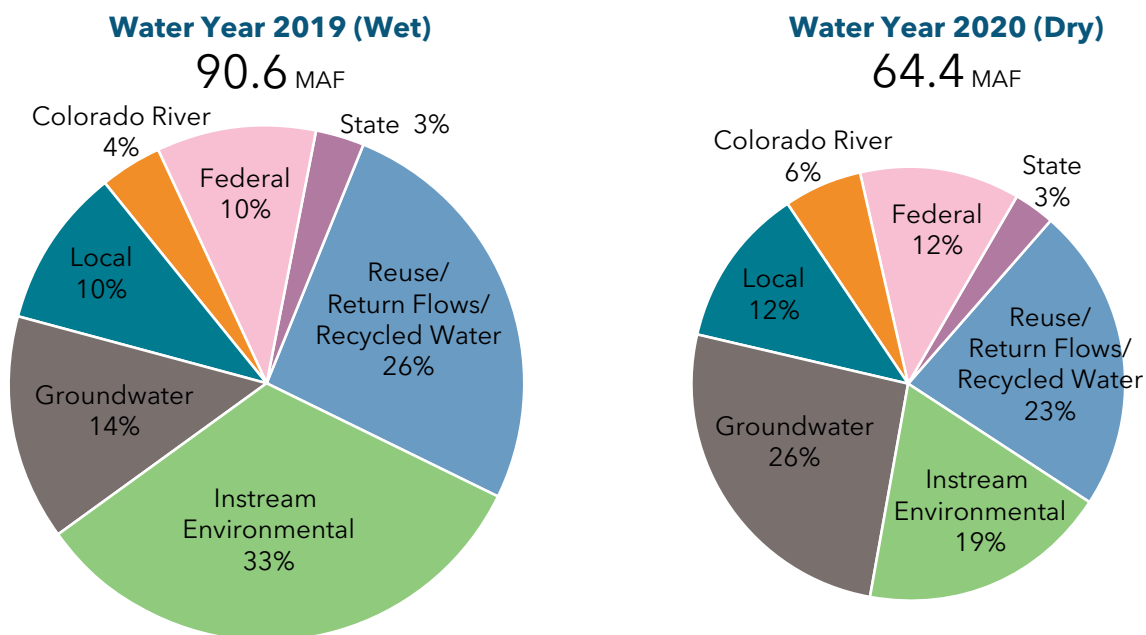
| Water Use                       | Definition   | Applied Water Use |      |            |      |
|---------------------------------|--|-------------------|------|------------|------|
|                                 |  | 2019 (Wet)        |      | 2020 (Dry) |      |
|                                 |  | %                 | MAF  | %          | MAF  |
| Urban                           | Water for urban purposes, including residential, commercial, institutional, and industrial.  | 9%                | 7.9  | 12%        | 8.0  |
| Agriculture                     | Water for irrigated agriculture including multi-cropping.  | 35%               | 31.6 | 50%        | 32.4 |
| Managed Wetlands                | Water for managed wetland areas.   | 2%                | 1.5  | 3%         | 1.7  |
| Minimum Instream Flow Req'ts    | Water within natural waterways as specified in an agreement, water rights permit, court order, FERC license, etc.  | 8%                | 7.7  | 10%        | 6.4  |
| Minimum Required Delta Outflow* | Freshwater outflow from the Sacramento-San Joaquin Delta required by law to protect the beneficial uses within the Delta from the incursion of saline water.                           | 9%                | 8.4  | 7%         | 4.4  |
| Wild and Scenic Rivers          | Over 2,000 miles of river systems are designated wild, scenic, and recreational under the 1968 National Wild and Scenic Rivers Act and the 1972 California Wild and Scenic Rivers Act. | 37%               | 33.4 | 18%        | 11.4 |

\*Total Delta Outflow is higher than Required Delta Outflow: 2019 = 27.4 MAF and 2020 = 6.6 MAF (pie chart includes Minimum Required Delta Outflow only).

Source: Department of Water Resources, California Water Plan 2023 water balances. <https://water.ca.gov/Programs/California-Water-Plan/Water-Portfolios>.

MAF = million acre-feet

Figure 2-7 Developed/Dedicated Water Supplies Vary During Wet and Dry Years



| Developed/Dedicated Water Supplies       | Definition   | Applied Water Supply |      |            |      |
|--|--|----------------------|------|------------|------|
|  |  | 2019 (Wet)           |      | 2020 (Dry) |      |
|  |  | %                    | MAF  | %          | MAF  |
| Groundwater Extraction                   | Annual estimate of groundwater extracted from banked, adjudicated, and unadjudicated basins.   | 14%                  | 12.2 | 26%        | 16.4 |
| Local Projects/Local Imported Deliveries | Volume of surface water delivered by local water agencies and individuals and/or conveyed by local agencies from other regions of the state. | 10%                  | 9.2  | 12%        | 7.5  |
| Colorado River Project                   | Volume of surface water imported from the Colorado River.  | 4%                   | 4.0  | 6%         | 4.1  |
| Federal Projects (CVP and Others)        | The volume of surface water delivered to a given area from the Central Valley Project and other federal projects.                            | 10%                  | 8.9  | 12%        | 7.8  |
| State Water Project (SWP)                | Volume of all surface water delivered to State Water Project contractors.  | 3%                   | 2.4  | 3%         | 1.9  |
| Reuse/Return Flows/Recycled Water        | Volume of previously used water to meet other beneficial uses, with or without treatment prior to subsequent use.                            | 26%                  | 23.6 | 23%        | 14.6 |
| Instream Environmental                   | Instream flows used only for environmental purposes.   | 33%                  | 30.3 | 19%        | 12.0 |

Total Delta Outflow is higher than Required Delta Outflow: 2019 = 27.4 MAF and 2020 = 6.6 MAF (pie chart includes Minimum Required Delta Outflow only).

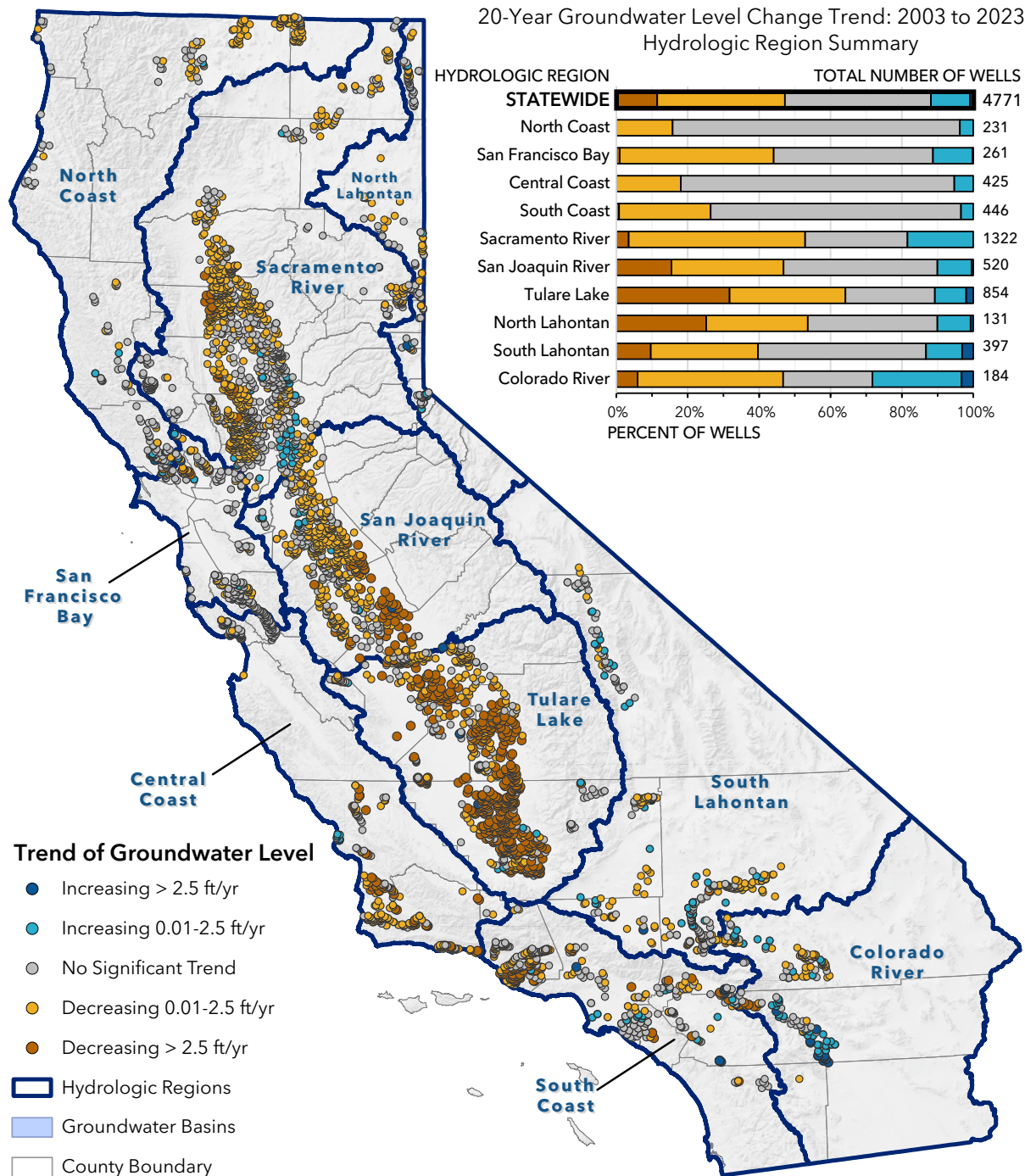
Source: Department of Water Resources, California Water Plan 2023 water balances. <https://water.ca.gov/Programs/California-Water-Plan/Water-Portfolios>.

MAF = million acre-feet

## Statewide and Water Sector Challenges and Conditions

Figure 2-8 shows groundwater-level trends as measured in wells from 2003 to 2023. Statewide, 45 percent of wells show a trend of declining groundwater levels over the 20-year period. Declining groundwater levels have resulted in dry wells, land subsidence affecting infrastructure and water conveyance, and degradation of groundwater quality.

**Figure 2-8 Statewide Groundwater Level Trends Showing Long-Term Declines over 20 Years**



## Statewide and Water Sector Challenges and Conditions

The margin between water supplies and demands has become tighter over time. The hotter and drier conditions related to climate change are causing major shifts in the seasonality and volume of runoff, higher consumptive use by crops, natural vegetation, and urban landscapes, and substantial reduction of natural water storage in the form of snowpack, soil moisture, and aquifer replenishment. Under future conditions, existing available water supplies are expected to decrease by 10 percent by 2040, challenging many vulnerable Californians in accessing their human right to water (California Natural Resources Agency 2022).

It is anticipated that California's water management systems will be unable to deliver the same quality and level of service as in the past. Climate change will exacerbate challenges for California's aging statewide and interregional surface-water storage and conveyance infrastructure, their operation, and groundwater infrastructure (production wells) and management. A decline is expected in the performance of California's major water conveyance systems, including reductions in average annual reservoir carryover storage and surface water export reliability from the Sacramento-San Joaquin Delta (Schwarz et al. 2018; Wang et al. 2018). Surface reservoir and river temperature management is becoming more difficult with increases in temperature. In the Sacramento-San Joaquin Delta, salinity intrusion with sea level rise will require increased outflows to manage salinity and cause changes in its brackish water habitat (California Natural Resources Agency 2020). Prolonged drought impacts are compounded over time as surface reservoirs are depleted and groundwater storage and levels decline.

The Water Plan's **future scenarios analysis** provides new information for understanding the vulnerabilities of water systems to climate change and identifying and prioritizing climate adaptation strategies, as required by the California Water Code.

The future scenarios analysis for *California Water Plan Update 2023* (Update 2023) used the Water Evaluation and Planning (WEAP) model to stress-test water systems and understand potential climate change impacts. The Water Plan's WEAP model currently covers the Central Valley (i.e., Sacramento River, San Joaquin River, and Tulare Lake hydrologic regions) and, for the first time, was used to perform risk-based climate assessments to quantify frequency and magnitude of climate vulnerabilities for multiple sectors with an array of 42 climate scenarios (combinations of temperature and precipitation changes). For California Water Plan Update 2028, the future scenarios analysis using the WEAP model will include the evaluation of climate adaptation strategies and, with additional resources, will be expanded to cover the state's seven other **hydrologic regions**.

## Statewide and Water Sector Challenges and Conditions

The Update 2023 **future scenarios** evaluated climate vulnerabilities for the Central Valley using six key indicators.

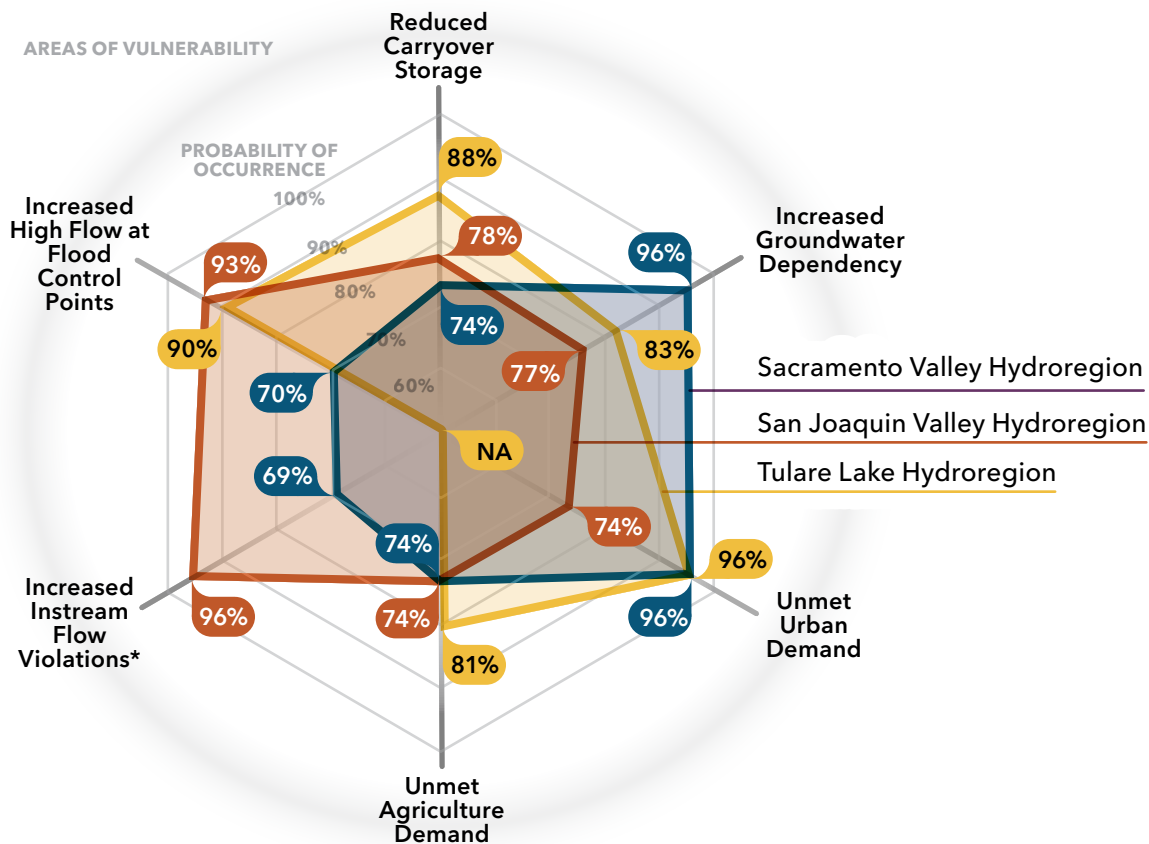
- Reduction in surface storage at the beginning of each water year (carryover storage).
- Increase in groundwater dependency.
- Inability to meet urban water demand.
- Inability to meet agricultural water demand.
- Increases in violations of instream environmental and water-quality flow requirements.
- Increases in high (90th percentile) monthly flows at key flood-control points.

Results from the future scenarios analysis are summarized in Figure 2-9. The results demonstrate that each hydrologic region has unique vulnerabilities and challenges, exacerbated by future climatic conditions. Figure 2-9 depicts the probability that the six indicators will be more vulnerable in 2070 than current conditions for the Sacramento River, San Joaquin River, and Tulare Lake hydrologic regions. The figure shows that there is more than a 65-percent likelihood that all six modeled indicators will become more vulnerable in the future across the Central Valley.

Figure 2-10 illustrates the most probable magnitude of the vulnerabilities for each indicator, as well as a range of possible vulnerabilities resulting from climatic uncertainties informed by Global Climate Model projections. Using the Sacramento River hydrologic region as an example, in approximately 74 percent of future climate projections, there is reduced carryover storage in the region's reservoirs at the end of the water year. The most likely reduced average carryover storage is approximately 7 percent (probable value), but could be as much as 48 percent (possible value) because of climate uncertainty.

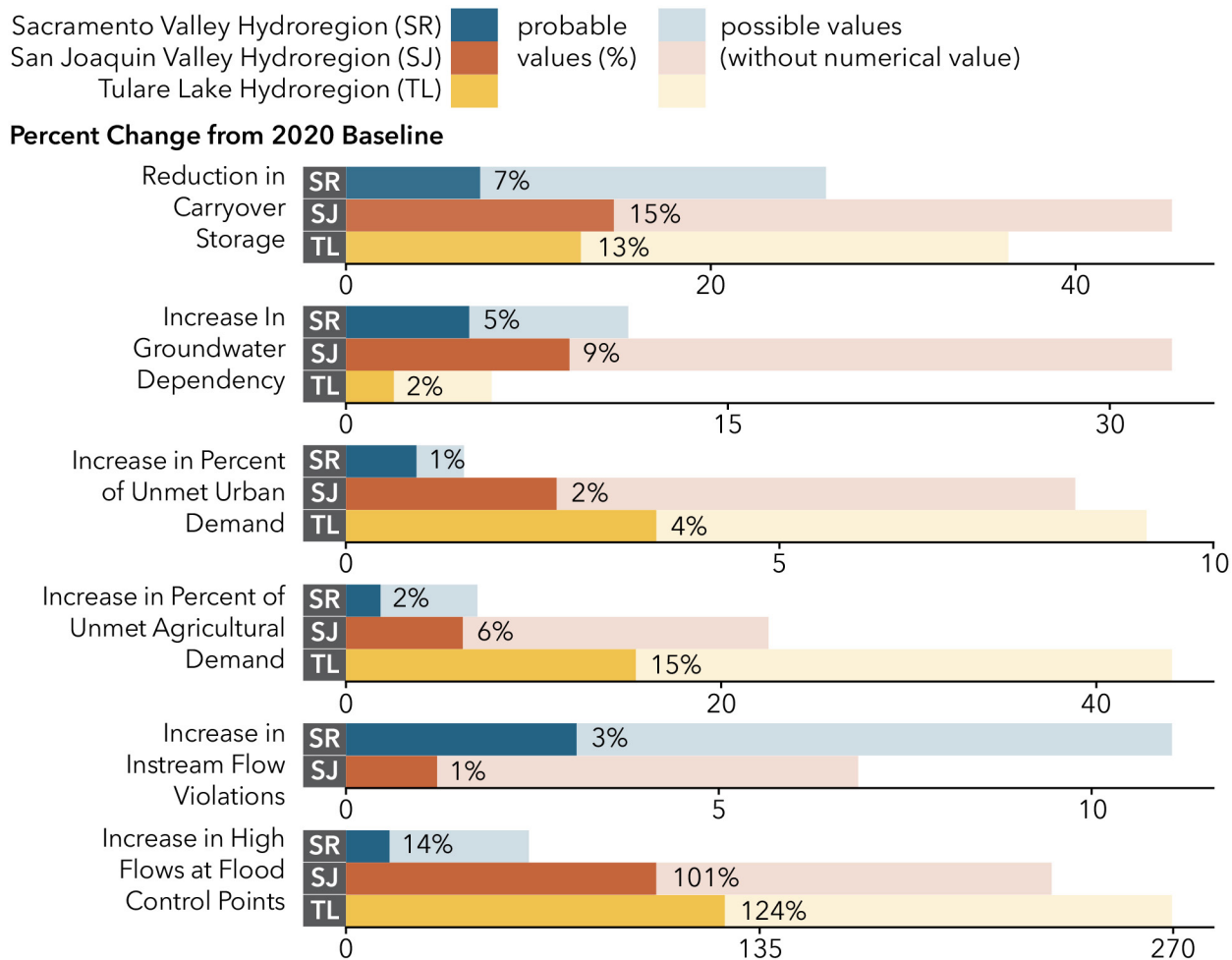
Figure 2-9 The Central Valley Is Likely to be Increasingly Vulnerable in 2070 Based on Six Water Metrics

Probability of Increased Vulnerability of Conditions by 2070



## Statewide and Water Sector Challenges and Conditions

**Figure 2-10 Bar Plot Shows Large Magnitude Changes for Six Water Metrics by 2070**

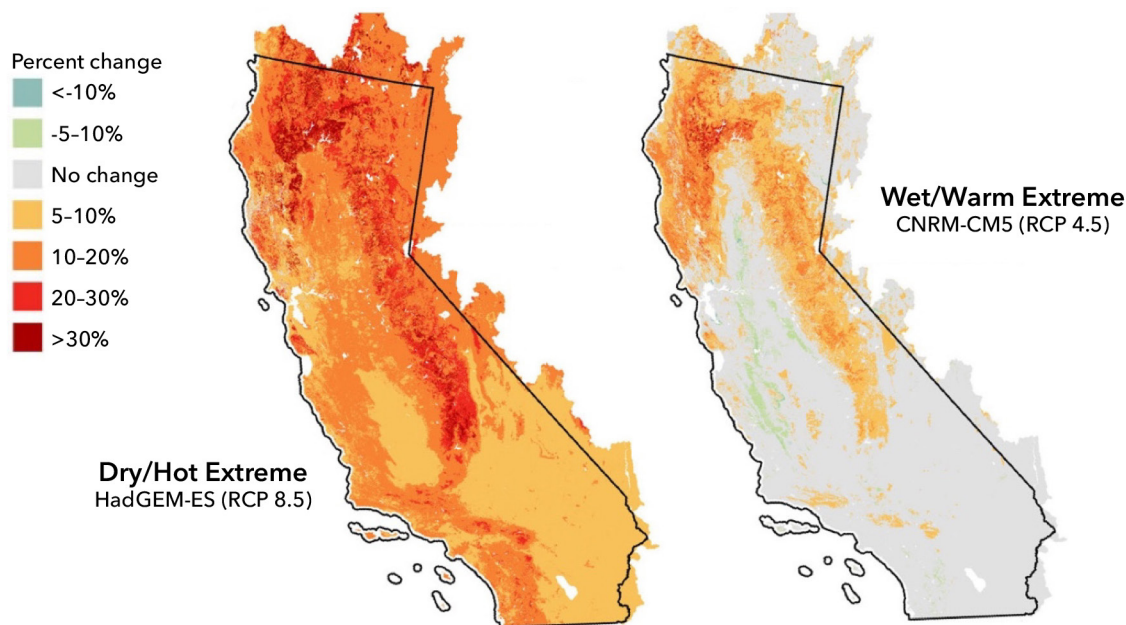


*Figure 2-10 Notes: Probable value = most likely future condition based on the Coupled Model Intercomparison Project 5 (CMIP5) Global Climate Model (GCM) projections of future climatic conditions for California in 2070. Possible Value = most adverse condition within the 95th percentile confidence interval on the CMIP5 CGM projections.*



Climate scenarios were input to the U.S. Geological Survey’s Basin Characterization Model, which computes a monthly **water balance** at high-spatial resolution across California (Flint and Flint 2014). **Climatic water deficit** represents evaporative demand that exceeds available surface water supplies. Figure 2-11 shows a map of the percentage of change in average annual climatic water deficit for dry/hot and wet/warm climate scenarios (California Department of Water Resources 2021). Almost all of California would experience large changes in climatic water deficit under the dry/hot extreme climate scenario (evaporative demand would more likely exceed available surface water supplies), with many areas of the state experiencing significant impacts under the wet/warm extreme scenario.

**Figure 2-11 Statewide Percent Change in Average Annual Climatic Water Deficit for Dry/Hot and Wet/Warm Climate Scenarios Shows Much of California Expected to Experience Significant Climate Impacts**



*Figure 2-11 Notes: HadGEM = Hadley Centre Global Environment Model, CNFM = National Centre for Meteorological Research model. Visual representation of drier with extreme warming scenario (left) and wetter with moderate warming scenario (right).*

## Statewide and Water Sector Challenges and Conditions

### Water Quality

Water quality varies greatly above and below ground by region. Pollution from many diffuse, difficult-to-control sources – contaminants of emerging concern, legacy and current use pesticides, sediment, pathogens, and other sources – cause regional-scale water quality issues and are difficult to address through singular regulatory actions. Emerging contaminants such as microplastics and polyfluoroalkyl substances (PFAS) can greatly affect the quality and use of water supplies. Figure 2-12 provides an overview of water quality hotspots occurring across California.

For many California residents, the right to safe drinking water continues to be a struggle. The State Water Resources Control Board’s Safe and Affordable Funding for Equity and Resilience (SAFER) Dashboard from 2023 indicates that more than 380 water systems serving more than 950,000 California residents are failing to provide safe drinking water. In addition, nearly 900 water systems, serving approximately 2.5 million California residents are either at risk of failing or potentially at-risk of failing to provide safe drinking water. In total, more than 80 percent of these systems are small water systems that serve fewer than 1,000 people. Moreover, many Californians who depend on small water systems or private wells are vulnerable to groundwater contamination from synthetic fertilizers, manure, and septic systems. Surface and groundwater sources of drinking water are vulnerable to pollution, but sometimes communities cannot afford to treat these water sources. For more information on equity-related water quality challenges, see Chapter 6, “Understanding and Addressing Equity in the Management of California’s Water Resources.”

Surface water quality is affected by sediment, pesticides, temperature, nutrients, metals, pathogens, municipal and industrial wastewater, and urban and agricultural runoff. California’s major water pollution problems are often from diffuse, difficult-to-control sources and legacy sources from past industrial activities. Numerous web portals from the California Water Quality Monitoring Council show water quality data for rivers, streams, estuaries, wetlands, and watersheds throughout the state (California Water Quality Monitoring Council 2023).

Groundwater quality is affected by both naturally occurring and human-made chemicals. In urban areas, industrial compounds such as volatile organic compounds and metals have impacted large portions of basins and can take decades of treatment to remediate. In more rural areas, compounds such as nitrate from synthetic fertilizers, manure, arsenic, and septic systems can pose water quality risks to both public water systems and private domestic well users. These threats are particularly acute across the San Joaquin Valley and portions of the Central Coast. Online tools through the State Water Board’s Groundwater Ambient Monitoring and Assessment Program summarize groundwater quality throughout California (State Water Resources Control Board 2023).

Figure 2-12 California’s Regions Have a Wide Variety of Water Quality Issues

California faces numerous water quality problems.



Figure 2-12 Note: TMDL = total maximum daily load

## Statewide and Water Sector Challenges and Conditions

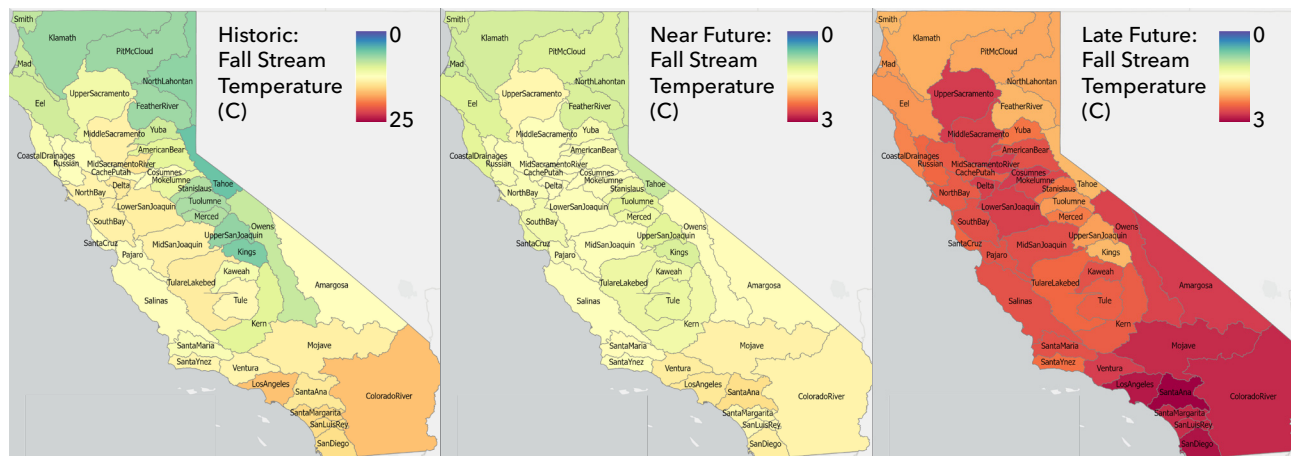
Available science indicates that a significant potential for frequent and severe water quality problems, especially in source waters, can result from increasing stormwater runoff, erosion, and sedimentation, as well as a greater frequency of harmful algal blooms caused by warming waters in combination with an increase in nutrients (Michalak 2016). According to the California Natural Resources Agency (2018), those conditions can be caused by a combination of the following:

- Increased volatility in precipitation.
- Continued reductions in snowpack.
- Unsustainable use of groundwater.
- Tendency toward decreased soil moisture.
- Higher overall in-stream temperatures.

Water quality can also be affected by wildfire, which makes the ground less able to absorb water resulting in more overland flow during storms. This can lead to flooding; erosion; and delivery of sediment, ash, pollutants, and debris to surface water. Sea level rise also affects coastal aquifers, where intruding saltwater degrades water quality, can mobilize pollutants in soil and thus may reduce available water supply for communities.

The DWR Climate Change Risk and Preparedness Assessment estimated changes in stream temperature at a watershed scale under future climate change projections (California Department of Water Resources 2023). Figure 2-13 depicts estimated changes in fall-season average daily stream water temperature for near future (2026-2055) and late future (2056-2085) conditions relative to historical averages. Warmer water temperatures create conditions for more harmful algal blooms that can not only force the closure of beaches, rivers, and lakes to avoid health risks to people and pets, but also further limit water supplies.

**Figure 2-13 Fall Stream Temperature is Projected to Increase Significantly for Near and Late Future Scenarios Compared with Current Conditions**



*Figure 2-13 Notes: Change in the fall season (October–December) stream water temperature at watershed scale during Near future (2026–2055, center, °C) and Late future (2056–2085, right, °C) with respect to historic period (1981–2010, left, °C) using 10 climate models under RCP 4.5 and RCP 8.5.*

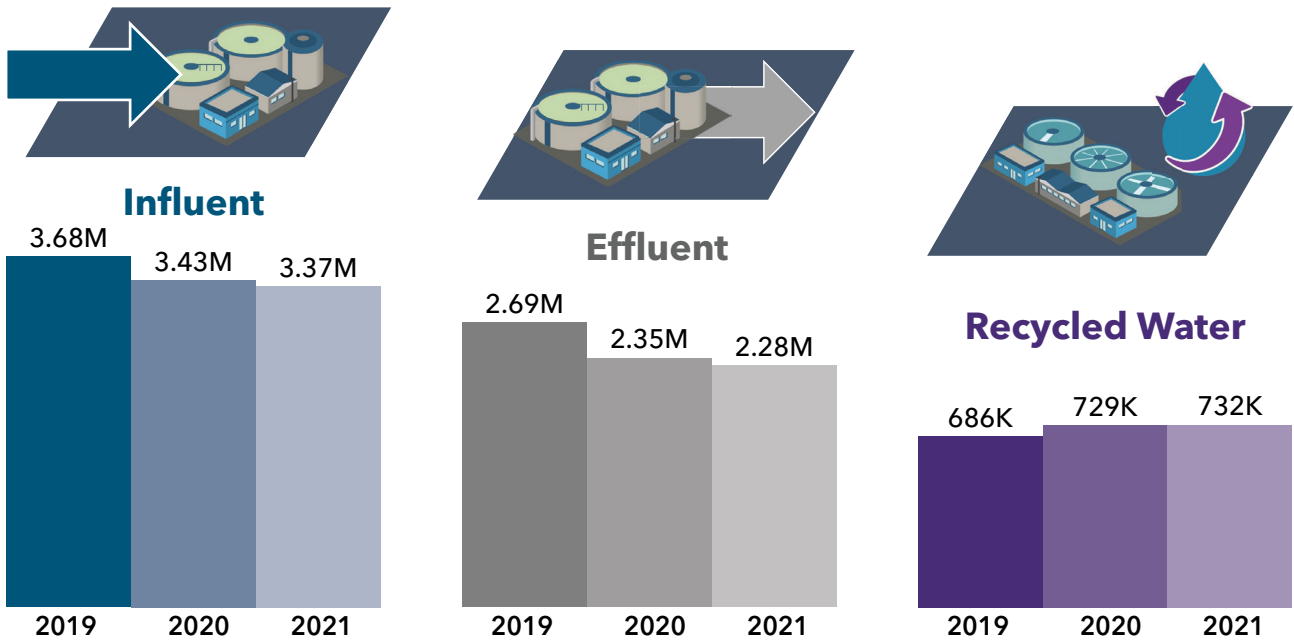
## Wastewater

Wastewater is water that has been used in a home, business, or as part of an industrial process. Wastewater treatment helps protect people and local ecosystems from water that has been polluted. Wastewater is often treated through centralized systems, such as a wastewater treatment plant, or through decentralized systems, such as septic tanks and other onsite treatment systems. Water recycling (also commonly known as water reuse or water reclamation) collects water from a variety of sources then treats and reuses it for beneficial purposes such as agriculture and irrigation, potable water supplies, groundwater replenishment, industrial processes, preventing seawater intrusion, and environmental restoration. Recycled water is a critical water supply for California and an important resource for diversifying local supplies and improving water **resilience**. In 2021, there were 421 wastewater treatment plants, 267 wastewater treatment plants that produce recycled water and 20 recycled water producers (facilities that do not receive raw wastewater) across California.

The State Water Board produces a volumetric annual report which tracks monthly volumes of influent, wastewater produced, and effluent, including treatment level and discharge type of all wastewater and recycled water dischargers in the state. Figure 2-14 shows influent, effluent, and recycled water volumes for 2019 through 2021. Historical water reuse volumes for regional water quality control boards from 1970 through 2022 is shown in Figure 2-15.

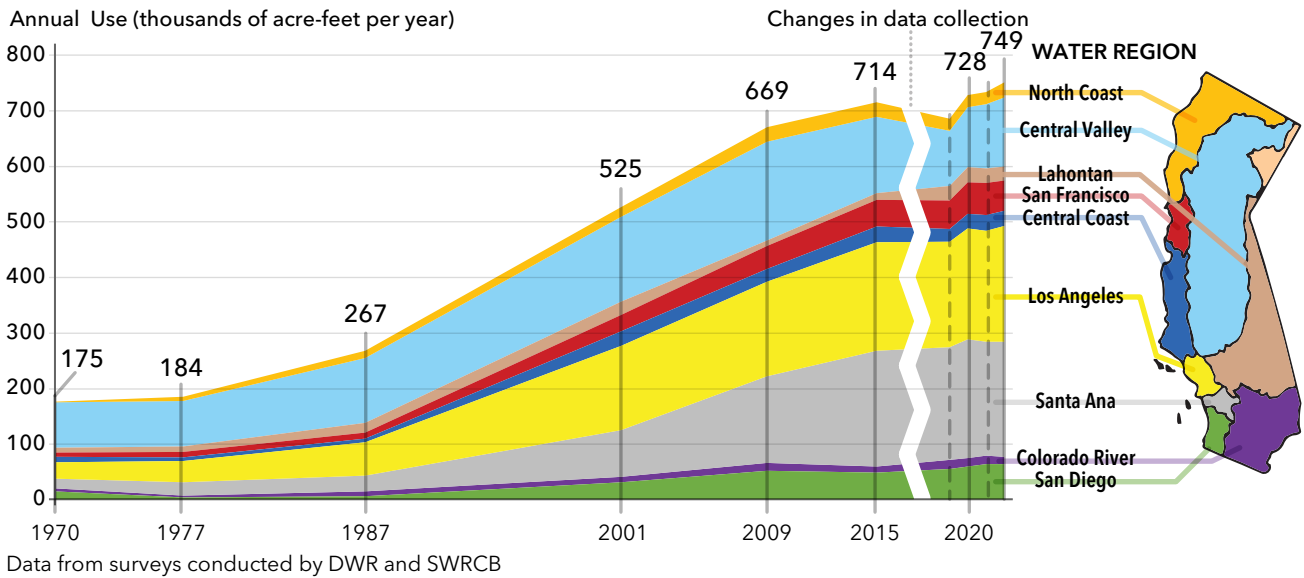
## Statewide and Water Sector Challenges and Conditions

Figure 2-14 Influent, Effluent, and Recycled Water Volumes (2019-2021)



Acre-feet (AF) per year; M - million; K - thousand

Figure 2-15 Municipal Water Reuse by Regional Water Quality Control Board (1970-2022)



### Flood Risk Management

California receives most of its annual precipitation from a handful of major winter storms, including atmospheric rivers. Atmospheric rivers are long, concentrated regions in the atmosphere that transport moist air from the tropics to higher latitudes. On average, 30 to 50 percent of annual precipitation in the West Coast states occurs from just a few atmospheric river events (National Oceanic and Atmospheric Administration 2023). Levees and surface reservoirs were constructed to help reduce flood risk from these storms. But more intense winter storms are increasing pressure on levees and complicating reservoir operations to balance flood protection with water supply storage.

More than 7 million Californians, or one in five, live in a **floodplain** along with approximately \$580 billion in assets (i.e., crops, structures, and public infrastructure, excluding transportation facilities and utility pipelines) that are exposed to flooding within the 500-year floodplain (that is, having a 0.2 percent chance of flooding each year). In addition, more than \$7 billion in crop values are exposed within California's 500-year floodplains and approximately 35 percent of agricultural land in the state is in floodplains. (California Department of Water Resources 2013).



Flooding in the Tulare Lakebed, March 24, 2023

Even with a history of continuing investment and action by local, State, and federal flood management agencies, residual flood risks exist in every California county. Each of the state's 58 counties have experienced at least one significant flood event in the last 25 years. In addition to the tragic loss of life, flooding in California can have a serious effect on state and national economies and environmental resources. Table 2-3 shows populations exposed to flooding in each hydrologic region.

## Statewide and Water Sector Challenges and Conditions

**Table 2-3 Many Californians are Exposed to Flood Risk**

| <b>Hydrologic Region</b> | <b>100-Year Floodplain: Population Exposed</b> | <b>100-year Floodplain: Percentage Exposed</b> | <b>500-year Floodplain: Population Exposed</b> | <b>500-year Floodplain: Percentage Exposed</b> |
|--------------------------|--|--|--|--|
| Central Coast            | 90,000   | 6  | 430,000  | 29   |
| Colorado River           | 30,000   | 5  | 230,000  | 38   |
| North Coast              | 30,000   | 5  | 40,000   | 7  |
| North Lahontan           | 4,000  | 4  | 4,000  | 4  |
| Sacramento River         | 200,000  | 8  | 930,000  | 36   |
| San Francisco Bay        | 360,000  | 6  | 1,040,000                                      | 17   |
| San Joaquin River        | 160,000  | 9  | 540,000  | 31   |
| South Coast              | 390,000  | 2  | 3,410,000                                      | 19   |
| South Lahontan           | 20,000   | 3  | 150,000  | 21   |
| Tulare Lake              | 130,000  | 7  | 500,000  | 27   |
| <b>Total</b>             | <b>1,414,000</b>                               | <b>N/A</b>                                     | <b>7,274,000</b>                               | <b>N/A</b>                                     |

*Table 2-4 Notes: N/A = not applicable*

*The “percentage exposed” applies to the population in each hydrologic region, meaning the total does not add up to 100 percent.*

*Population data are based on the 2020 U.S. Census.*

*Source: California Department of Water Resources 2013, California’s Flood Future: Recommendations for Managing the State’s Flood Risk.*

California’s flood management infrastructure has saved many lives and prevented billions of dollars of damage. Nonetheless, resources for operations and maintenance and much-needed improvements of aging 20th-century infrastructure have not kept up with the demand for necessary infrastructure improvements and the rate of climate change, putting people and property at increased risk. Equity-related challenges associated with flood management are described in Chapter 6, “Understanding and Addressing Equity in the Management of California’s Water Resources.”

Regional studies, such as the 2022 Central Valley Flood Protection Plan (CVFPP) update, have recent information and analysis of climate change impacts. The CVFPP update found that watershed characteristics and system performance strongly influence the hydrological response to climate change, with the high-elevation San Joaquin basin watersheds showing larger percent increases in flood volumes than Sacramento basin watersheds because of a reduction in precipitation as snowfall and more rapid snowpack melting (California Department of Water Resources 2022). Over a projected 50-year period (2022 through 2072), estimates of the annual lives lost as a result of flooding more than doubles in the Sacramento River Basin and quadruples in the San Joaquin Basin without recommended flood system investments (California Department of Water Resources 2022).



Mean sea-level has already risen by approximately 8 inches along portions of the state and is projected to continue to rise and likely produce more frequent and potentially more damaging floods, increasing the exposure of people, property, and infrastructure to flood hazards in coastal floodplains, the San Francisco Bay-Delta, and lower Sacramento River and San Joaquin River watersheds.

Although large flood volumes can cause risks to people and assets, stormwater can be an important source of water supply through stormwater capture. Over the last 30 years, an average of approximately 324,000 **acre-feet** of stormwater a year has been captured and recharged in communities in the South Coast alone (California Natural Resources Agency 2022).

### Natural Ecosystems

California is one of 25 global biodiversity hotspots (Myers et al. 2000), in large part because of its diverse mountain ranges, geology, and climatic conditions. California's world-renowned biodiversity relies on healthy surface and groundwater-dependent habitats, from desert washes to seasonal pools to perennial streams. The state's rivers provide habitat for abundant fish and wildlife and have sustained human populations for thousands of years. California's ecosystems sustain communities; support the economy; provide for recreation; and anchor history, culture, and traditions. Human activities have altered and fragmented the natural functions of most major rivers and water-dependent habitat in the state and has facilitated dramatic landscape-scale changes across previously arid regions. Reclamation has eliminated most of the state's historical wetlands. Reduced stream flows, increased temperatures, lack of habitat, pollution, and proliferation of invasive species have affected many fish species across the state. Native fish and wildlife evolved to cope with drought, but prolonged dry periods are increasingly stressful because many streams warm, lessen, or dry up. In many areas, fish and wildlife exposure to these dry periods is often extended or amplified by consumptive water use.

Over the last two centuries, 75 percent of California's native vegetation has been altered and more than 90 percent of its wetlands have been lost, diminishing ecosystems across the state (U.S. Department of the Interior 1994) (Dahl 1990). Blue oak woodlands, riparian zones, and grasslands now occupy a small fraction of their historic range (California Natural Resources Agency 2022). Many species are declining, and the number of fish species considered highly vulnerable to extinction rose from nine in 1975 to 31 species in 2020 (California Department of Water Resources 2020). While ecosystem restoration to pre-human conditions is not practical, ecosystem functions, processes, and services can be improved through better conservation and management.

Because California's various climates strongly influence its biodiversity, climate change has direct and indirect impacts on aquatic and terrestrial plants and animals. Direct effects of climate change to California's ecosystems include the physiological stress that species experience with changes in temperature and precipitation. This stress will cause population declines in many species and may force vegetation communities and individual species to shift their geographic distributions or ranges to track the shifts in suitable climates (California Natural Resources Agency 2018).

## Statewide and Water Sector Challenges and Conditions

Climate change is also causing the spread of invasive species, pests, pathogens, and diseases that affect ecosystems and species. A likely consequence is the creation of different ecosystems comprised of native species from diverse sources and non-native species from all over the world. In the next 50 to 100 years, many aquatic ecosystems in California will morph into highly modified ecosystems supporting fishes, aquatic plants, and invertebrates from all over the world, with just a few remaining native species (Moyle 2014). This situation already exists in the Sacramento-San Joaquin Delta and many Central Valley streams. Chronic temperature stress, more frequent and extreme droughts, pest and pathogen outbreaks, and wildfires will interact as compound disturbances amplify effects and facilitate major ecosystem transitions in California (Batllori et al. 2017; Buma 2015; Dale et al. 2001; Paine et al. 1998) (California Natural Resources Agency 2018).

### Forest and Wildfire Management

California's 33 million acres of forestland capture and clean the water supply, provide habitat for countless wildlife, cool cities, support local economies, and serve as spiritual and cultural centers for Indigenous and local communities across the state. There is increasing concern about the sustainability of forest and rangelands. The frequency and severity of mega-disturbances resulting from climate change, such as drought, decreasing snowpack, wildfire, and pests, are escalating even as the human population demands more from natural systems and thus increases impacts on those systems.

The management of these lands also greatly influences the quantity and quality of water, along with timing and distribution of water for downstream uses. Forested watersheds are the origin of most of the state's water supply for urban, agricultural, and environmental use. This supply is often conveyed hundreds of miles to populations who bear little, if any, cost for maintaining forest health and the ecosystem services they provide. The cost of maintaining healthy forested watersheds and associated ecosystems is often instead borne by sparse populations within these upper watersheds.

Nearly one in four Californians live in a high fire-risk zone. Over the last five years, California has faced the deadliest and most destructive wildfires in the state's history. Most of these wildfires were concentrated in the upper watersheds of the Sierra Nevada and Southern Cascade ranges, which on average sources about 60 percent of California's water supplies, exacerbating drought conditions, and creating a reinforcing cycle of climate catastrophes. In the last two years, more than 17,000 wildfires consumed nearly 7 million acres of California – an area approximately the size of Massachusetts. These fires decimated mountain communities such as Paradise, Grizzly Flats, Greenville, and Berry Creek and forced more than a quarter of a million people to evacuate.

Increasing frequency and severity of wildfires can affect public health over a large area outside an active fire area. At the local level, fires can damage water supply sources for years to come. Water supply infrastructure can become subject to flooding, siltation, and landslides, and thus worsen water quality.

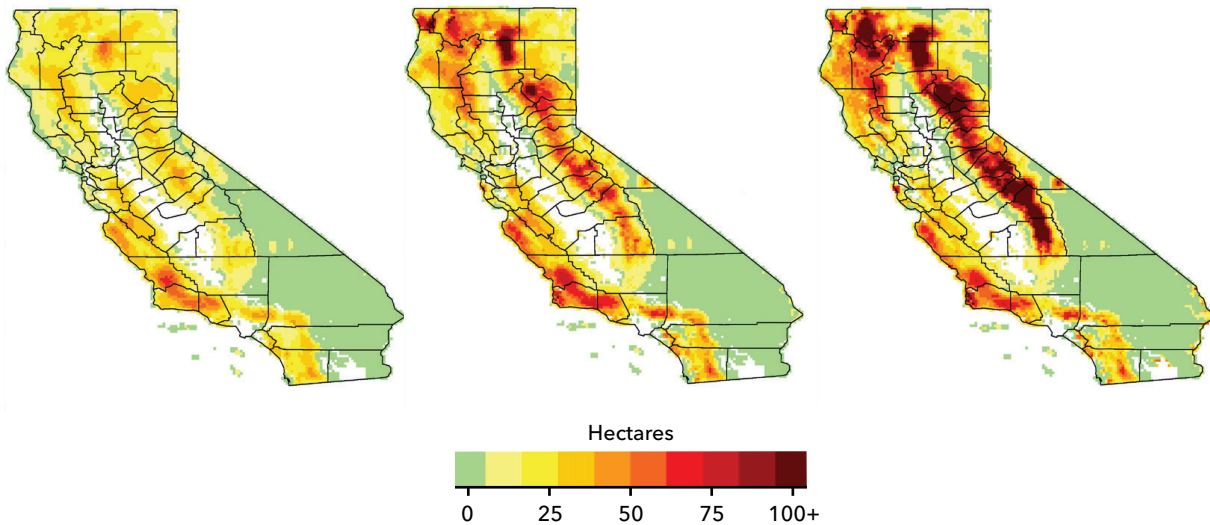
Fire, like water, is an integral part of California's natural ecology. Many ecosystems have adapted to frequent fires that burn at low temperatures and help germinate seeds and

return nutrients to the soil. For millennia, Native American Tribes actively managed California's wildlands with cultural fire practices, achieving healthier, more productive ecosystems and protecting residents from wildfires. With colonization, a legacy of fire suppression has removed the natural and cultural role of fire from California's landscape, leaving overly dense forests of smaller diameter trees vulnerable to drought, wildfire, and infestation. This changed the structure of forest ecosystems and caused significant buildup of fuel, much of which must be removed before natural fire regimes can be restored to improve forest health.

In 2020, as part of a trend of increasing mega-fires fueled by hotter and drier conditions, California recorded the largest acreage of land burned on an annual basis in its history. Since the 1970s, summer temperatures have increased by approximately 2.5 °F, which, coupled with extended drought conditions, has greatly increased fuel aridity. By the end of this century, California's wildfires are expected to burn 77 percent more acreage – roughly the size of Delaware – every year (Figure 2-16) (California Natural Resources Agency 2018).

Climates in some regions are changing relatively quickly, and it is likely that many forest species will not be able to persist where they are now. Climate change will influence forest ecosystems through changes in the timing of seasonal and natural patterns, respiration, snow storage, and atmospheric moisture demand (Anderegg et al. 2015; Mankin and Diffenbaugh 2015; Williams et al. 2013; Torne et al. 2015; Wolkovich et al. 2012). Droughts co-occurring with, and worsened by, increasingly high temperatures are of particular importance in California's forests (Diffenbaugh et al. 2015; Williams, Schwartz, et al. 2015). Land use and development patterns also play an important role in future fire activity (Mann et al. 2014).

**Figure 2-16 Large Average Annual Area Burned by Wildfire is Projected Under 1961-1990, 2035-2064, and 2070-2099 Global Climate Model Scenarios**



Source: Westerling 2018

Figure 2-16 Note: Average annual area in hectares burned using four global climate models and 30-year periods for RCP 8.5, mid-range population growth. (a) 1961-1990; (b) 2035-2064; (c) 2070-2099.

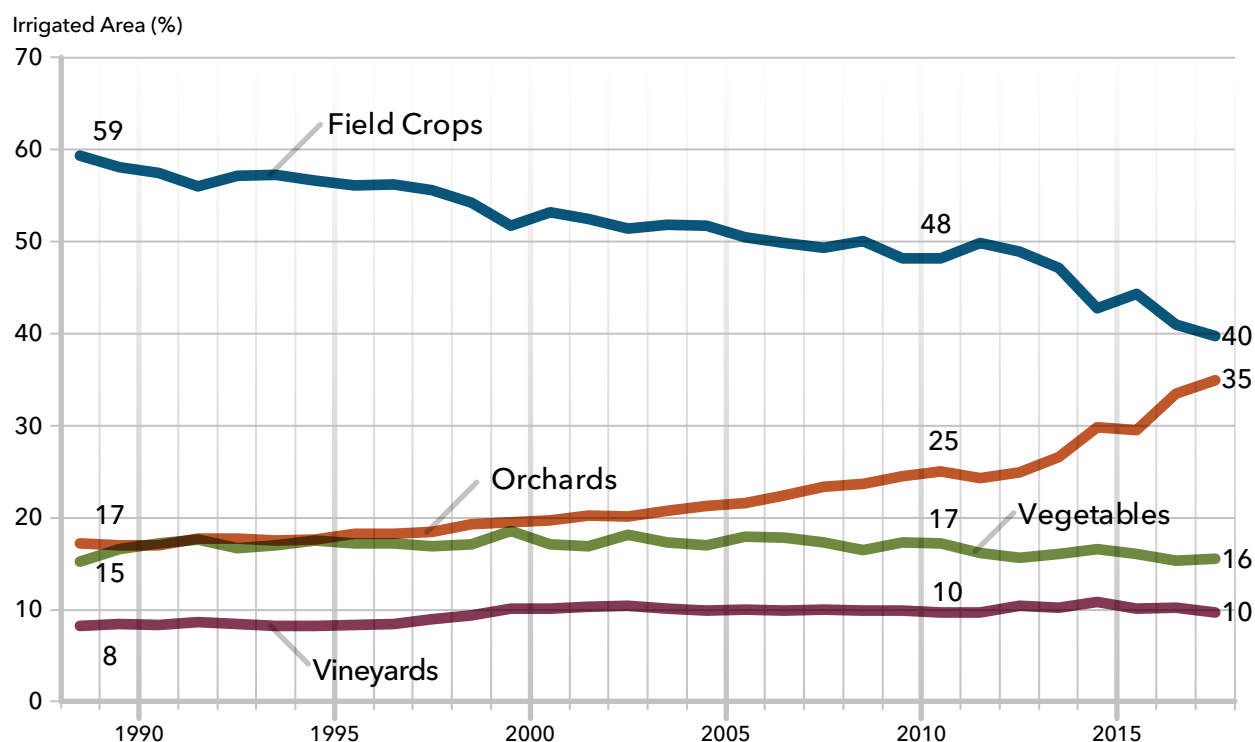
### Land Use

Population growth and associated development have always had significant impacts on the environment, and their impacts are becoming more critical under a changing climate. The ways in which people plan, organize, and build will not only affect how the climate continues to change, but also how people will experience the impacts of climate change (Garmestani and Allen 2014).

Land use conversion can result in the loss of habitat that provides natural protection for communities and infrastructure. Development in high-hazard areas (e.g., coastal areas at risk of sea level rise, floodplains, fire-prone areas) place people, infrastructure, and other assets at risk. More than 1 million housing units fall within a Very High Fire Hazard Severity Zone. For communities in rural fire-prone areas, the threat to public safety, loss of property, and rising economic costs of fire suppression and post-fire recovery are becoming unsustainable. This is driving a need to reevaluate land use planning, pre-fire management, and investments in ecosystem health.

The way urban and agricultural lands are managed greatly influence water demands. Urban land-use decisions and water-efficient landscape design practices can drive urban water demand because half of urban water produced in California is used for landscape irrigation. For agricultural lands, Figure 2-17 shows historical California land-use data for field crops, vegetables, orchards, and vineyards from 1988 to 2018. Beginning around 2006, irrigated land planted to orchards increased significantly in four hydrologic regions, while the percentage of land planted in field crops has decreased. The shift to permanent crops further constrains options during drought conditions because temporary fallowing is not possible with higher-value permanent crops.

Figure 2-17 Orchards Replaced Field Crops in Water Years 1988-2018



Source: California Department of Water Resources. Land and Water Use Program. Land Use Survey Data, 2023

[California’s Fourth Climate Change Assessment](#) includes projections of population and land use change through the end of the 21st century. Developed lands are projected to increase 40 to 90 percent by 2100. Urbanization will continue to have profound effects on the composition of ecosystems in California and on natural and working lands. Land use modeling found that urban expansion will most likely occur adjacent to existing cities, with some towns continuing to merge into larger metropolitan areas.

### Seismic Risks

A major seismic event causing catastrophic levee failures in the Sacramento-San Joaquin Delta (Delta) is another key risk. According to the U.S. Geological Survey, there is a 72 percent chance of the San Francisco Bay Area experiencing a 6.7 or greater magnitude earthquake by 2043. An earthquake of this magnitude close to the Delta could cause multiple Delta levees to fail, resulting in saltwater inundation of deeply subsided Delta islands that are below sea level. Such levee failures would pull seawater into the Delta, significantly affecting the water supply for millions of Californians. When combined with high tides, the resulting damages and needed recovery times could take months before facilities could become fully operational.

But seismic risks in California are not limited to the Bay-Delta region. Major seismic risks exist to water conveyance of the SWP, Los Angeles Aqueduct, Colorado River Aqueduct, All-American Canal, Coachella Canal, Salton Sea, and other water conveyance infrastructure throughout

## Statewide and Water Sector Challenges and Conditions

California. In addition, more than 100 dams in California have been identified as unsatisfactory in condition assessments. Many of these assessments have identified seismic risks, requiring some dams to operate below design-storage capacity.

### Water-Energy Nexus

Climate change, water, energy, food, and ecosystems are inextricably linked. There will be increasing demand for fresh water, energy, and food under the pressures of future population growth, climate change, and compromised ecosystem health. More extreme heat and drought are expected to increase demands on energy grids and strain hydropower production. Energy is also used throughout the water sector to extract, convey, treat, distribute, and heat water. The large majority of water sector electricity consumption is driven by end-uses of water, including residential and industrial uses.

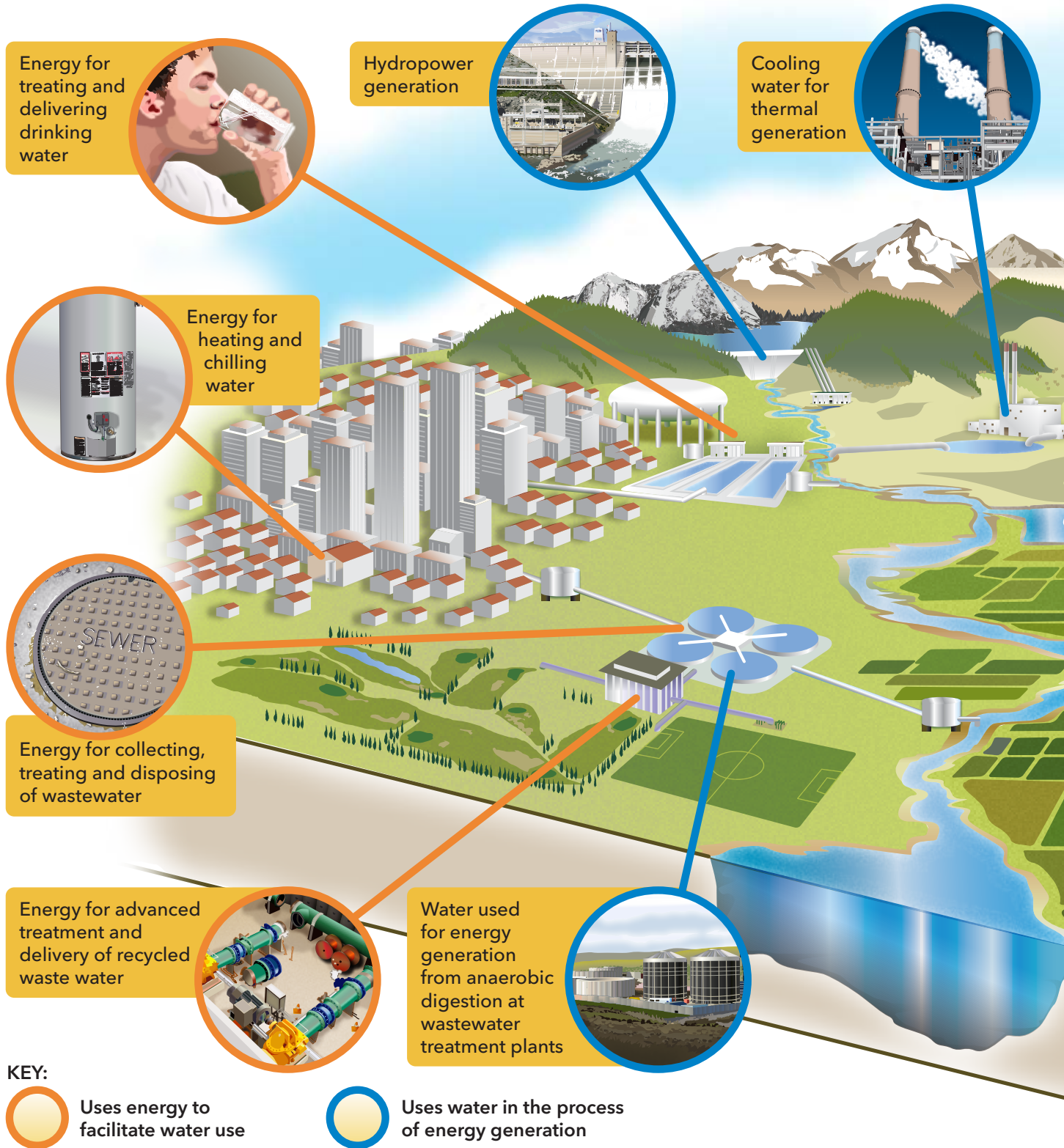
Figure 2-18 shows multiple ways that California's water and energy sectors are linked. Connections where water is used in the generation of energy are highlighted in blue; connections where energy is expended in the use of water are highlighted in orange. The energy required for extraction and conveyance of water are indicated with green hatches.

More frequent and extreme heat and drought conditions are expected to further stress and destabilize energy systems. Additionally, local water supply development in many parts of the state is moving toward more energy-intensive alternative water supplies, such as municipal recycled water, brackish groundwater desalination, and seawater desalination. Peak energy demands during extreme heat and drought can result in rescheduling of water deliveries to maintain energy grid security. Taking energy intensity into account can help make California more resilient and better able to adapt to the stresses of climate change.

As described above, all water sectors are at risk and are expected to become even more vulnerable with climate change. Potential cascading effects and externalities across water sectors create even greater uncertainty and complexity. The next chapter explores how conditions and challenges vary from region to region throughout California, along with the natural and built backbone infrastructure systems that connect them.

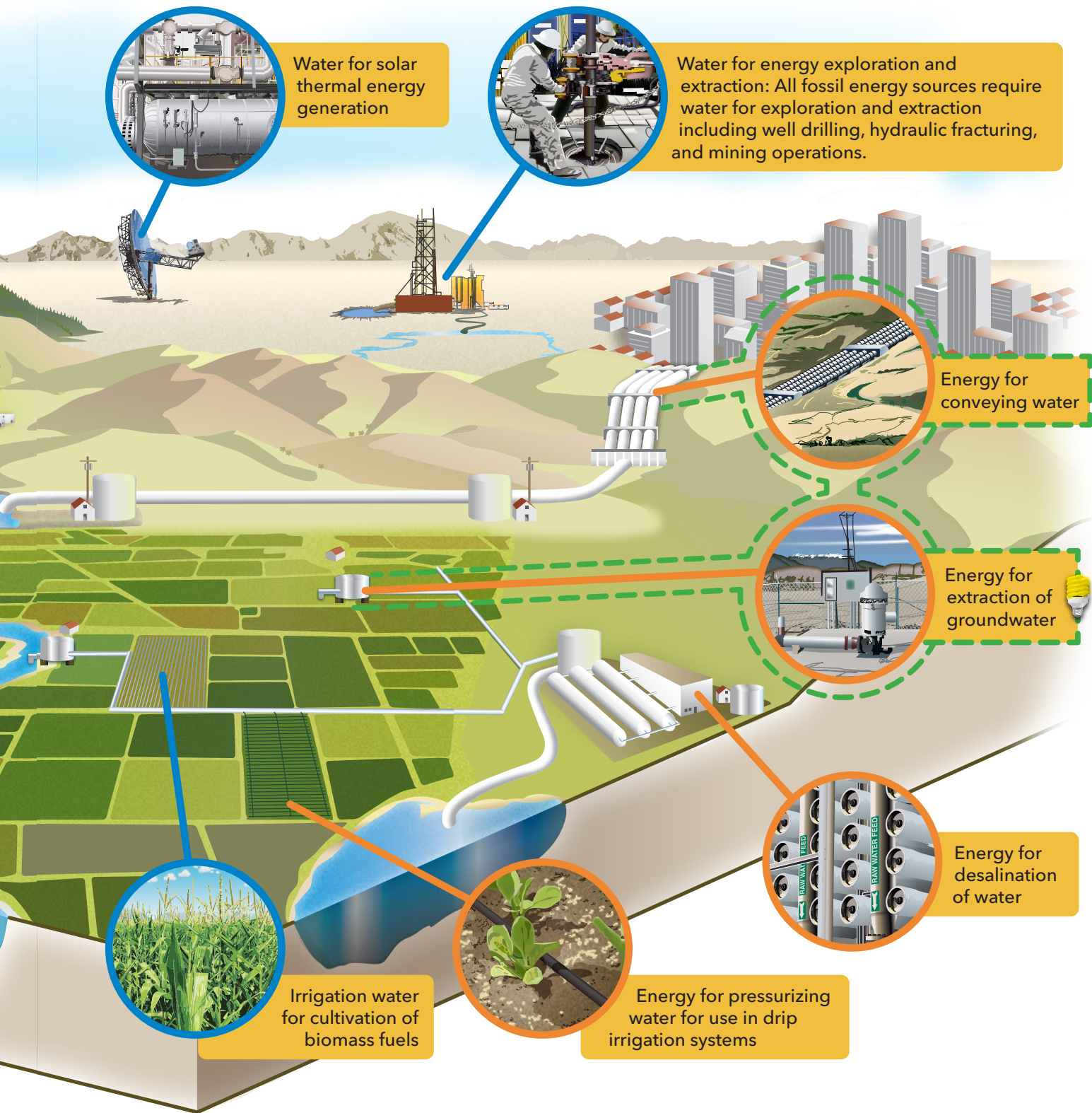
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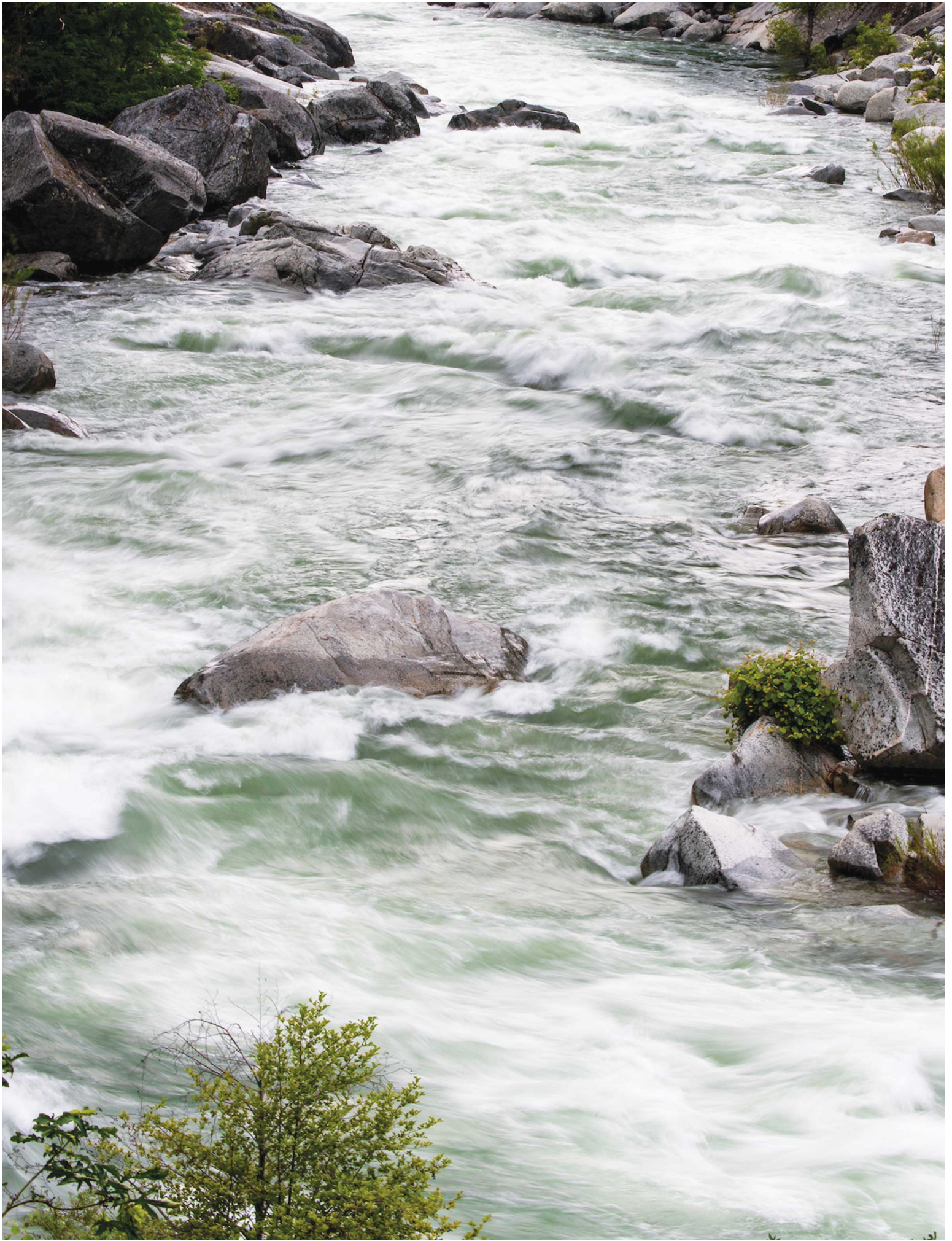
Figure 2-18 Water and Energy are Connected





# Statewide and Water Sector Challenges and Conditions





# 3

## Natural and Built Backbone Water Infrastructure and Regional Summaries

An intended outcome of *California Water Plan Update 2023* (Update 2023) is to make California's **watersheds** and "backbone" infrastructure, including natural systems and built systems, more resilient and sustainable and to ensure they are managed equitably. To that end, this chapter discusses the importance, nature, and challenges of the state's natural and **built backbone infrastructure**. The chapter also provides graphical regional summaries to describe regional challenges and opportunities for the state's 10 **hydrologic regions** and two overlay areas of interest.

### Natural and Built Backbone Infrastructure

Regional **resilience** cannot be achieved without investment in California's natural and built backbone infrastructure. Backbone infrastructure refers to the natural and the built systems that connect and benefit multiple regions throughout the state. The interconnection between natural systems and built infrastructure is underappreciated, often leading to lack of investment in natural infrastructure. The State's water resiliency depends on the effective management of these integrated backbone systems.

**Natural backbone infrastructure** includes the conservation, preservation, or sustainable management of source watersheds, forests, rivers, **floodplains**, estuaries, wetlands, meadows, aquifers, groundwater basins, and working lands (e.g., range land and Cultural Reserve Program land). If properly managed, source watersheds provide many ecosystem services, such as natural storage, high-quality supply, regulation of water supply across seasons and years, attenuation of peak flood flows, and thermal regulation. Rivers and floodplains help convey water from source to diversion, deliver flood benefits, and provide for healthy riverine and delta ecosystems, while aquifers and groundwater basins help regulate, retain, and treat infiltrated water for annual and drought-year supply and support groundwater dependent ecosystems. All these natural systems play an essential role in providing vital ecosystem services, enhancing **adaptation** to **climate change**, and ensuring long-term resilience for built infrastructure.

## Natural and Built Backbone Water Infrastructure and Regional Summaries

Built infrastructure supporting water management is ubiquitous in California. This infrastructure includes dams, diversions, levees and bypasses, groundwater wells and recharge basins, conveyance, pumping plants, drinking water and wastewater treatment plants, and recycled water systems. Some of this built infrastructure, such as major State, federal, and local water projects is considered backbone infrastructure in that it helps manage or move water from one watershed to another (Figure 3-1). Examples of these built backbone systems include the State Water Project, federal Central Valley Project, Hetch Hetchy Regional Water System, State Plan of Flood Control, and Los Angeles Aqueduct. More than two-thirds of Californians receive water from these systems, which include major dams and reservoirs with more than 40 million **acre-feet** of storage; more than 1,000 miles of canals, levees (e.g., Sacramento-San Joaquin Delta), and aqueducts; and hundreds of pump stations to deliver water from source watersheds to areas of need.

**Resilience:** *The capacity of a resource, natural system, or constructed system to adapt to and recover from changed conditions after a disturbance.*

**Built backbone infrastructure:** *Human-constructed infrastructure that provides water management benefits to communities, ecosystems, and economies across regional and watershed boundaries. The California Aqueduct, Oroville Dam, and Los Angeles Aqueduct are examples of built backbone infrastructure.*

**Natural backbone infrastructure:** *Watershed lands, aquifers, and processes that provide, collect, clean, store, and convey water within and among watersheds or hydrologic regions. The Feather River watershed above Lake Oroville, the Sacramento-San Joaquin Delta, the Colorado River basin, and the State's 515 groundwater basins are examples of natural backbone infrastructure.*

Most of California's built backbone infrastructure was designed based on historical climate conditions and must be modernized to adapt to climate change and continue to provide the necessary levels of service. Larger storms, more severe droughts, hotter temperatures, and earlier snowmelt runoff are changing the operating conditions for these facilities.

The resiliency of built backbone infrastructure is intrinsically linked to the resilience of their associated natural infrastructure systems. Figures 3-2, 3-3, and 3-4 depict California's natural and built backbone infrastructure, including key federal, State, and local projects and their source watersheds.

Update 2023 recognizes that a considerable amount of water management infrastructure is situated and managed at the local or regional level independently of these backbone systems. Water and wastewater treatment plants, distribution systems; domestic,

## Natural and Built Backbone Water Infrastructure and Regional Summaries

agricultural, industrial, and community wells; wastewater collection, dams; recycled water systems; and other infrastructure exist in all regions of California as examples of local and regionally managed infrastructure. The State is supporting these entities to improve these local and regional systems through funding, regulation, and technical support via programs such as Safe and Affordable Funding for Equity and Resilience, focused Environmental Protection Agency grants, Division of Drinking Water oversight, and the Sustainable Groundwater Management Act. This chapter emphasizes the importance of the natural and built backbone infrastructure, which affects water management in multiple watersheds and regions and is of greater statewide significance.

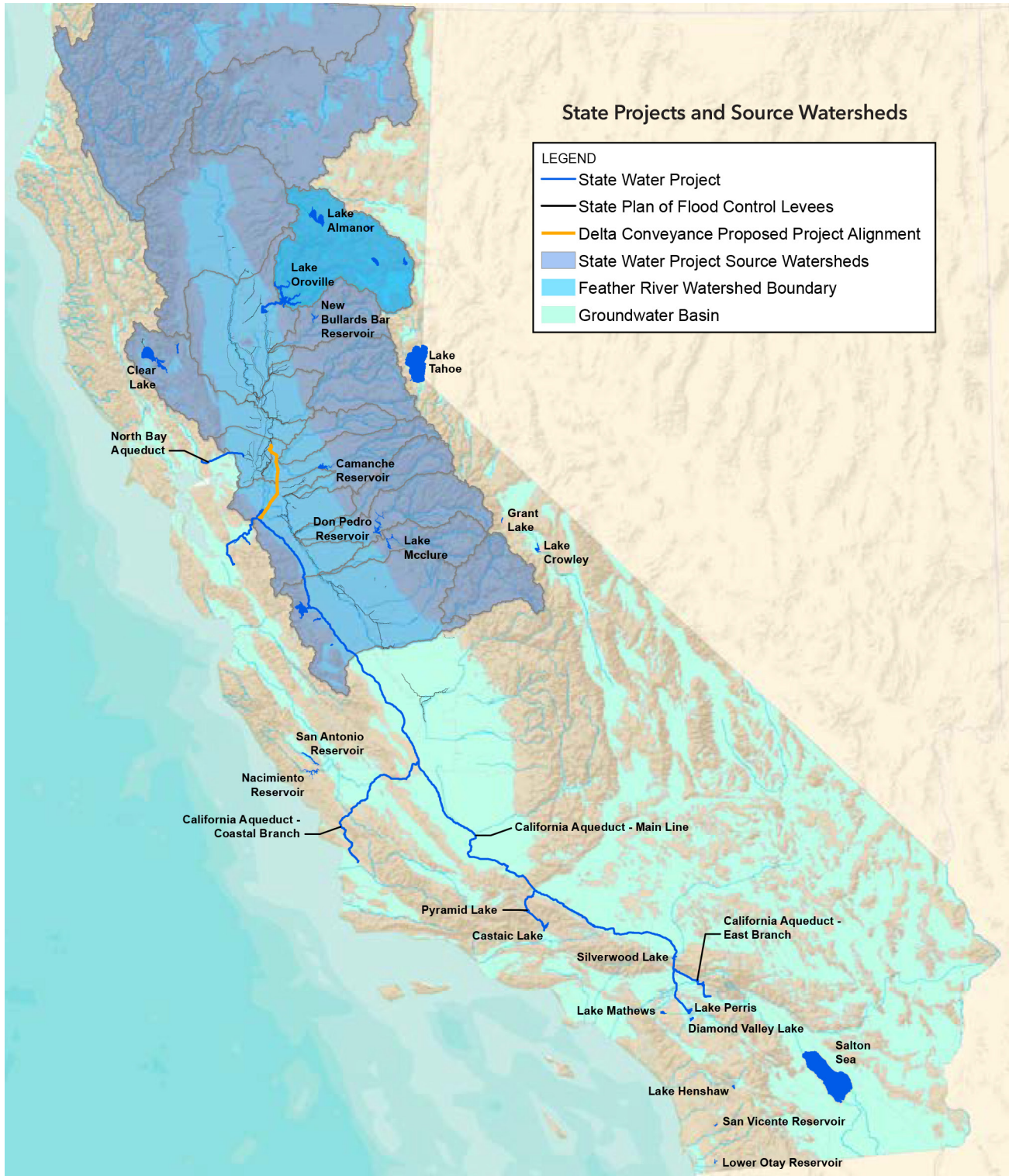
Figure 3-1 California's Resilience Depends on Natural and Built Backbone Infrastructure



Figure 3-2 California's Source Watersheds and Built Federal Infrastructure are Linked



Figure 3-3 California’s Source Watersheds and Built State Infrastructure are Linked



*Figure 3-3 Note: There are more than 300,000 wells in California. Most production wells service users within watershed and groundwater basins. Some wells, such as those managed as part of Kern and SemiTropic water banks, provide supply to backbone systems that convey water between watersheds.*



Figure 3-4 California's Source Watersheds and Built Local Infrastructure are Linked



## Natural and Built Backbone Water Infrastructure and Regional Summaries

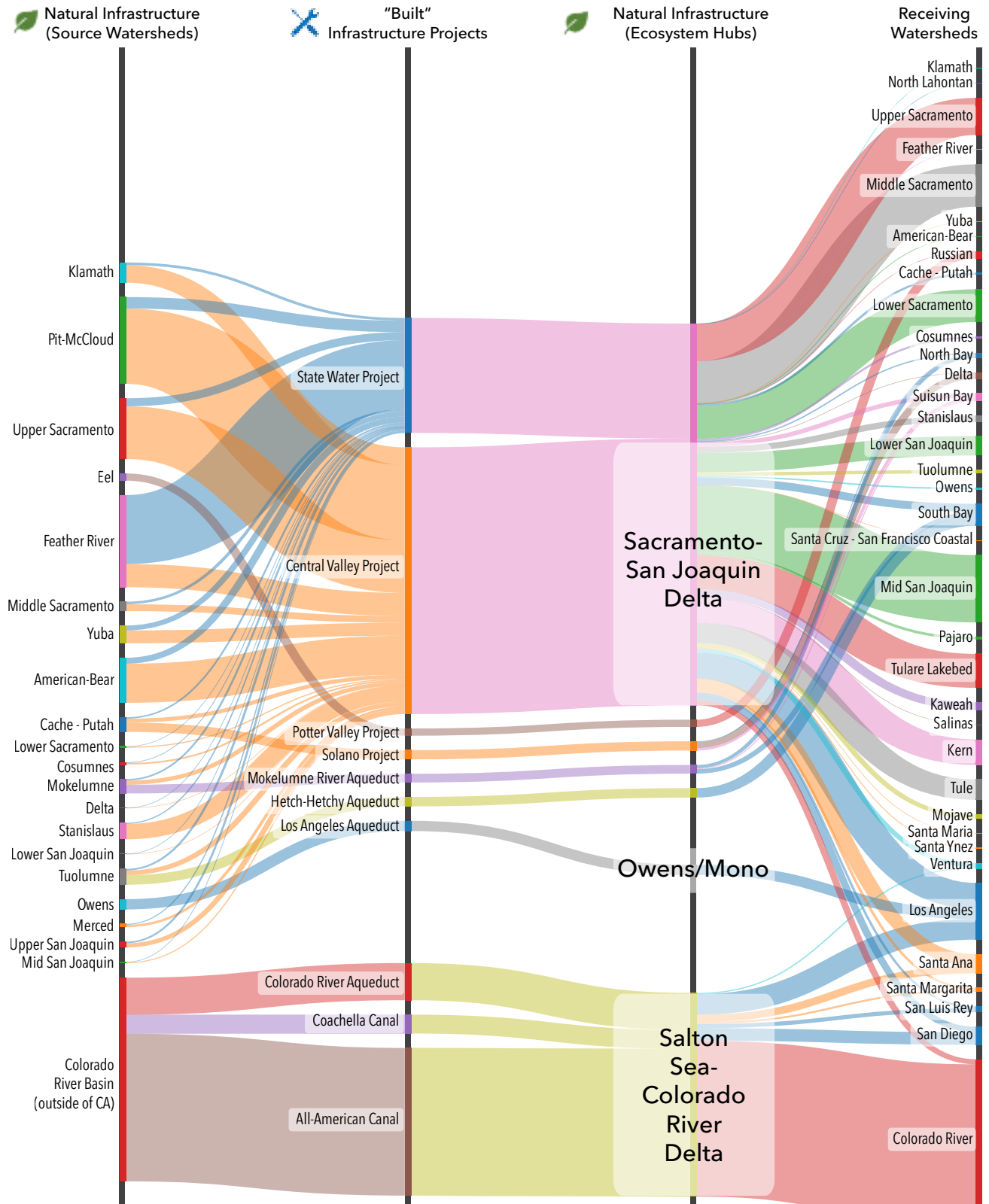
Figure 3-5 depicts how surface water supply delivery throughout the state is made possible by natural and built backbone infrastructure interties or hubs. The figure shows the movement of water from each of the source or originating watersheds on the left by major built backbone infrastructure projects to the receiving watersheds. The width of the lines is proportional to the average quantity of water moving through these systems. The figure also identifies major natural infrastructure system hubs, including the Bay-Delta, Owens and Mono lakes, the Salton Sea, and Colorado River Delta. The resilience of each of these natural system hubs is critical to the resilience of the built infrastructure systems.

Nearly all receiving watersheds in the state depend, in part, on source water from other watersheds. Twenty source watersheds are the major contributors of water to the largest interregional built water-infrastructure systems (e.g., Central Valley Project, State Water Project, Colorado River Aqueduct). Those built systems provide water to 37 receiving watersheds and the connected groundwater basins that serve more than 30 million people and 5 million acres of agricultural lands.

The figure highlights the many regions or watersheds that cannot achieve regional resilience separately but are interconnected and dependent on other watersheds throughout the state. Recognizing the interdependency of these systems, investments in resilience need to occur in both the built and natural system to achieve statewide water resilience. Robust natural and built backbone infrastructure is a critical component of contributing to and achieving climate resilience.

# Natural and Built Backbone Water Infrastructure and Regional Summaries

**Figure 3-5 California's Water Resilience is Interconnected and Dependent on Built and Natural Backbone Infrastructure**

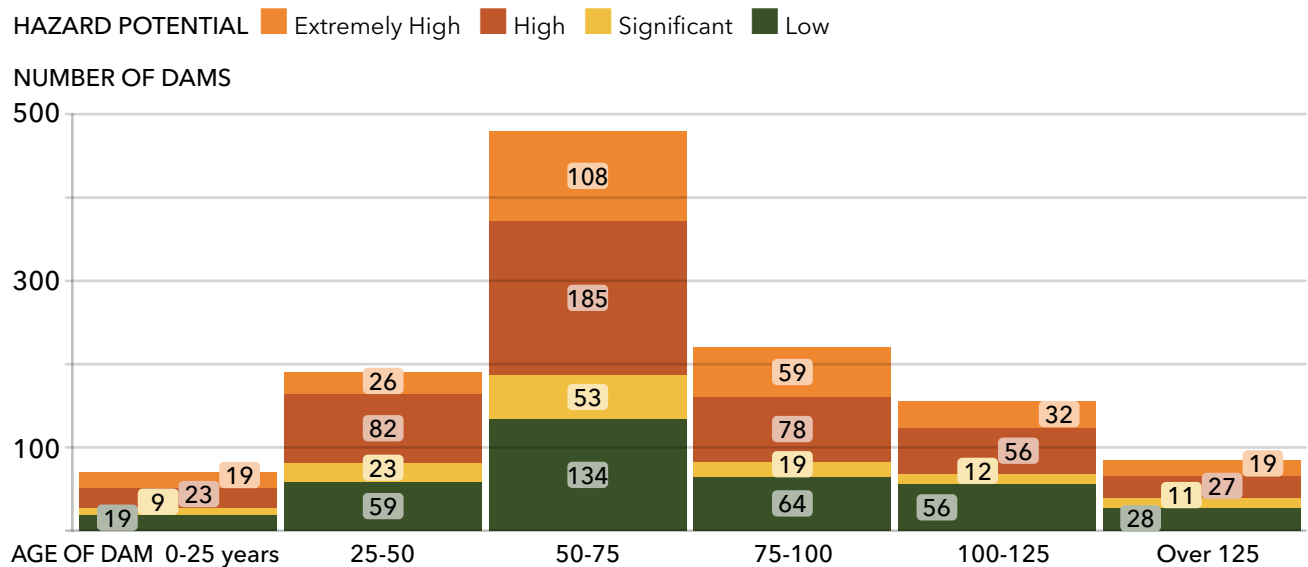


## Natural and Built Backbone Water Infrastructure and Regional Summaries

Aging built systems and deferred maintenance of built infrastructure, along with outdated operations standards based on past conditions (e.g., less climate variability, fewer and less frequent extreme weather events, population growth, land use changes), are common problems throughout California. The deferment of needed maintenance, rehabilitation, and repair of aging critical water-related infrastructure puts the health and safety of public and the environment at increased risk of the systemwide failure of essential services. Because of what is known as the “time value of money,” that is, the same amount of money being worth more now than in the future, costs for deferring infrastructure improvements increase over time, further exacerbating affordability gaps. Many “low-hanging fruit” water system improvements have been implemented, so each additional increment is often more expensive and difficult to implement. This is especially concerning for communities with infrastructure that is already vulnerable to failure.

The status of California’s dams and reservoirs is one example of the challenges of aging, built infrastructure. Figure 3-6 provides a summary of dams under State jurisdiction, their age, and their downstream hazard classifications. The downstream hazard shown is based solely on potential downstream impacts to life and property should the dam fail when operating with a full reservoir. The hazard is not related to the condition of the dam or its appurtenant structures. The State Division of Safety of Dams assigned a condition assessment of less than “Satisfactory” to more than 100 of the 1,240 dams under its jurisdiction. Each of these more than 100 dams have been found deficient in some way, requiring some level of remediation, and some are required to operate at a storage capacity below design capacity. With the average age of California’s dams being 74 years, the number of dams needing remediation will continue to grow. In addition to public safety threats downstream, other functions of dams, including water supply, flood management, recreation, water quality, water for the environment, and hydroelectric power production, will decline as the infrastructure ages. This challenge is often compounded by the lack of funding necessary for timely remediation. The decline is occurring even as surface storage, and the suite of benefits listed above, plays increasingly important and unique roles in adapting to the impacts of climate change.

**Figure 3-6 Age and Hazard Classification of Dams under State Jurisdiction Pose Water Resource Challenges**



### Summaries of California’s Hydrologic Regions

The variety of challenges in California diverse regions demonstrate the importance of taking a regional approach to water resilience. Climate change is affecting all of California, and those impacts are experienced uniquely at the watershed level. Unique watershed and aquifer characteristics of hydrology, topography, land use, and groundwater are factors when characterizing a region’s climate vulnerabilities and recognizing the interactions between one watershed and another.

California’s 10 hydrologic regions have their own water management tools, water-related assets, and challenges (Figure 3-7). The same is true of two overlay areas, the western slope of the Sierra Nevada and the Sacramento-San Joaquin Delta (Delta), where there is heightened statewide significance (e.g., source water or conveyance hub for most Californians’ water supplies) and vulnerabilities that require focused collaboration among federal, State, or local entities (e.g., wildfire risk in national forests and aging levees in the Delta).

Regional summaries, describing conditions in the 10 hydrologic regions and two overlay areas (Figures 3-8 to 3-19), illustrate the vulnerability of each hydrologic region for 15 different factors, including water supply risk, flood risk, drinking water threats, and affordability challenges. Regional vulnerability to each factor was rated on a scale of “1” to “5,” with “5” being the most vulnerable. Values on the left were derived from a statewide climate-change risk and preparedness assessment conducted by DWR. Values on the right were derived from the “Regional Assessment” section of the Newsom administration’s [Water Resilience Portfolio](#). The vulnerability ratings in the regional summaries were developed at high-level for statewide assessment and do not account for regional infrastructure detail that may affect localized vulnerabilities.

## Natural and Built Backbone Water Infrastructure and Regional Summaries

In addition, climate change vulnerabilities from the Water Plan's **future scenario** analysis described in Chapter 2 are presented for the Sacramento, San Joaquin River, and Tulare Lake hydrologic regions. A description of methodology and sources used to conduct the assessments is included in *Statewide Climate Change Risk and Preparedness Assessment*, a supporting document for Update 2023. Additional groundwater conditions and management information is available in [California's Groundwater Update 2020](#) (also known as Bulletin 118).

Tribal challenges common to many or all hydrologic regions are not listed individually within the regional summaries, including:

- The need for increased cultural knowledge and understanding to support effective consultation and partnerships among agencies (local, State, and federal) and Tribal Nations.
- The lack of equity, as well as economic and **environmental justice**, for Tribal communities.
- The need for more watershed and ecosystem restoration using **Tribal Ecological Knowledge** and nature-based solutions (e.g., cultural burns, meadow restoration).
- Specific challenges for the North Coast, Sacramento, San Joaquin, and Central Coast hydrologic regions related to the degradation and decline of the salmonid fisheries, include the lack of inclusion in fisheries management decisions and of resources to manage fisheries on Tribal lands, Tribal cultural views, climate change, water rights, adequate flows, various pollution discharges, and loss of habitat.

Figure 3-7 California's Hydrologic Regions



Figure 3-8 North Coast Hydrologic Region

**NORTH COAST HYDROLOGIC REGION**

**HYDROLOGIC REGION DESCRIPTION**

The North Coast region encompasses approximately 19,000 square miles, including 340 miles of scenic coastline and remote wilderness areas. About half of the region is protected as open space. It is the wettest region in California, with a mean annual runoff (29-million-acre feet) that amounts to 40 percent of the state’s total natural runoff. The population totaled about 680,000 in 2020, less than two percent of the state’s population, with the highest percentage of Tribal members. Groundwater accounts for about one-third of the region’s water supply.

HYDROLOGIC REGION MAP

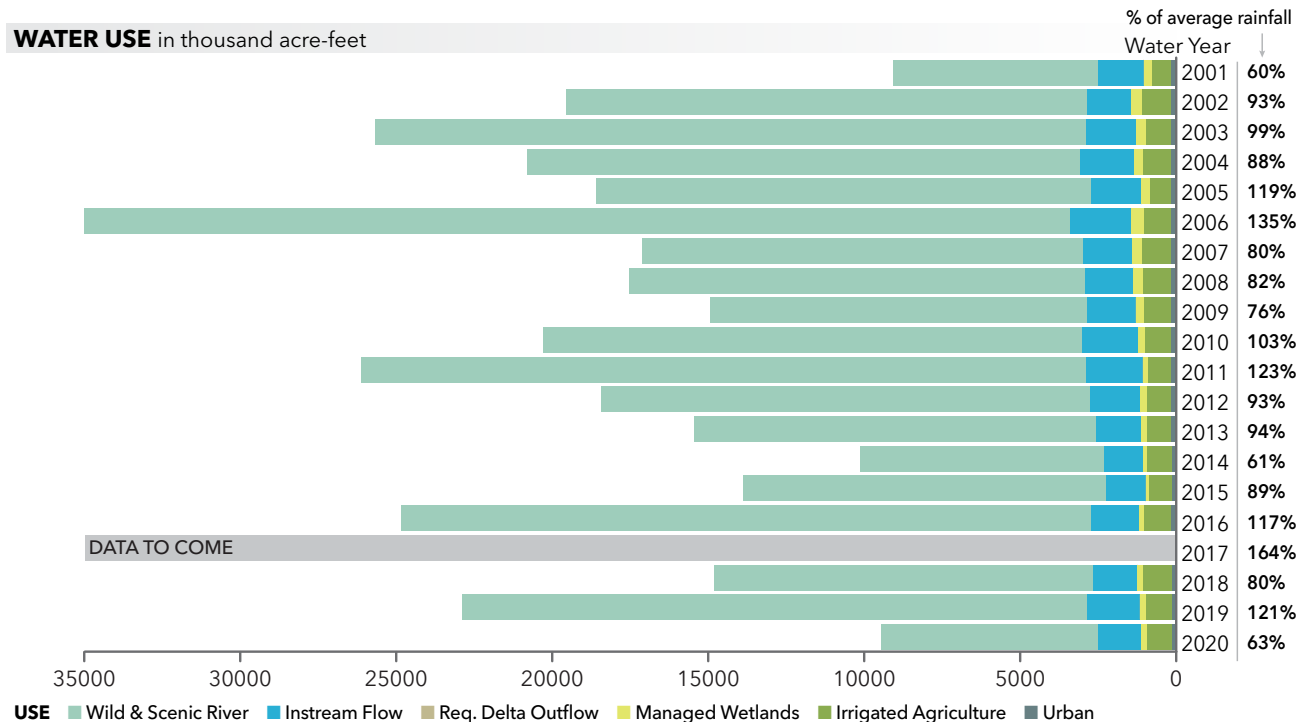




Figure 3-8 North Coast Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Impacts to spawning and rearing of anadromous fish from reduced natural flows caused by water diversions and stream dewatering from groundwater pumping
- Highest atmospheric river-related flood damages in western US
- Erosion and landslides, caused by wildfires, extensive timber harvesting, and heavy precipitation in rugged, steep terrain; with highly erodible, loosely consolidated soils
- Point and non-point-source runoff from logging, rural roads, agriculture, urban areas, stream sedimentation, channel modifications, and increasing water temperatures, sediment, nutrient, and contaminant loading
- Groundwater challenges including seawater intrusion, nitrates, high TDS and alkalinity, elevated iron, boron, and manganese concentrations; and septic tank failures
- Other concerns include MTBE, abandoned mine and forest herbicide discharges, and discharge from lumber mills

**Equity**

- Of the 10 counties in the region, only Marin and Sonoma do not qualify as disadvantaged.
- Improvements to salmonid fisheries, water quality, water supply, and compliance with State and federal water quality regulations and flow standards would help address equity/ environmental justice concerns

**Tribal**

- Isolation, language barriers, lack of funding and resource, and climate change impacts
- Water rights conflicts and maintaining sufficient flows to sustain a healthy environment
- Lack of access to easements along river corridors for Tribal beneficial uses and watershed and ecosystems restoration using TEK and nature-based solutions (e.g., cultural burns and meadow restoration)
- Pesticides, herbicides, and other chemicals support invasive plant species and threatens the health of the watershed, restricting Tribal access to culturally important resources

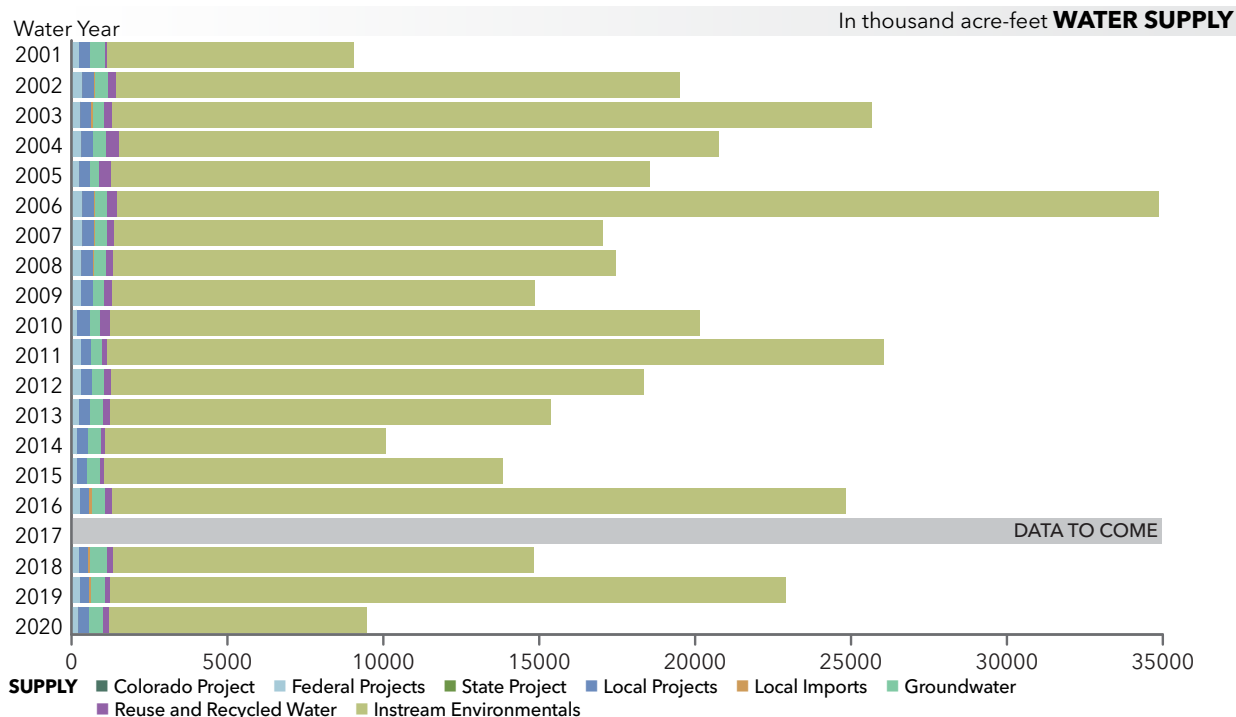
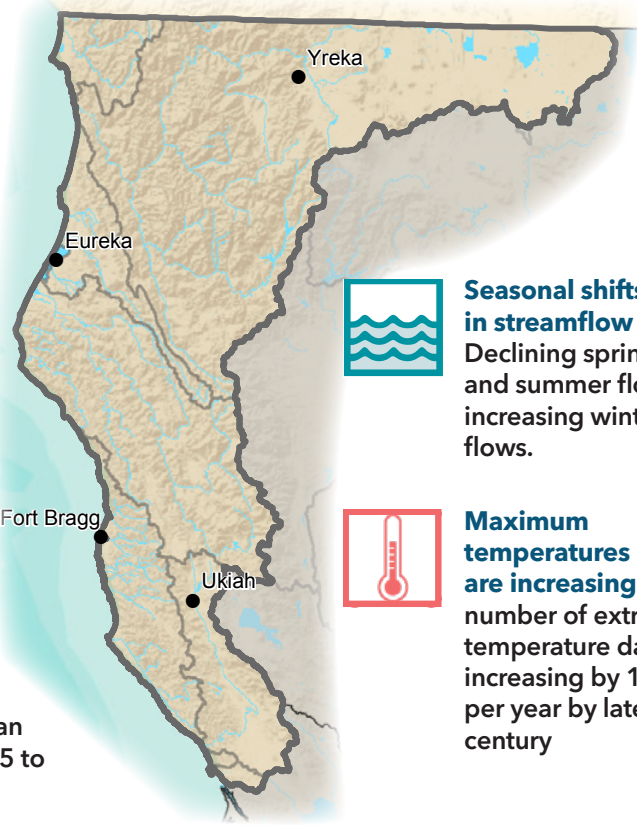


Figure 3-8 North Coast Hydrologic Region (continued)

### NORTH COAST HYDROLOGIC REGION

**FUTURE CLIMATE RISKS**

Current Population: 681,000  
2070 Population: 635,000



**Increasing air temperatures ...**  
Average daily air temperature likely to increase by 5 degrees F or more by late-century



**Increasing flood risk ...**  
Flood flows may increase by more than 30%. Flood risk in low lying and coastal areas will increase.



**Increasing wildfire risk ...**  
Probability and size of wildfires will increase.



**Sea levels are rising ...** Mean sea level may increase by 2.5 to 4.5 feet by 2100



**Seasonal shifts in streamflow ...**  
Declining spring and summer flows, increasing winter flows.



**Maximum temperatures are increasing ...**  
number of extreme temperature days increasing by 15 days per year by late-century

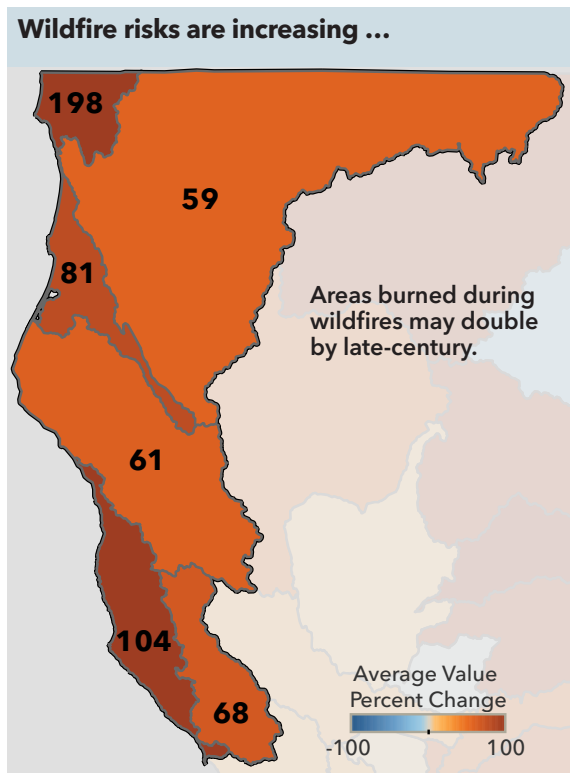
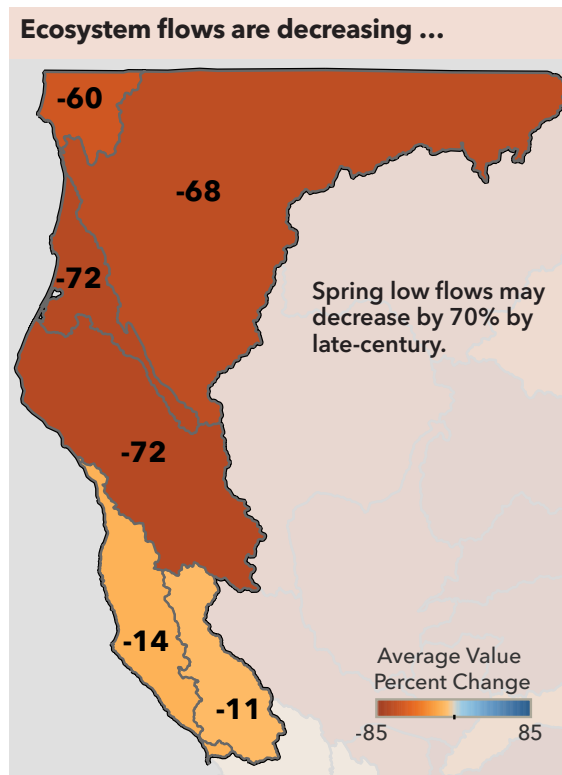
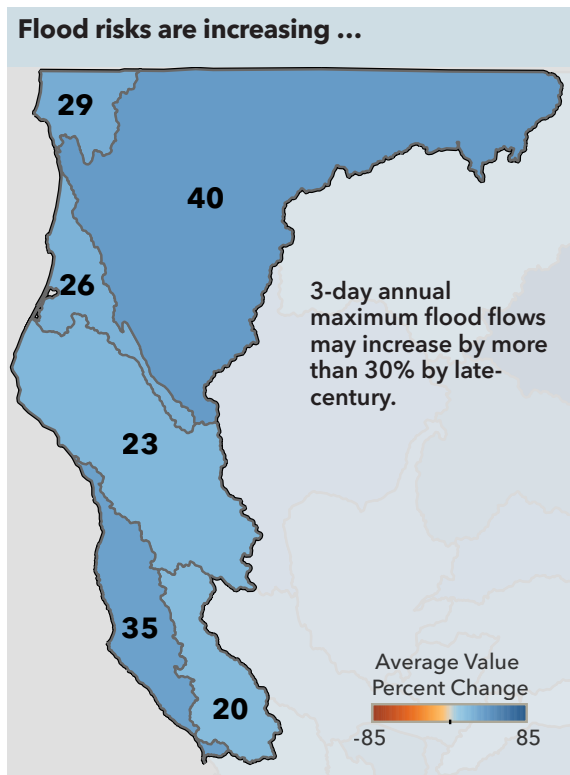
**REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY**

The North Coast hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management, ecosystem management, wildfire and infrastructure are assessed at higher vulnerability.



Figure 3-8 North Coast Hydrologic Region (continued)

KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT



**HIGHLIGHTS OF MAJOR ACTIONS Being Taken by State and Partners to Address Challenges**

- Klamath Basin Restoration Agreement (KBRA)
- Klamath Dam Removal
- Five Counties Salmonid Conservation Program
- Sage Steppe Ecosystem Restoration Strategy
- Extensive restoration completed in the Shasta and the Scott Valleys
- Salt River Ecosystem Restoration Project restoring fish habitat, water quality, and flood protection
- Big River Program providing permanent protection of the estuarine, wetlands, wildlife, and associated seral-stage forest
- Trinity River Restoration Program collaborative working to restore Trinity River physical processes and fisheries
- Mattole Integrated Water Management program improving water supply, water quality, and fish habitat, and stabilizing sediment discharges.
- Potter Valley Project decommissioning
- Lake Mendocino Forecast Informed Reservoir Operations

Figure 3-9 San Francisco Bay Hydrologic Region

### SAN FRANCISCO HYDROLOGIC REGION

#### HYDROLOGIC REGION DESCRIPTION

San Francisco Bay hydrologic region covers approximately 4,500 square miles. Average precipitation ranges from 15 inches to 20 inches, depending upon location. It is the second smallest of the state’s 10 hydrologic regions but home to the second largest population at nearly 6.9 million people in 2020. Land use ranges from Napa and Sonoma valley vineyards to the technological production of Silicon Valley. About 70 percent of the urban supply is imported into the region, much of it from the Sierra Nevada mountains and the Sacramento-San Joaquin Delta. Local groundwater and streams meet about a third of the region’s water demand.

HYDROLOGIC REGION MAP



#### WATER USE

In thousand acre-feet

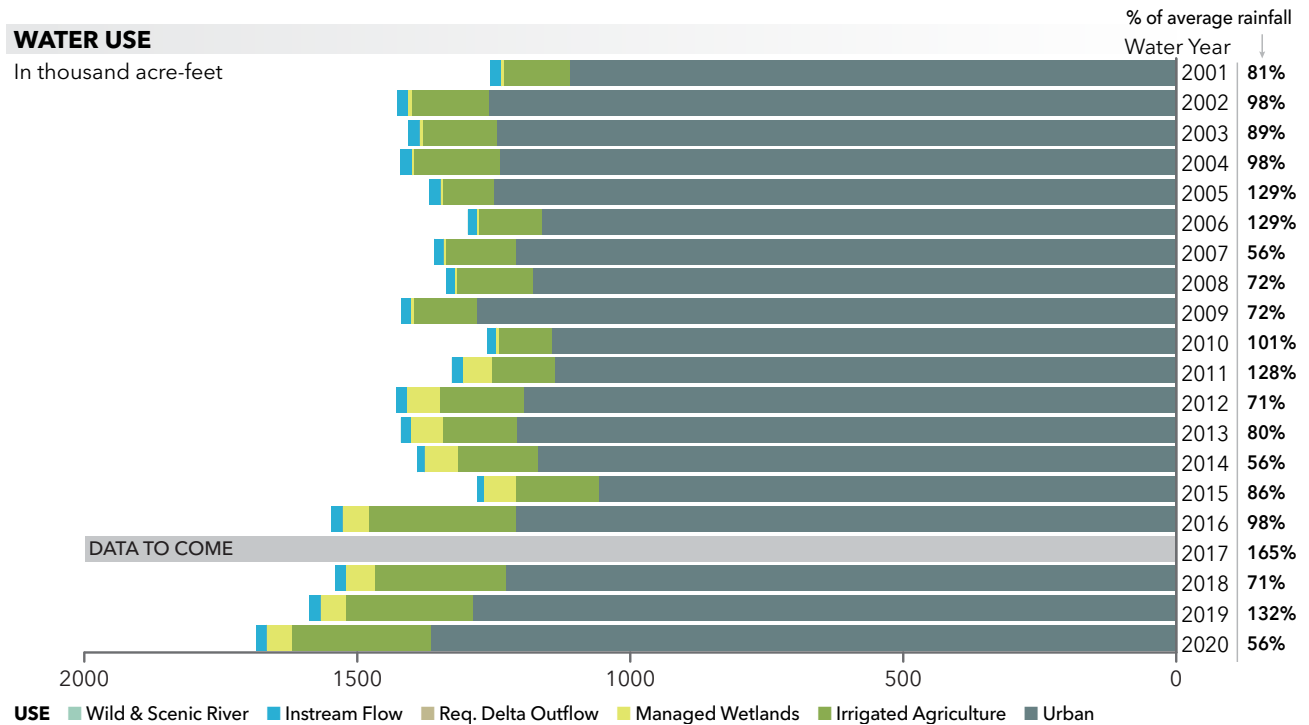


Figure 3-9 San Francisco Bay Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Climate change vulnerabilities from sea level rise, tidal floods, and storm surges
- San Francisco Bay ecosystem health and meeting environmental water demands
- Linking land use planning with water management planning for drought
- Developing alternative dry-year water supplies, adopting water shortage allocation plans, and catastrophic water supply interruptions
- Flood preparedness and recurring floods in vulnerable communities
- Maintaining or improving drinking water quality and protecting drinking water sources
- Wildfires and associated debris flows
- Groundwater overdraft and quality from both established and emerging pollutants.

**Equity**

- Majority of front-line communities located in Alameda and Contra Costa counties.
- Water resource projects serving front-line communities are a regional priority

- Front-line community construction projects and studies identify critical water supply or water quality needs, flood risk management, wastewater treatment and replacement of failing septic systems
- Assisting front-line communities vulnerable to sea level rise due to proximity to the bay

**Tribal**

- Region is home to California Tribes displaced from their original homelands within the State as well as Native Americans relocated from other states.
- Access to local, regional, and State grant funding
- Tribal members dispersed throughout region’s population and often not living in Tribal-specific communities
- High cost of living and housing access
- Access to water of sufficient quality and affordability
- Environmental issues and watershed level impacts (e.g., saltwater intrusion) are now being exacerbated by climate change

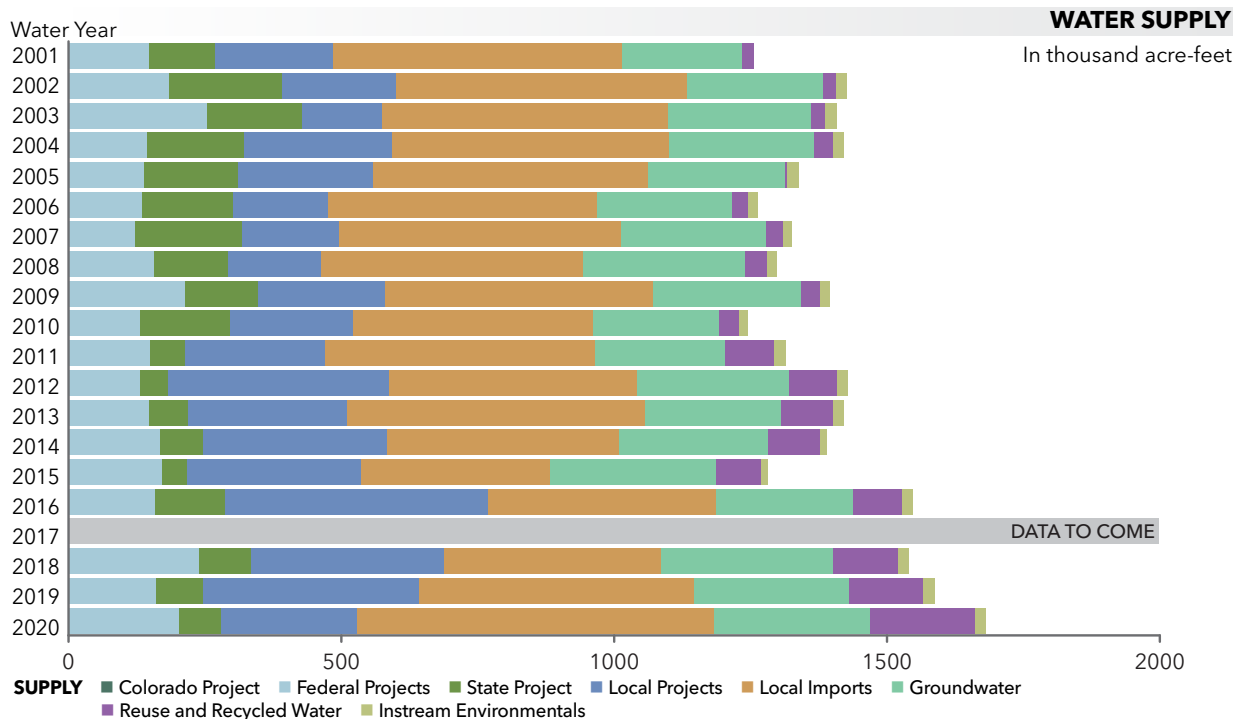


Figure 3-9 San Francisco Bay Hydrologic Region (continued)

### SAN FRANCISCO HYDROLOGIC REGION

#### FUTURE CLIMATE RISKS

Current Population: 6.8 million  
2070 Population: 7.8 million



**Increasing air temperatures ...**  
Average daily air temperature likely to increase by 5 degrees F or more by late-century.



**Increasing flood risk ...**  
Flood flows may increase by more than 30%. Flood risk in low lying and coastal areas will increase.



**Increasing wildfire risk ...**  
Probability and size of wildfires will increase.



**Sea levels are rising ...** Mean sea level may increase by 2.5 to 4.5 feet by 2100



**Seasonal shifts in streamflow ...**  
Declining spring and summer flows, increasing winter flows.



**Maximum temperatures are increasing ...** number of extreme temperature days increasing by 15 days per year by late-century.

#### REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY

The San Francisco hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management and water quality, ecosystem management, and infrastructure are assessed at higher vulnerability.

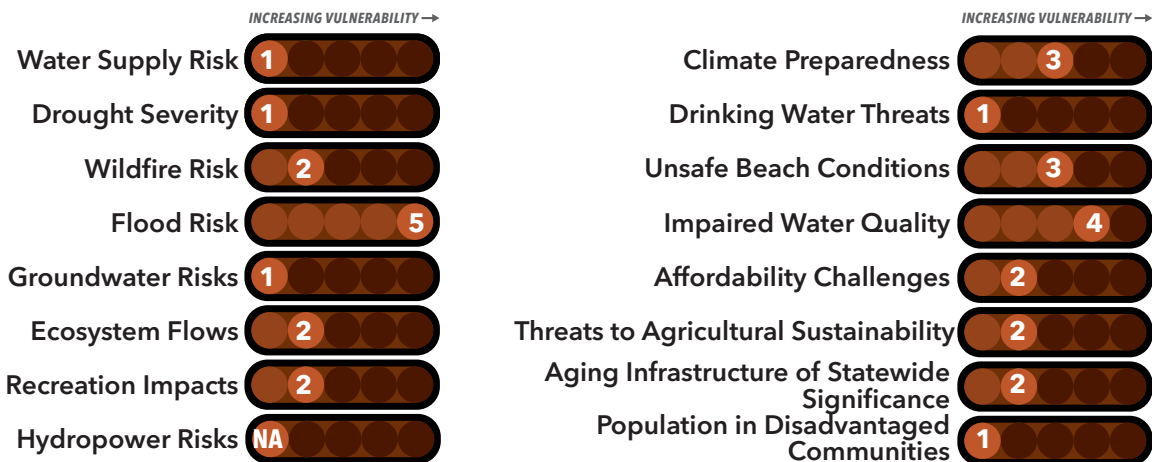
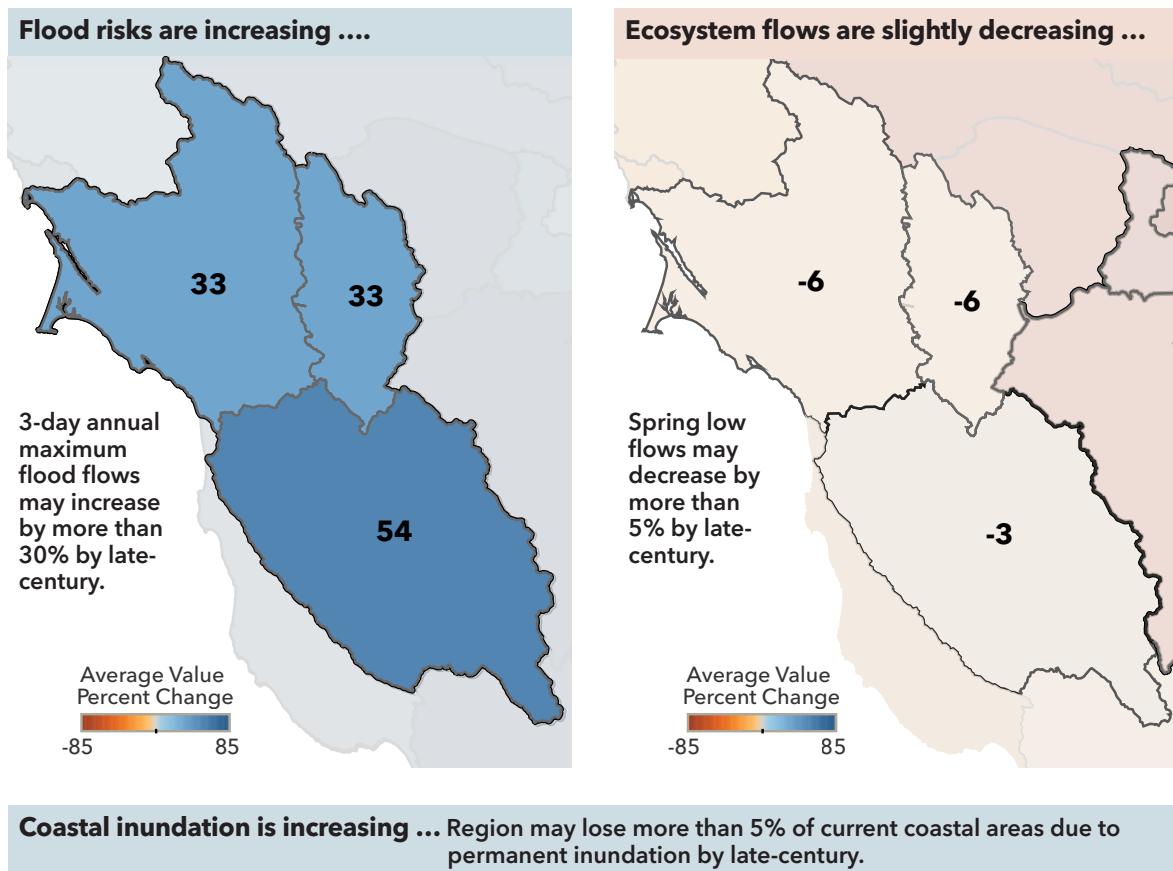


Figure 3-9 San Francisco Bay Hydrologic Region (continued)

KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT



**HIGHLIGHTS OF MAJOR ACTIONS**  
Being Taken by State and Partners to Address Challenges

- Hetch Hetchy Water System Improvement Program
- Multi-year South Bay Salt Pond Restoration Project reestablishing 15,100 acres of industrial salt ponds in Alameda and Santa Clara counties
- Bay wetland restoration projects including the Napa Sonoma Marsh, Bair Island, Sonoma Baylands, Hamilton Bel Marin Keys, Cullinan Ranch, Sears Point Restoration, Bruener Marsh, and Montezuma Wetland projects
- Improved Recycling of Municipal Water
- Improved Urban Runoff Management for both point and non-point discharges
- Improved data monitoring programs
- Improved sustainable management of urban runoff
- Marin Drought Water Supply Assessments

Figure 3-10 Central Coast Hydrologic Region

**CENTRAL COAST HYDROLOGIC REGION**

**HYDROLOGIC REGION DESCRIPTION**

The Central Coast hydrologic region covers approximately 11,300 square miles in central California. The average annual precipitation is 18.7 inches. An estimated 1.6 million people lived in the region in 2020. Average annual precipitation ranges from 11 inches to 36 inches. Groundwater accounts for more than three-quarters of the supply, making the Central Coast the state’s most groundwater-dependent region. The frost-free coastal valleys grow crops including strawberries and artichokes. Citrus and avocados are grown in the southern part of the region near Santa Barbara.



**WATER USE**

In thousand acre-feet

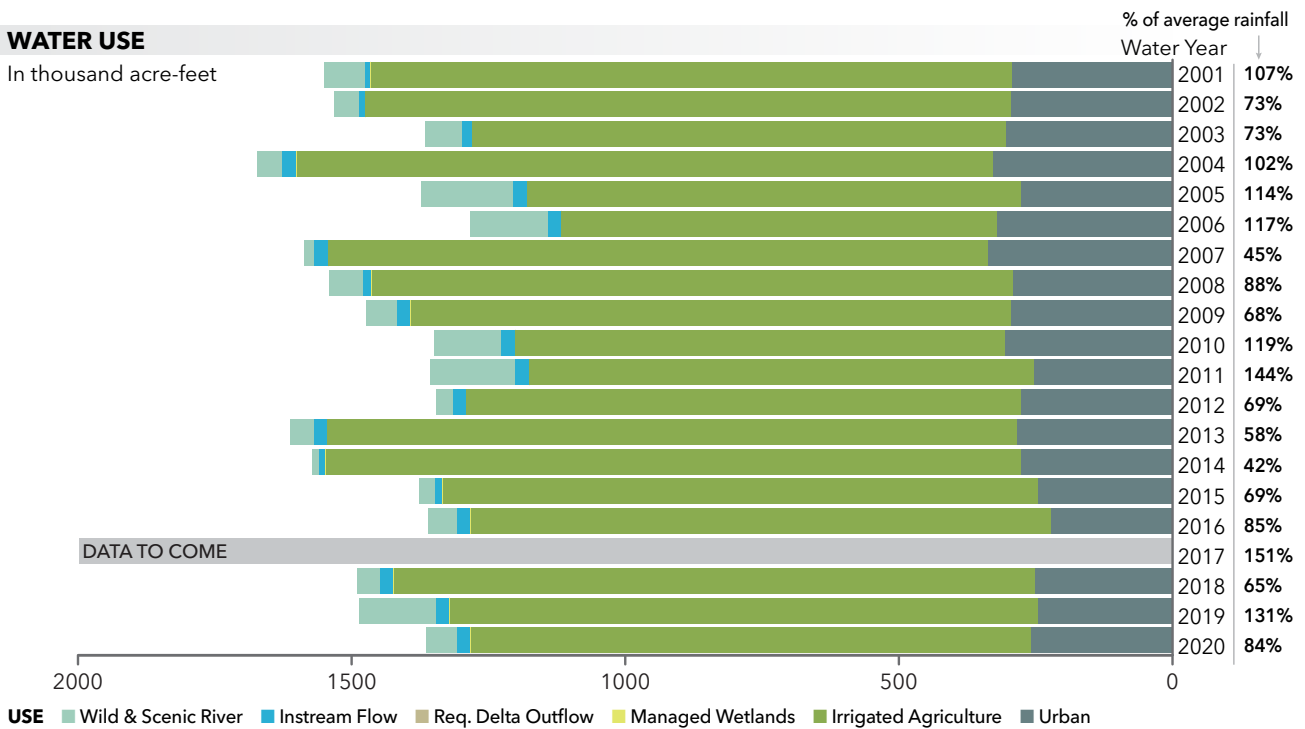




Figure 3-10 Central Coast Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Region-wide groundwater quality, basin overdraft, and saline water intrusion
- Flood risk increased from sea level rise and pressures for floodplain development
- Wildfires and associated debris flows
- Water supply reliability from both surface water and groundwater supplies
- Declining salmon and managing nearly 4,000 acres of estuarine and other key habitats in Elkhorn Slough watershed
- Funding limitations

**Equity**

- Provisioning of high-quality, potable, affordable water, and healthy conditions for front-line communities.
- Numerous small agricultural communities in the Central Coast are front-line communities, many

of which are population centers for Spanish-speaking workers supporting labor-intensive agricultural production

- Central Coast is one of the regions with the highest percentage of populations living in poverty that rely heavily on farm labor and agriculture

**Tribal**

- Isolation, language barriers, lack of funding and resource, and climate change impacts
- Water rights conflicts
- Lack of access to easements along river corridors for Tribal beneficial uses
- Pesticides, herbicides, and other chemicals support invasive plant species and threatens the health of the watershed, restricting Tribal access to culturally important resources
- Saltwater intrusion

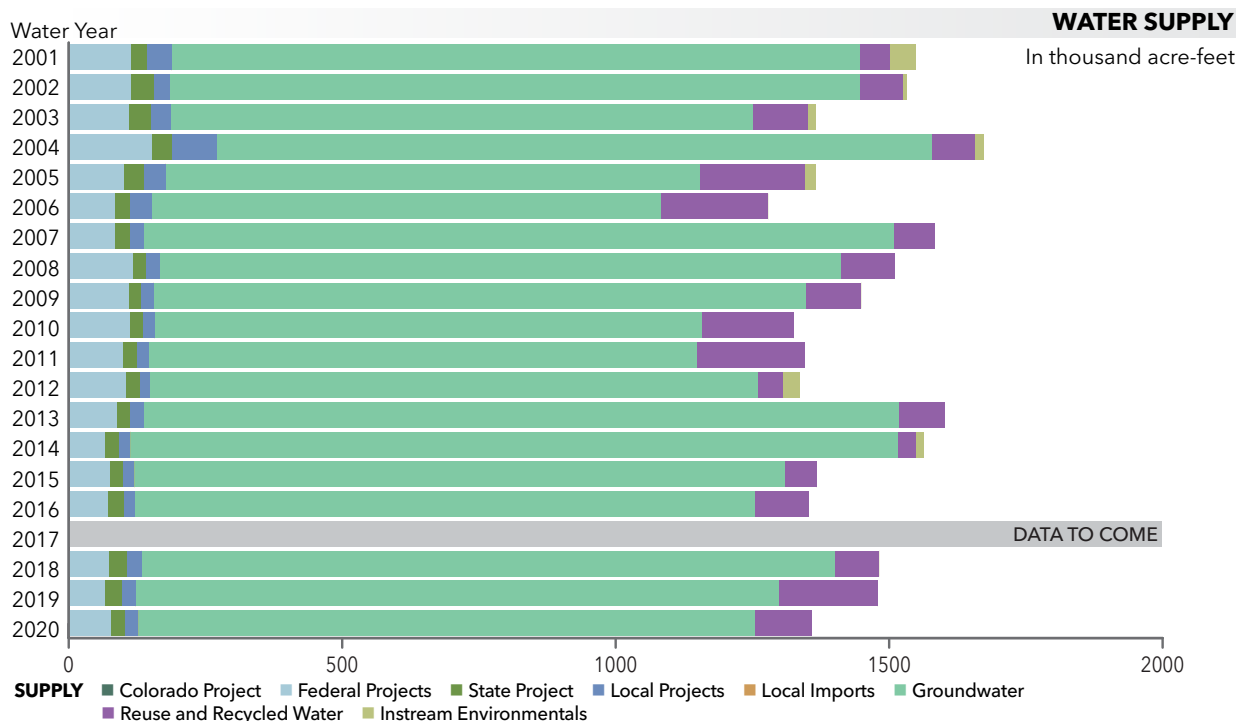
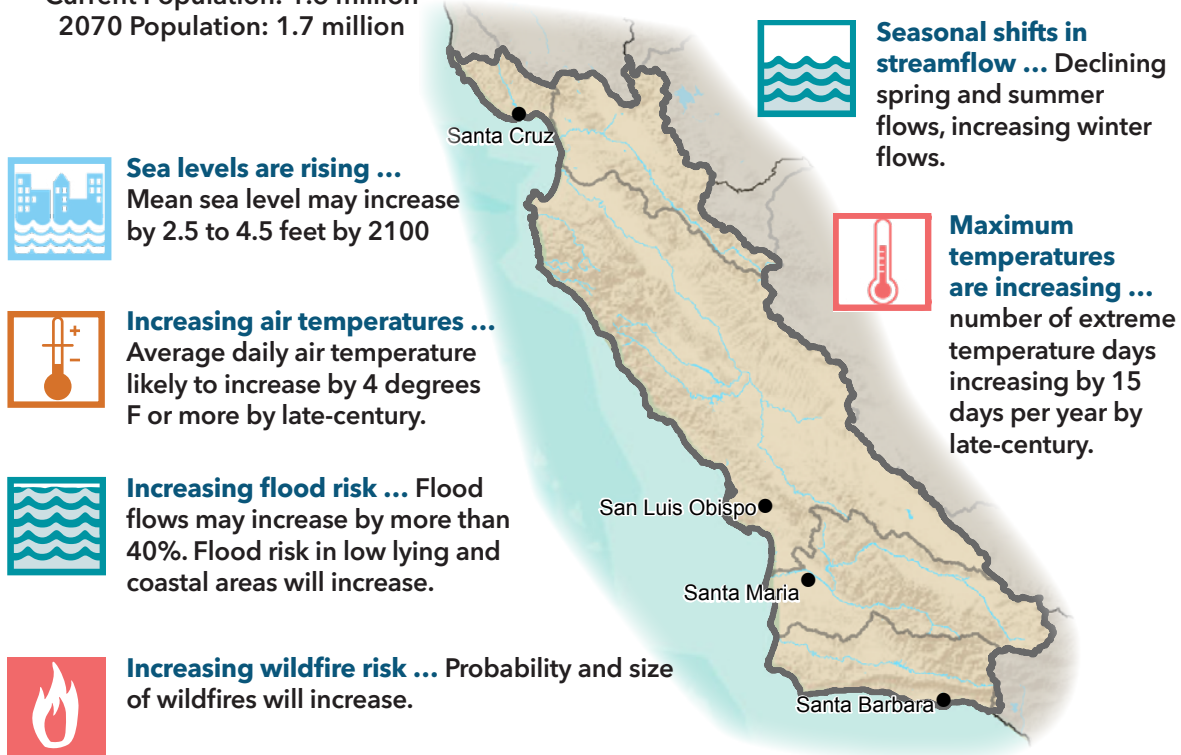


Figure 3-10 Central Coast Hydrologic Region (continued)

### CENTRAL COAST HYDROLOGIC REGION

#### FUTURE CLIMATE RISKS

Current Population: 1.6 million  
2070 Population: 1.7 million



#### REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY

The Central Coast hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management and drinking water threats, ecosystem management, and infrastructure are assessed at higher vulnerability.

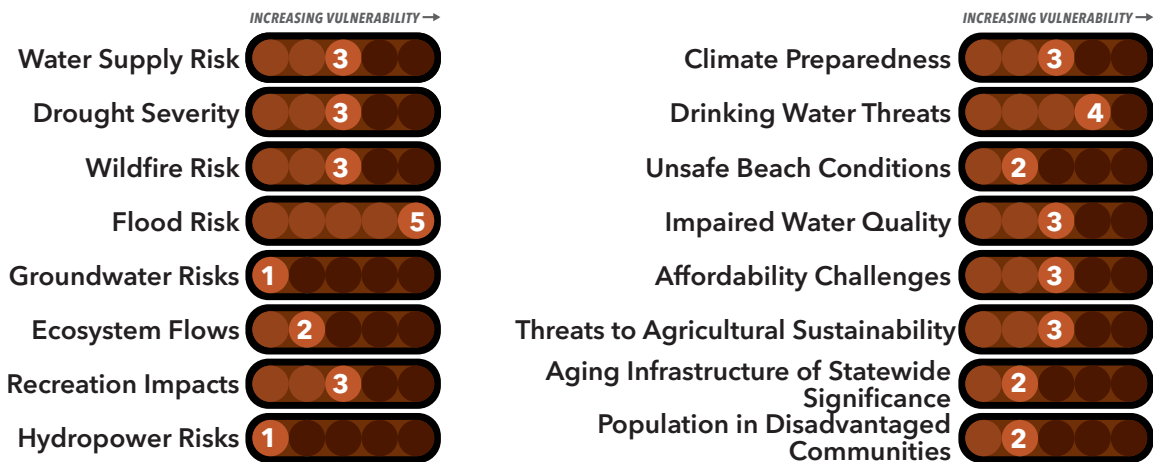
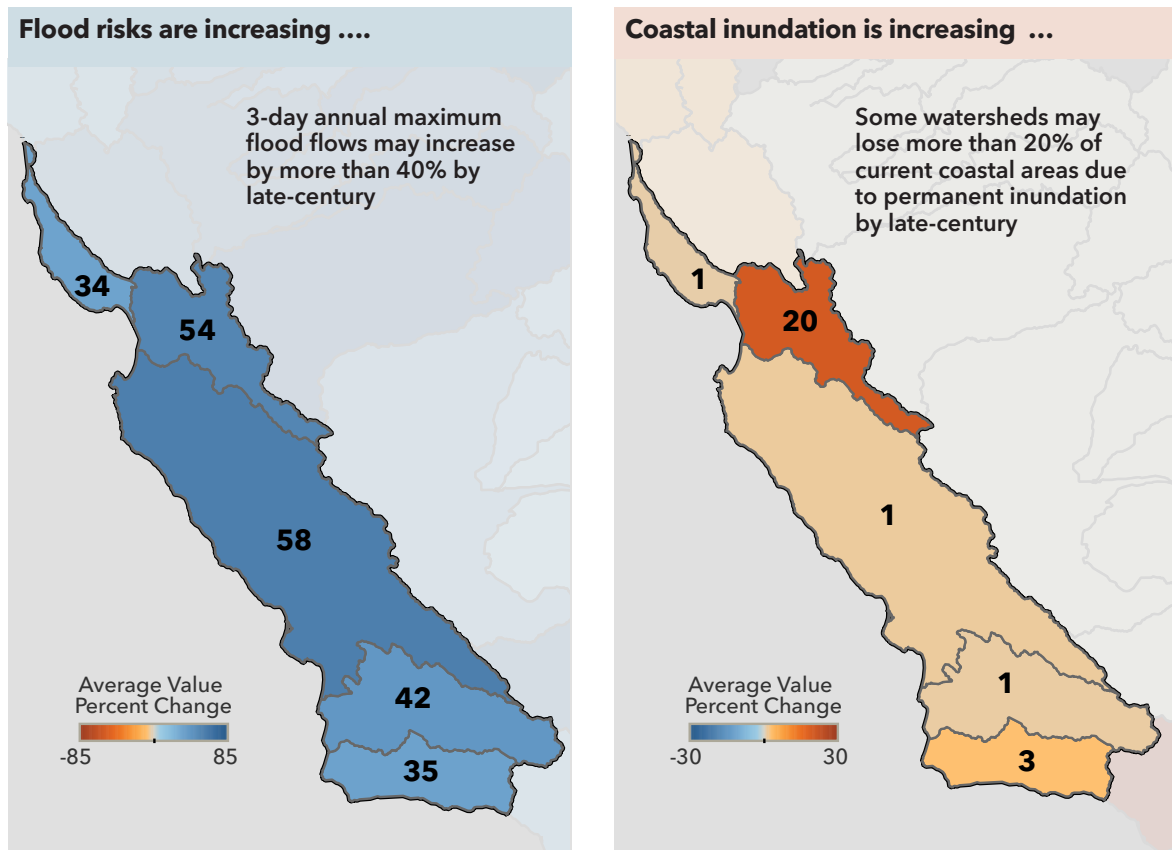


Figure 3-10 Central Coast Hydrologic Region (continued)

KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT



**HIGHLIGHTS OF MAJOR ACTIONS**  
Being Taken by State and Partners to Address Challenges

- The **Integrated Watershed Restoration Program** brings together local, State, and federal partners for multi-benefit restoration projects
- **Elkhorn Slough Foundation** and the **Elkhorn Slough Tidal Wetland Project** implementing restoration strategies for managing nearly 4,000 acres of estuarine and other key habitats in the watershed
- **Protecting the Monterey Bay National Marine Sanctuary** while sustaining economic viability of agriculture in the watersheds through the **Agriculture Water Quality Alliance** partnership
- **Santa Cruz RCD rural roads cost-share funding program** reducing erosion on mountainous roads in rural Santa Cruz County and preventing tons of sediment per year from entering steelhead and salmon-bearing river systems
- **Improved regional partnerships for increasing local surface water storage, emergency management; use, expansion, and planning of recycled water projects, and brackish and ocean water desal projects**

Figure 3-11 South Coast Hydrologic Region

### SOUTH COAST HYDROLOGIC REGION

#### HYDROLOGIC REGION DESCRIPTION

The South Coast hydrologic region covers 11,000 square miles, just seven percent of the state’s total area, but in 2020 was home to more than half the state’s population, 20.5 million people. The region extends from the Pacific Ocean to Riverside County and from Ventura south to San Diego. Major crops include citrus, avocado, and nursery production. Water supplies are diverse, ranging from local rivers and the Sacramento, San Joaquin, Colorado, and Owens rivers to transfers, recycling, and desalination. Groundwater comprises on average 34 percent of the water used in the region.

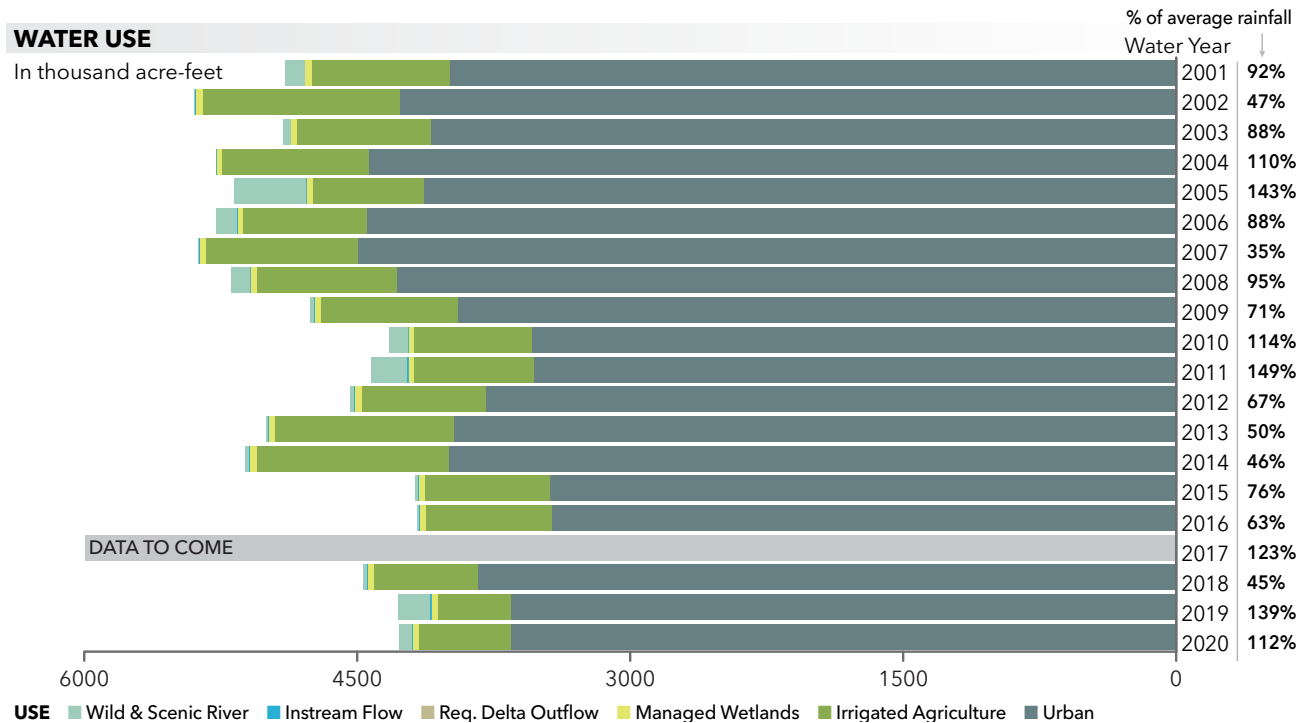


Figure 3-11 South Coast Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Water supply needs identified for restoring and maintaining environmental habitats
- Colorado River drought conditions
- Growth and development increasing water demands and wildlands encroachment
- Develop, test, and implement climate change adaptation strategies to mitigate impacts to communities, power, water, and wastewater facilities; wetlands, and other environmental habitat damage from sea level rise, flooding, and drought.
- Recurrent flooding in many areas
- Wildfires and associated debris flows threaten communities and infrastructure
- Water system reliability and aging infrastructure
- Groundwater, salinity, and brine management

**Equity**

- Adoption and implementation of policies and actions to assist vulnerable communities
- Water contaminants, impaired water bodies, water quality, groundwater quality, water infrastructure, communication needs and other water health risks

- Technical and financial assistance needed for freshwater treatment and conveyance and wastewater systems
- Many small community water systems are entirely dependent on fractured-rock aquifers.

**Tribal**

- The South Coast Region is home to California Tribes displaced from their original homelands within the State as well as Tribes relocated from other states.
- Isolation, language barriers, lack of funding and resource, and climate change impacts
- Ensuring water rights and reliable water supplies for Tribal lands
- Watershed and ecosystems restoration using TEK and nature-based solutions (e.g., cultural burns and meadow restoration)
- Protecting surface water and groundwater resources for domestic use
- Land use development and agricultural activities (within or adjacent to reservations)
- Environmental regulations and increasingly stringent water quality objectives
- Earthquakes, extreme drought conditions, and floods

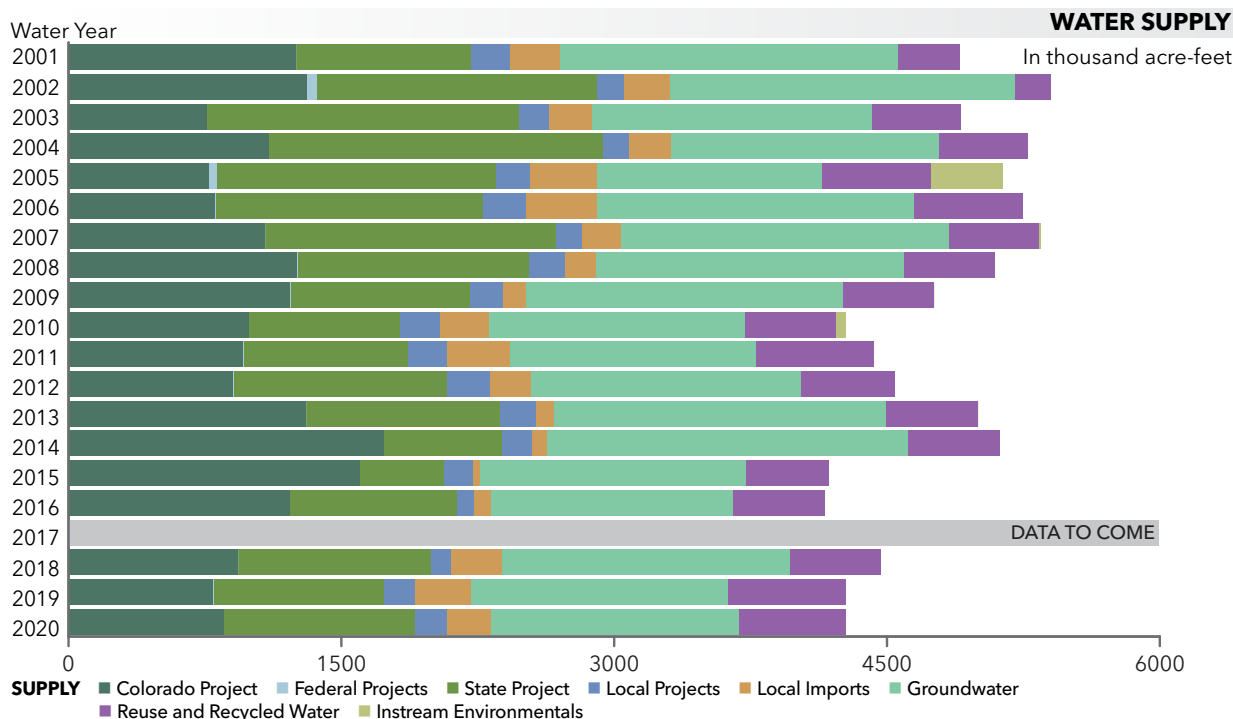


Figure 3-11 South Coast Hydrologic Region (continued)

### SOUTH COAST HYDROLOGIC REGION

#### FUTURE CLIMATE RISKS

Current Population: 20.5 million  
2070 Population: 18 million



**Sea levels are rising ...**  
Mean sea level may increase by 2.5 to 4.5 feet by 2100



**Increasing air temperatures ...**  
Average daily air temperature likely to increase by 5 degrees F or more by late century.



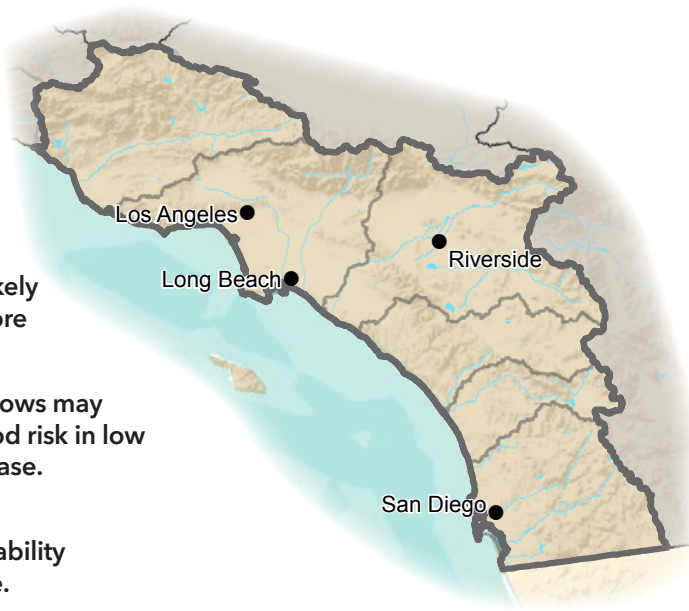
**Increasing flood risk ...** Flood flows may increase by more than 50%. Flood risk in low lying and coastal areas will increase.



**Increasing wildfire risk ...** Probability and size of wildfires will increase.



**Seasonal shifts in streamflow ...**  
Declining spring and summer flows, increasing winter flows.



**Maximum temperatures are increasing ...** number of extreme temperature days increasing by 13 days per year by late-century.

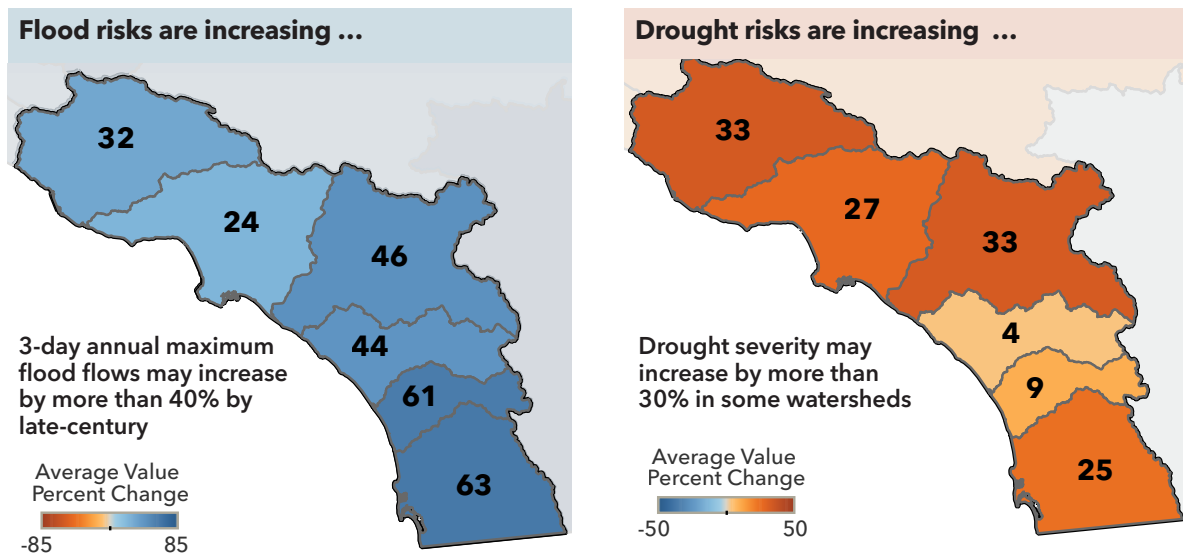
#### REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY

The South Coast hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in flood management are assessed at higher vulnerability.



Figure 3-11 South Coast Hydrologic Region (continued)

KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT



**HIGHLIGHTS OF MAJOR ACTIONS**  
Being Taken by State and Partners to Address Challenges

- Expansion of water transfers and groundwater storage programs
- Regional partnerships for surface water storage and emergencies
- Increased brackish groundwater and ocean water desalination use
- Increased use and expansion of recycled water including the Pure Water So Cal, Operation NEXT, Pure Water San Diego programs
- Stormwater capture and groundwater recharge programs
- Remediating and treating contaminated groundwater supplies
- Expanded implementation of water use efficiency programs
- Managing and responding to both inland and coastal flooding
- Developing injection wells used for managed aquifer recharge and seawater intrusion barriers

Figure 3-12 Sacramento River Hydrologic Region

**SACRAMENTO RIVER HYDROLOGIC REGION**

**HYDROLOGIC REGION DESCRIPTION**

The Sacramento River hydrologic region includes the entire drainage of the state’s largest river, from Modoc County to Solano County, where the Sacramento River flows into San Francisco Bay. The region covers approximately 27,200 square miles. In 2020, its population was estimated at nearly 3.3 million people. Climates in the region range from high desert with annual precipitation of 10 to 20 inches to the valley, where precipitation varies from about 35 inches annually in Redding to 18 inches in Sacramento. The region supports nearly 2 million acres of irrigated farmland. Groundwater supplies about a third of the water used in the region.

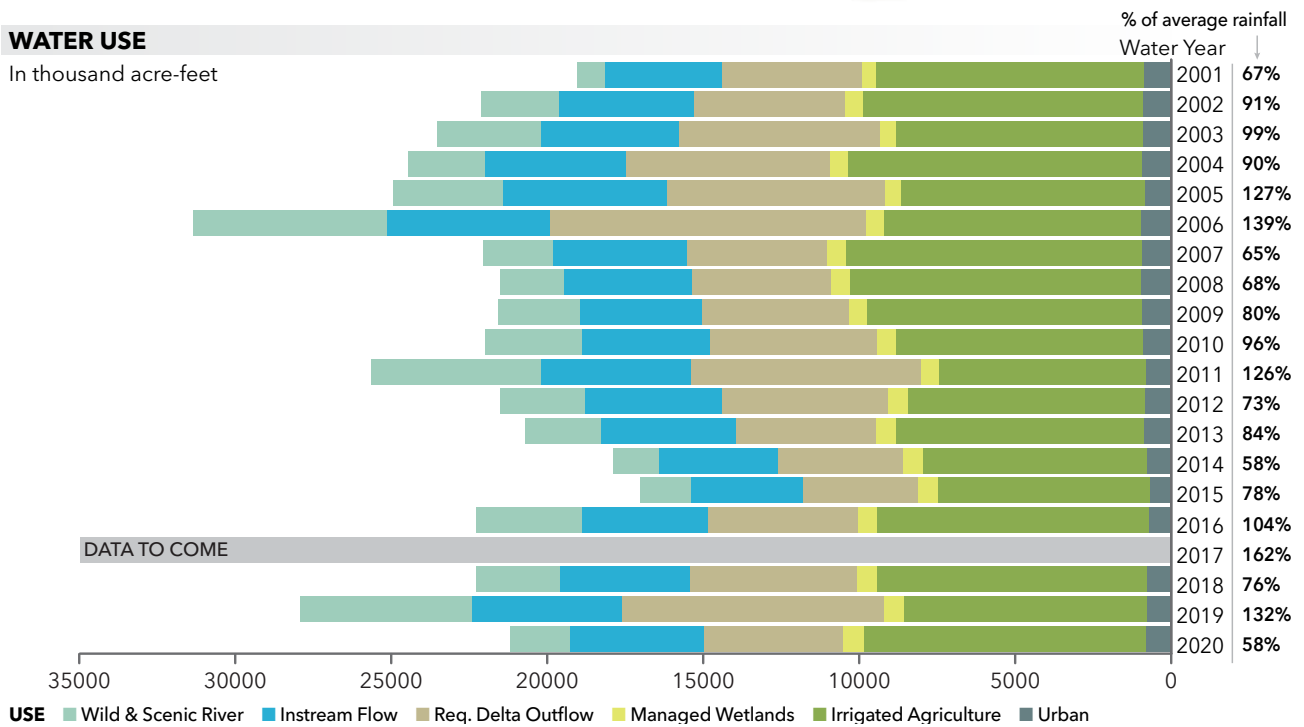
HYDROLOGIC REGION MAP

WATERSHED BOUNDARIES



**WATER USE**

In thousand acre-feet



**USE** Wild & Scenic River Instream Flow Req. Delta Outflow Managed Wetlands Irrigated Agriculture Urban



Figure 3-12 Sacramento River Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Maintaining water resources for all uses with reduced snowpack, earlier snowmelt, and warmer stream temperatures
- Sustainable groundwater management (declining groundwater levels) in portions of Redding and Sacramento Valley basins
- Restoring ecosystem functions and anadromous fish species in Sacramento River, tributaries, and floodplains
- Managing flood risk for greater Sacramento, Yuba City, Marysville urban areas
- Water quality, including increasing temperature and sediment management
- Managing catastrophic wildfire risks in federal, state, and private lands in upper watersheds

- Some front-line communities or individuals are served by small water systems and/or private wells
- The region seeks to restore ecological balance in the upper watersheds and resolve existing environmental justice issues

**Tribal**

- Channelization and levees impact Tribally important areas along the Sacramento River corridor and tributaries
- Lack of access to easements along river corridors for Tribal beneficial uses.
- Pesticides, herbicides, and other chemicals support invasive plant species and threatens the health of the watershed, restricting Tribal access to culturally important resources
- Tribes interested in partnering with state and federal entities with ongoing and future habitation restoration efforts

**Equity**

- 155 of the region’s 282 identified communities are defined as disadvantaged communities
- Entire watersheds can be considered disadvantaged due to high unemployment, low incomes

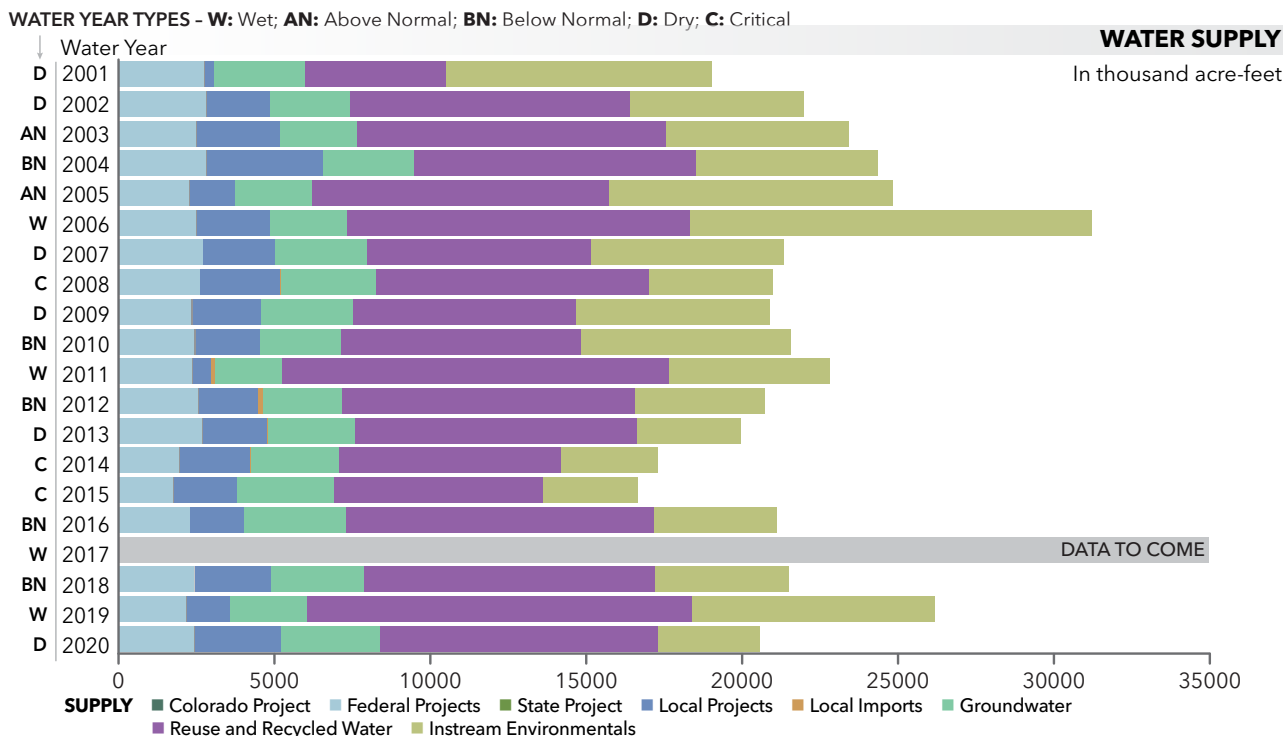


Figure 3-12 Sacramento River Hydrologic Region (continued)

### SACRAMENTO RIVER HYDROLOGIC REGION

**FUTURE CLIMATE RISKS**

Current Population: 3.3 million  
2070 Population: 3.8 million



**Increasing air temperatures**  
... Average daily air temperature likely to increase by more than 5 degrees F by late-century.



**Increasing flood risk ...**  
Flood flows may increase by more than 40%. Delta flood risk exacerbated by sea level rise.



**Increasing wildfire risk ...**  
Probability and size of wildfires will increase.



**Seasonal shifts in streamflow ...**  
Declining spring and fall flows, increasing winter flows.



**Maximum temperatures are increasing**  
... number of extreme temperature days increasing by 30 days per year by late-century

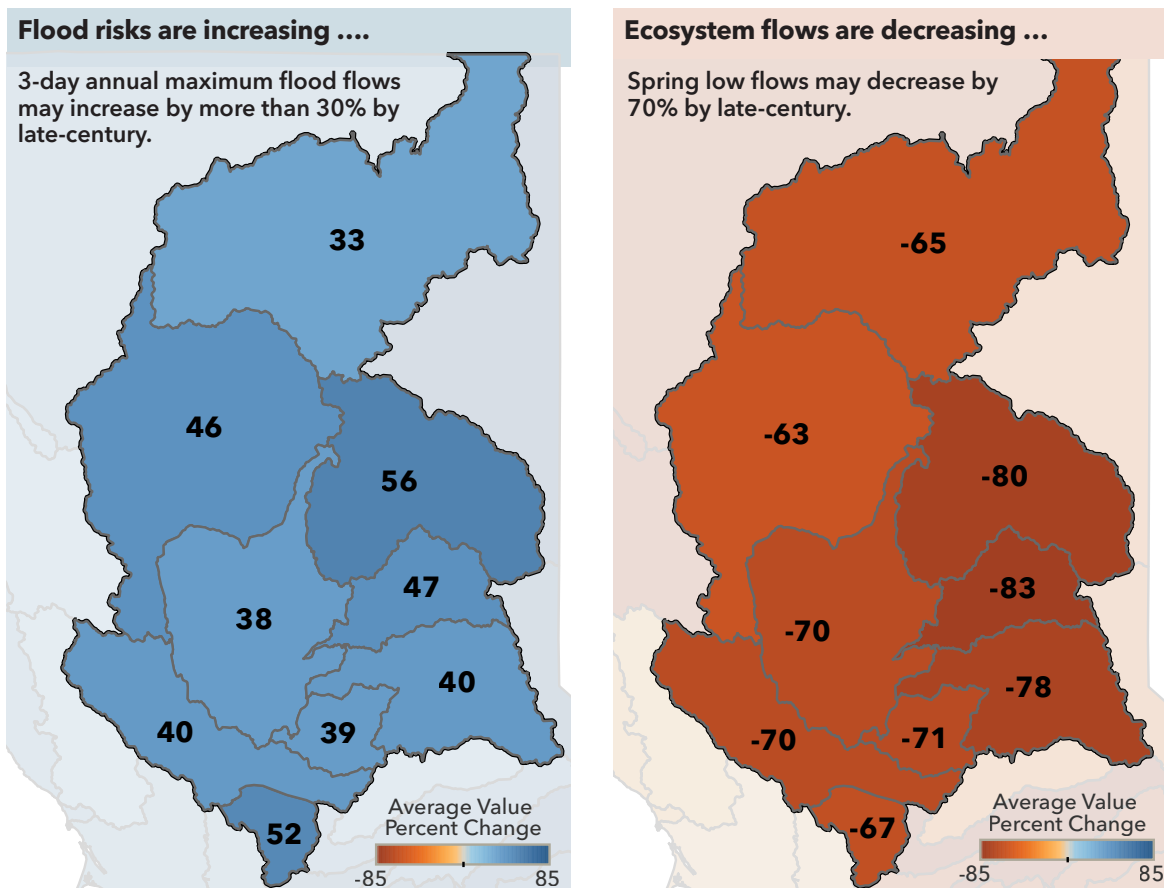
**REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY**

The Sacramento River hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management, ecosystem management, and infrastructure are assessed at higher vulnerability.



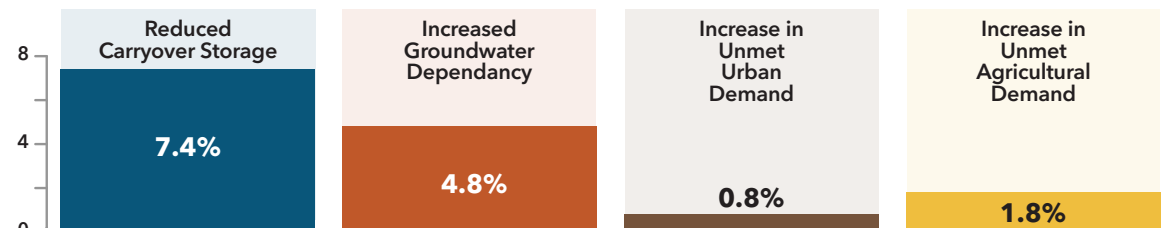
Figure 3-12 Sacramento River Hydrologic Region (continued)

**KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT**



**FUTURE SCENARIOS VULNERABILITIES**

Future vulnerabilities in water aspects in terms of percentage change from current conditions.



More details can be found in Chapter 2 of the Water Plan Update 2023 and the supporting documentation

**HIGHLIGHTS OF MAJOR ACTIONS Being Taken by State and Partners to Address Challenges**

- Yolo Bypass flood and habitat improvements
- Reservoir improvements (Folsom Dam, New Bullards Bar) and forecast-informed re-operations
- Regional Conjunctive Use
- Central Valley Flood Protection Plan and Regional Flood Plans
- Headwaters to State Water Project and federal Central Valley Project

Figure 3-13 San Joaquin River Hydrologic Region

**SAN JOAQUIN RIVER HYDROLOGIC REGION**

**HYDROLOGIC REGION DESCRIPTION**

The San Joaquin River hydrologic region covers about 15,200 square miles in the northern part of the San Joaquin Valley, the southern part of the Sacramento-San Joaquin Delta, and parts of the Sierra Nevada and Diablo Mountain ranges. It includes the entire drainage of the 300-mile-long San Joaquin River. Annual precipitation in the Sierra can be 35 inches, while on the heavily farmed valley floor, annual precipitation ranges from about 22 inches near Stockton to 6.5 inches in the southwest. About 2.3 million people lived in the region in 2020. Most natural flows from the upper San Joaquin River are diverted to irrigate crops outside the region. Most of the region’s surface water is delivered by the federal Central Valley Project. Groundwater accounts for about two-fifths of the region’s supply.

**HYDROLOGIC REGION MAP**

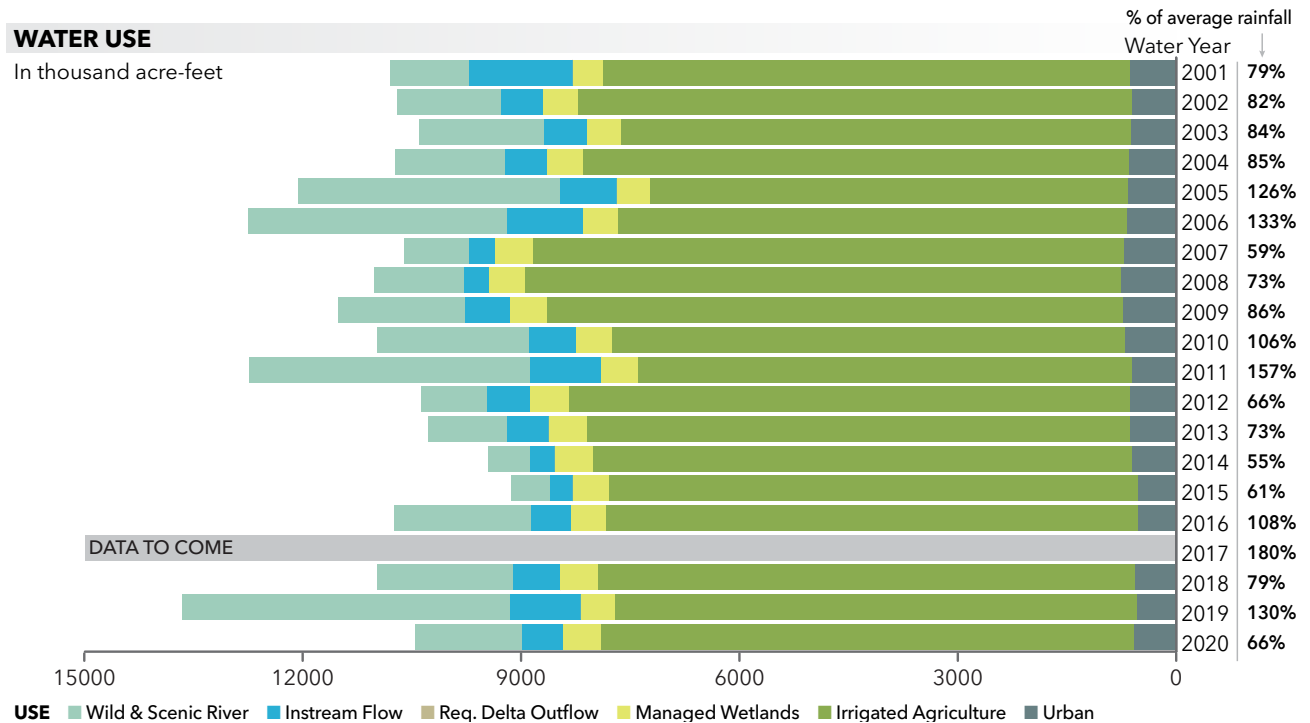


Figure 3-13 San Joaquin River Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Groundwater overdraft and dry wells
- High flood risk, especially in lower basin with climate change
- Drought risks
- Inadequate agency alignment and inconsistent agency roles and responsibilities.
- Insufficient funding to construct, repair, maintain or replace undersized or outdated infrastructure
- TMDL, CV-Salts, and dairy waste management, abandoned mines cleanup, OHV- erosion control
- Insufficient groundwater quality to meet rural domestic use
- Saline water intrusion into confined aquifers and intrusion into usable groundwater
- Maintaining adequate water quality, water temperature, and dissolved oxygen for environmental needs
- Degraded riparian and wetland habitat, disconnected floodplain, invasive species
- Sedimentation and erosion

- Inadequate data development and tracking of aerial images, mapping, river gauges

**Equity**

- Four most populous cities (Stockton, Merced, Lodi, Madera) are front-line communities
- Rural and urban areas struggle to improve water supply reliability, water quality, flood protection, water system infrastructure (e.g., fire flow, distribution, etc.), and outreach
- Limited conveyance connectivity in rural areas
- Low employment and wages
- Numerous dry domestic wells

**Tribal**

- Water rights conflicts
- Lack of access to easements along river corridors for Tribal beneficial uses
- Pesticides, herbicides, and other chemicals support invasive plant species and threatens the health of the watershed, restricting Tribal access to culturally important resources

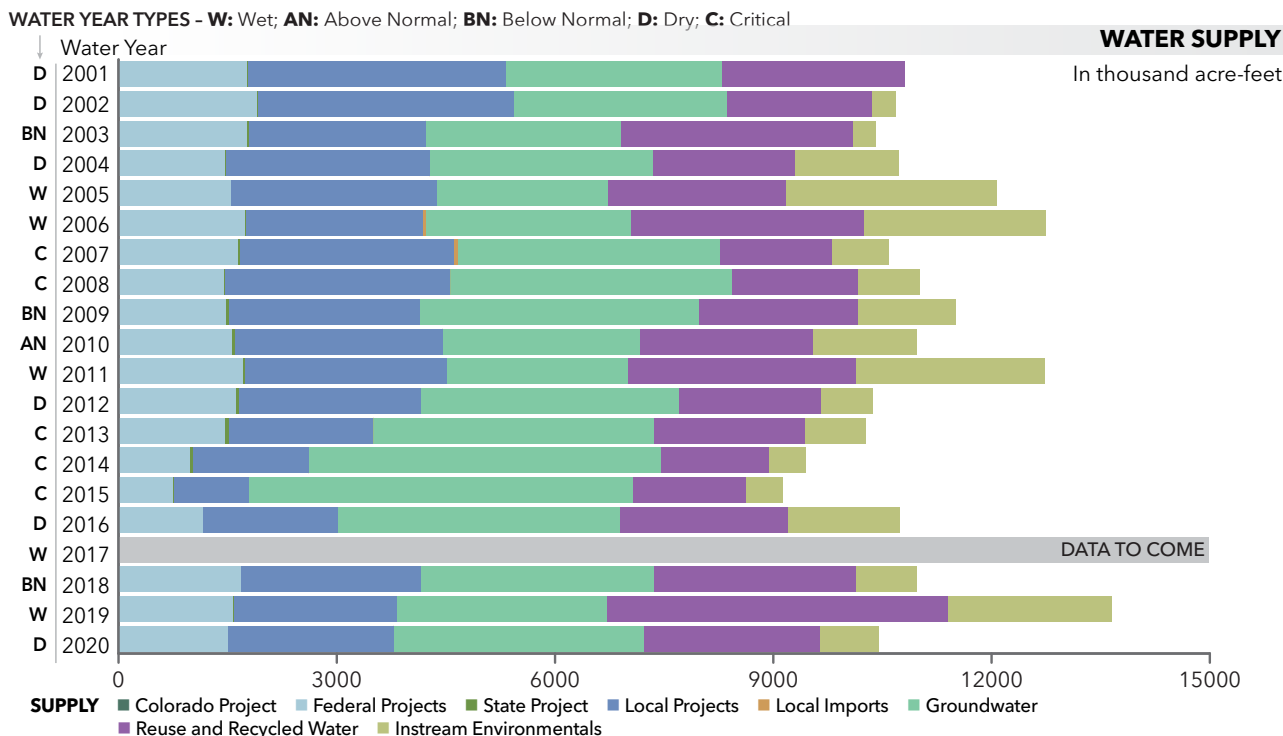


Figure 3-13 San Joaquin River Hydrologic Region (continued)

### SAN JOAQUIN RIVER HYDROLOGIC REGION

**FUTURE CLIMATE RISKS**

Current Population: 2.3 million  
2070 Population: 2.8 million



**Increasing air temperatures ...**  
Average daily air temperature likely to increase by 5 degrees F or more by late-century.



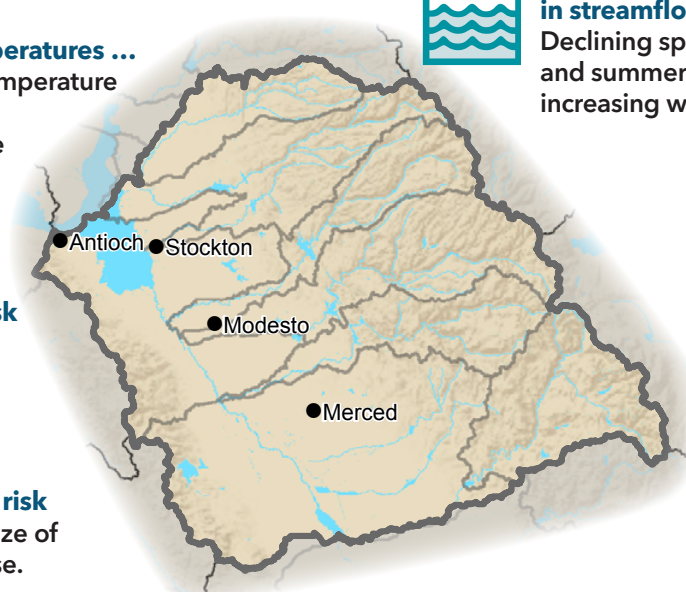
**Seasonal shifts in streamflow ...**  
Declining spring and summer flows, increasing winter flows.



**Increasing flood risk ...**  
Flood flows may increase by more than 50%.



**Increasing wildfire risk ...**  
Probability and size of wildfires will increase.



**Maximum temperatures are increasing ...**  
number of extreme temperature days increasing by 25 days per year by late-century.

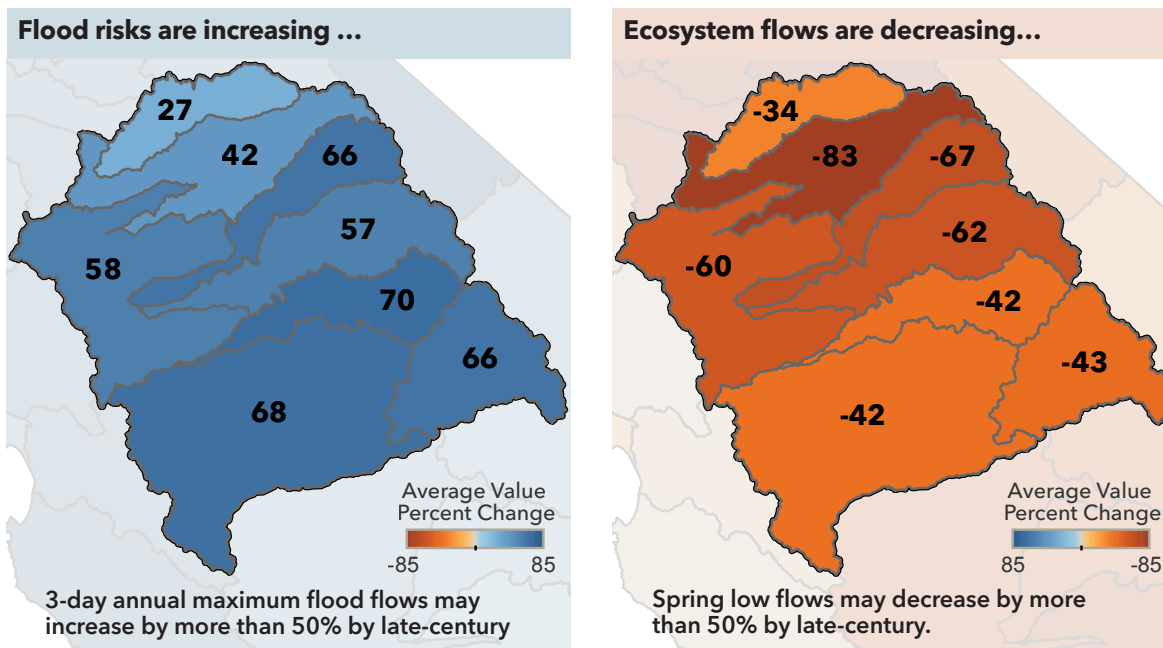
**REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY**

The San Joaquin River hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management, ecosystem management, water quality, agricultural sustainability, recreation and infrastructure are assessed at higher vulnerability.



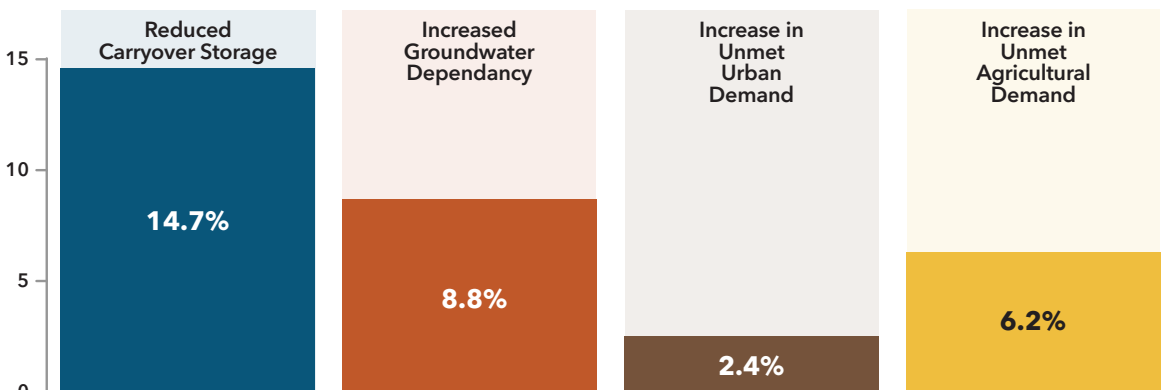
Figure 3-13 San Joaquin River Hydrologic Region (continued)

**KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT**



**FUTURE SCENARIOS VULNERABILITIES**

Future vulnerabilities in water aspects in terms of percentage change from current conditions.



More details can be found in Chapter 2 of the Water Plan Update 2023 and the supporting documentation

**HIGHLIGHTS OF MAJOR ACTIONS Being Taken by State and Partners to Address Challenges**

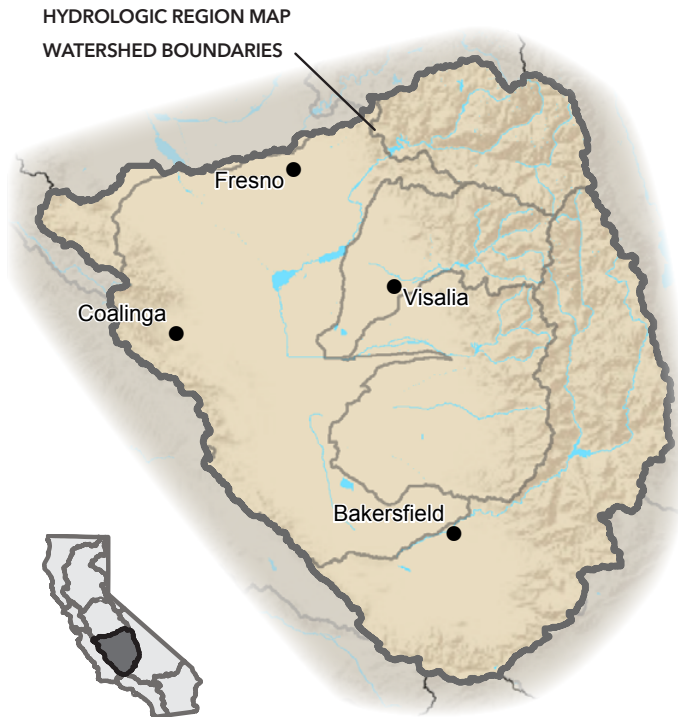
- **San Joaquin River Restoration Program** flows restoration from Friant Dam to the Merced River, ensures irrigation supplies to Friant water users, while restoring a self-sustaining fishery
- **Central Valley Flood Protection Plan**
- **San Joaquin Valley Watershed Studies**
- **Lower San Joaquin River Feasibility Study** (Stockton urban flood improvements)
- **CVRWQCB programs** reduced salt, boron, selenium, diazinon, and chlorpyrifos loading in the San Joaquin River and Delta
- **Three Amigos and Dos Rios Habitat Restoration**
- **Central Valley Joint Venture collaborative work** to restore wetlands and associated habitats for waterfowl, shorebirds, water birds, and riparian songbirds.
- **Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS)** and **Central Valley Salinity Management Plan**

Figure 3-14 Tulare Lake Hydrologic Region

**TULARE LAKE HYDROLOGIC REGION**

**HYDROLOGIC REGION DESCRIPTION**

The Tulare Lake hydrologic region encompasses roughly 17,000 square miles in the southern San Joaquin Valley that once contained a vast freshwater lake. The dramatically altered landscape now includes three million irrigated acres. Top crops are almonds and pistachios. Average annual rainfall on the valley floor ranges from about six to 11 inches. An estimated 2.4 million people lived in the region in 2020, with most residents in Fresno, Bakersfield, and Visalia. In normal years, surface water (primarily river water delivered through projects) supplies 70 percent of the demand by farms for water in the region. In dry years, farmers turn to groundwater for as much as 70 percent of supplies.



**WATER USE**

In thousand acre-feet

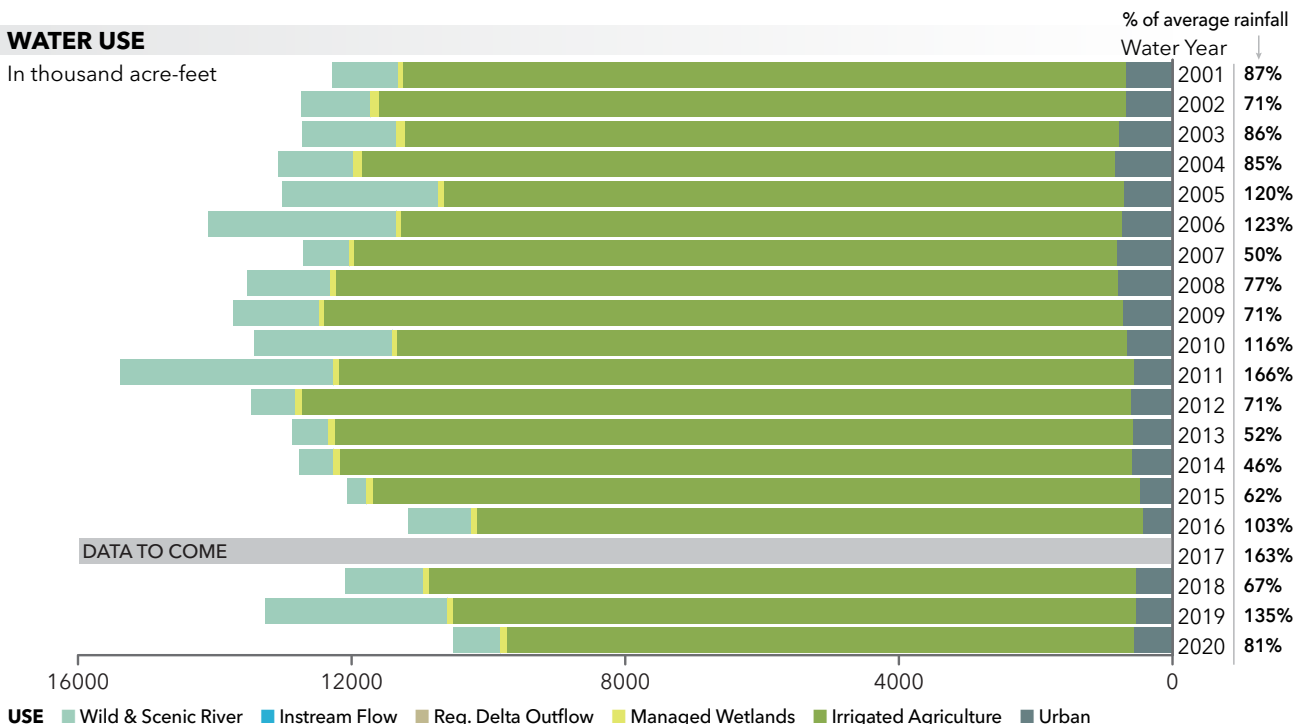




Figure 3-14 Tulare Lake Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Unique flood challenges due to being a natural lakebed with no outlet, development in floodplains
- Inconsistent agency roles, inconsistent funding for operations and maintenance
- Flood data and information needs including aerial images and mapping, data collection costs to design flood control structures, environmental regulatory compliance.
- Lack of flood storage, undersized and deteriorating flood infrastructure, lack of accountability for upstream/downstream impacts, and improved weather forecasting needs
- Drought risks
- Groundwater overdraft, subsidence and dry wells
- Insufficient upstream reservoir flood storage
- Salinity management
- Dairy industry pollution
- Small communities lack capacity and resources to address water quality, and aging wells and fresh and wastewater treatment infrastructure

**Equity**

- 51 percent of the region’s population lived in front-line communities in 2010
- Rural and urban areas need to improve water quantity, quality, supply reliability, flood protection, and water system infrastructure (e.g., fire flow, distribution, etc.).
- Lack of conveyance connectivity in rural areas
- Need for outreach, participation, and facilitation support services to access reliable funding

**Tribal**

- Water rights conflicts
- Lack of access to easements along river corridors for Tribal beneficial uses
- Declining ecosystems and streamflow depletion
- Access limited to along the Kings and Tule River corridors for traditional Tribal activities.
- Pesticides, herbicides, and other chemicals support invasive plant species and threatens the health of the watershed, restricting Tribal access to culturally important resources

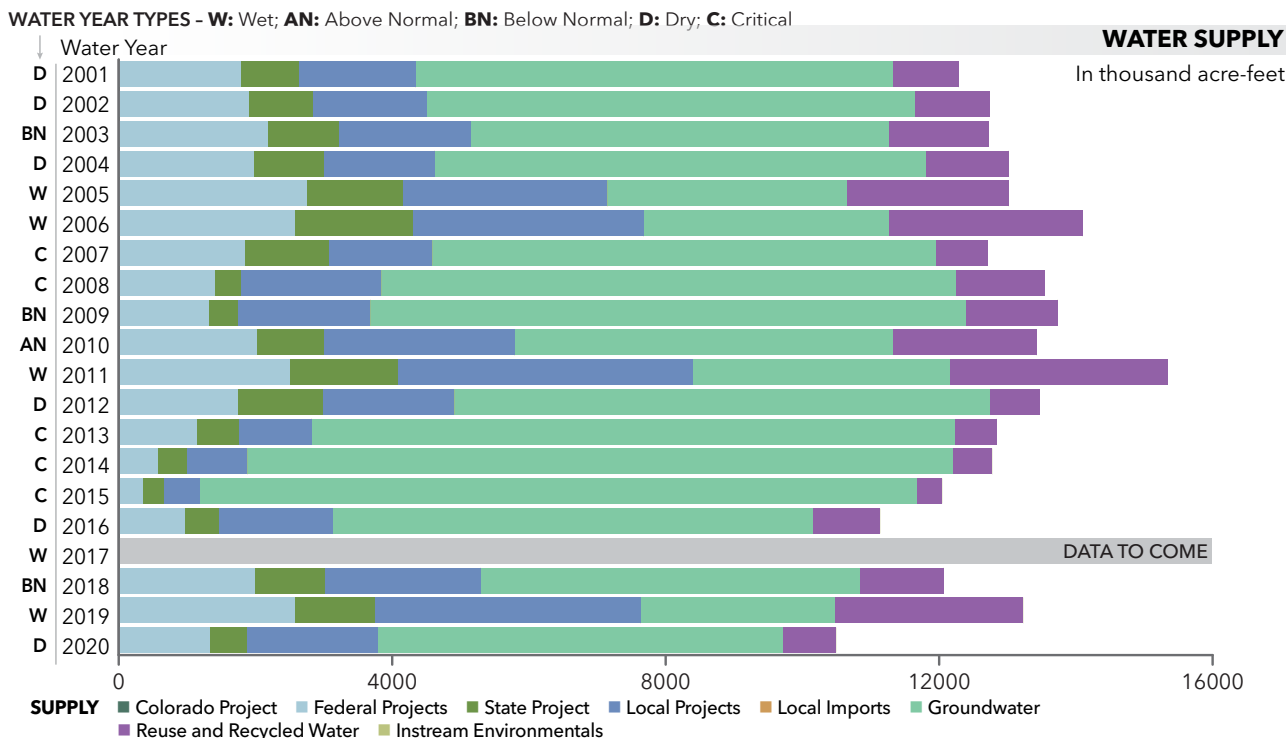
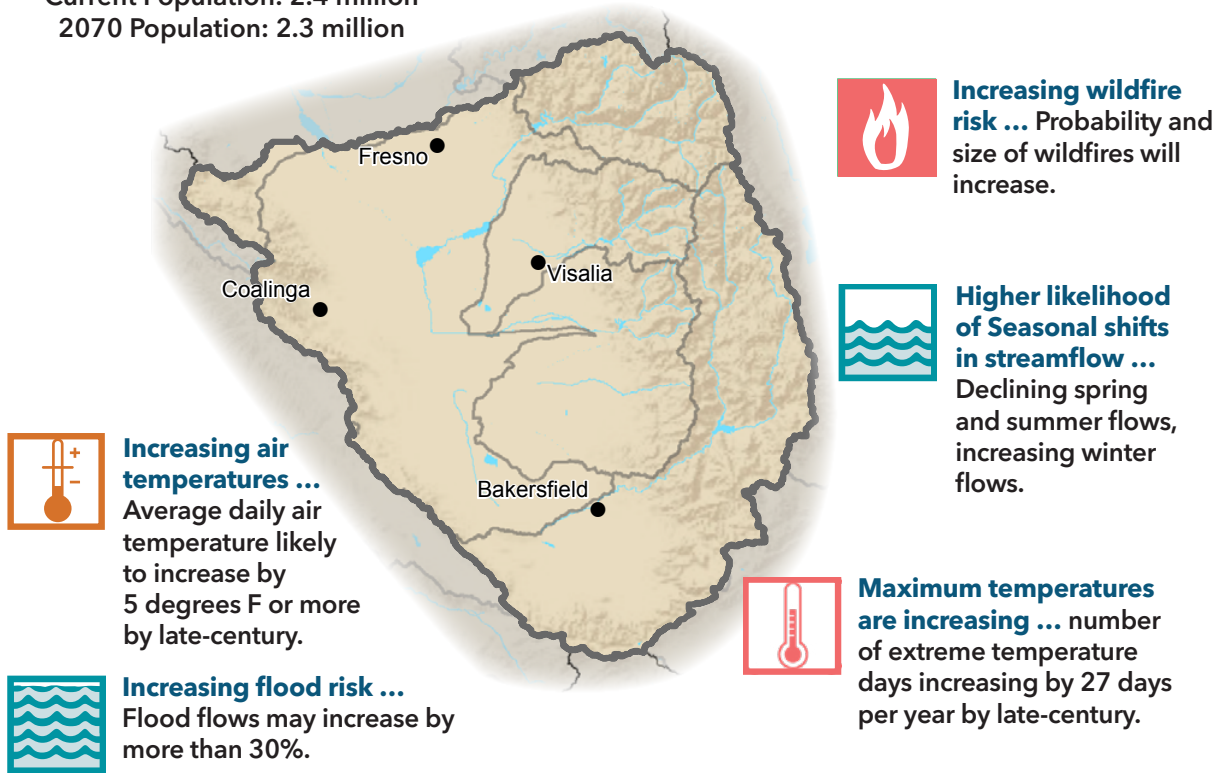


Figure 3-14 Tulare Lake Hydrologic Region (continued)

## TULARE LAKE HYDROLOGIC REGION

### FUTURE CLIMATE RISKS

Current Population: 2.4 million  
2070 Population: 2.3 million



### REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY

The Tulare Lake hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management, ecosystem management, and infrastructure are assessed at higher vulnerability.

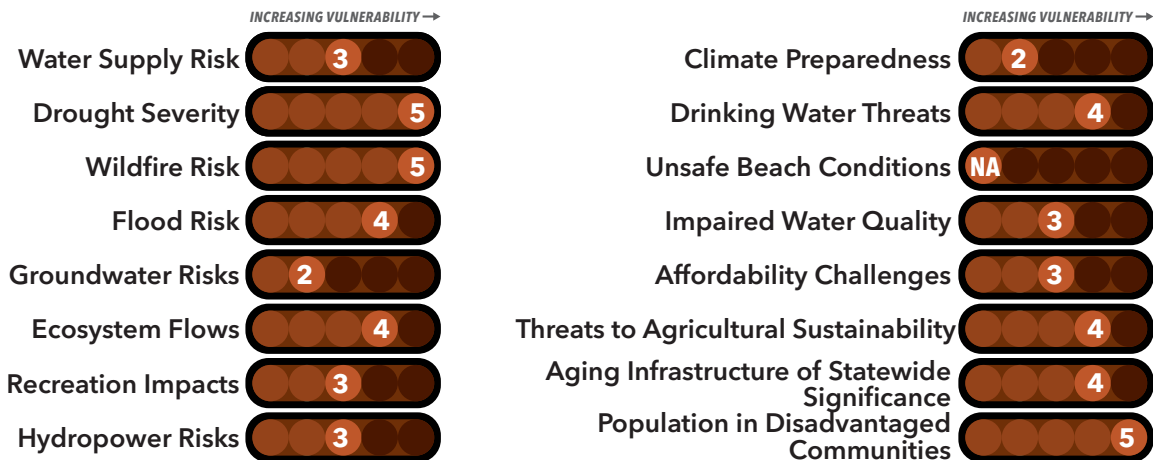
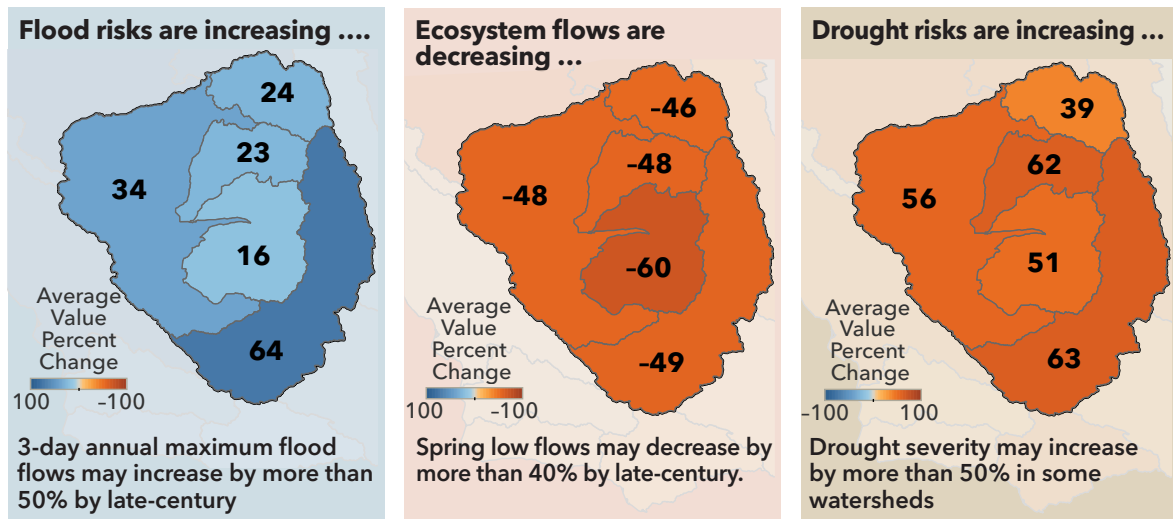


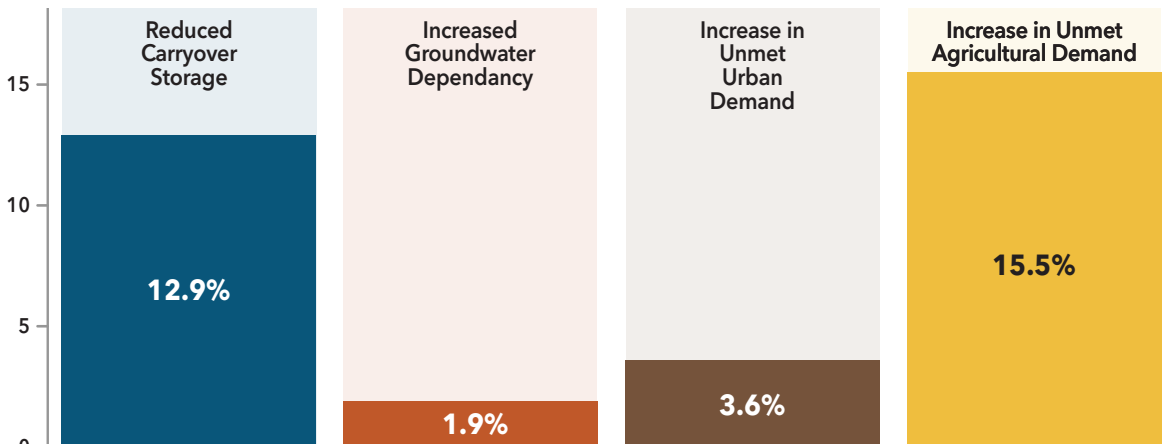
Figure 3-14 Tulare Lake Hydrologic Region (continued)

**KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT**



**FUTURE SCENARIOS VULNERABILITIES**

Future vulnerabilities in water aspects in terms of percentage change from current conditions.



More details can be found in Chapter 2 of the Water Plan Update 2023 and the supporting documentation

**HIGHLIGHTS OF MAJOR ACTIONS**

**Being Taken by State and Partners to Address Challenges**

- Kings Basin Water Authority front-line communities and water-related needs (drinking water, wastewater, and stormwater/drainage) inventory in the Kings Basin Region
- Local efforts for salt management have initiated outreach programs to reduce salt loads to Regional Wastewater Reclamation Facility and to groundwater
- Agricultural operations are initiating integrated on-farm drainage management systems
- Continued implementation of the long-term Irrigated Lands Regulatory Program addressing both surface water and groundwater discharges
- CVRWQCB implementing its general order for existing milk cow dairies to manage waste and nutrients
- Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) and Central Valley Salinity Management Plan
- Tulare Lakebed flood emergency response

Figure 3-15 North Lahontan Hydrologic Region

**NORTH LAHONTAN HYDROLOGIC REGION**

**HYDROLOGIC REGION DESCRIPTION**

The North Lahontan hydrologic region covers approximately 6,100 square miles in far northeastern California. Average annual precipitation is 23 inches, and all runoff drains east to Nevada. Roughly 94,000 people lived in the region in 2020, but visitors to the Tahoe basin often outnumber local residents. Most of the land is federal, with many ski and vacation resorts. Cattle ranching is the principal agricultural activity. Groundwater accounts for about 30 percent of the annual supply.

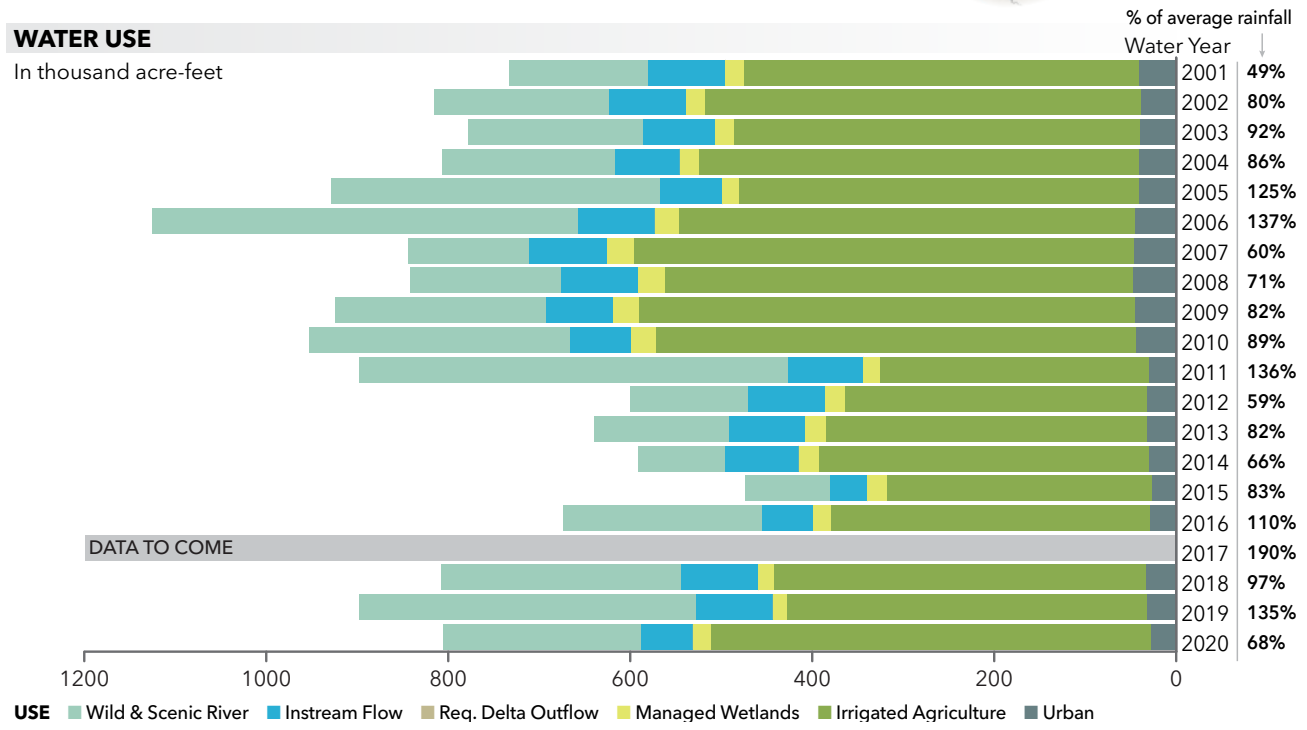


Figure 3-15 North Lahontan Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Re-operating Truckee River reservoirs for better drought and flood management.
- Unpredictable drought periods strain local water supplies
- Perpetual water shortages limit agricultural production
- Groundwater for agriculture is often exhausted each year during drier years
- Preventing and managing catastrophic wildfire impacts
- River flows decreasing over time
- Lake Tahoe water clarity and quality
- Cannabis cultivation causing ecological impacts
- Declining ecosystem functions and services

**Equity**

- There are 11 front-line communities in the Lahontan Basins region, 5 in the Tahoe-Sierra region, 2 in the Inyo-Mono region; and 4 in the Surprise Valley area of Modoc County
- Water contaminants, impaired water bodies, water related health and safety risks
- Lack of capacity for grant proposal development and data management
- Climate change impacts of drought, forest health, and flooding on frontline communities

**Tribal**

- Water rights conflicts
- Lack of access to easements along river corridors for Tribal beneficial uses
- Groundwater depletion and surface water diversions are drying up historical springs and ancient agricultural water systems

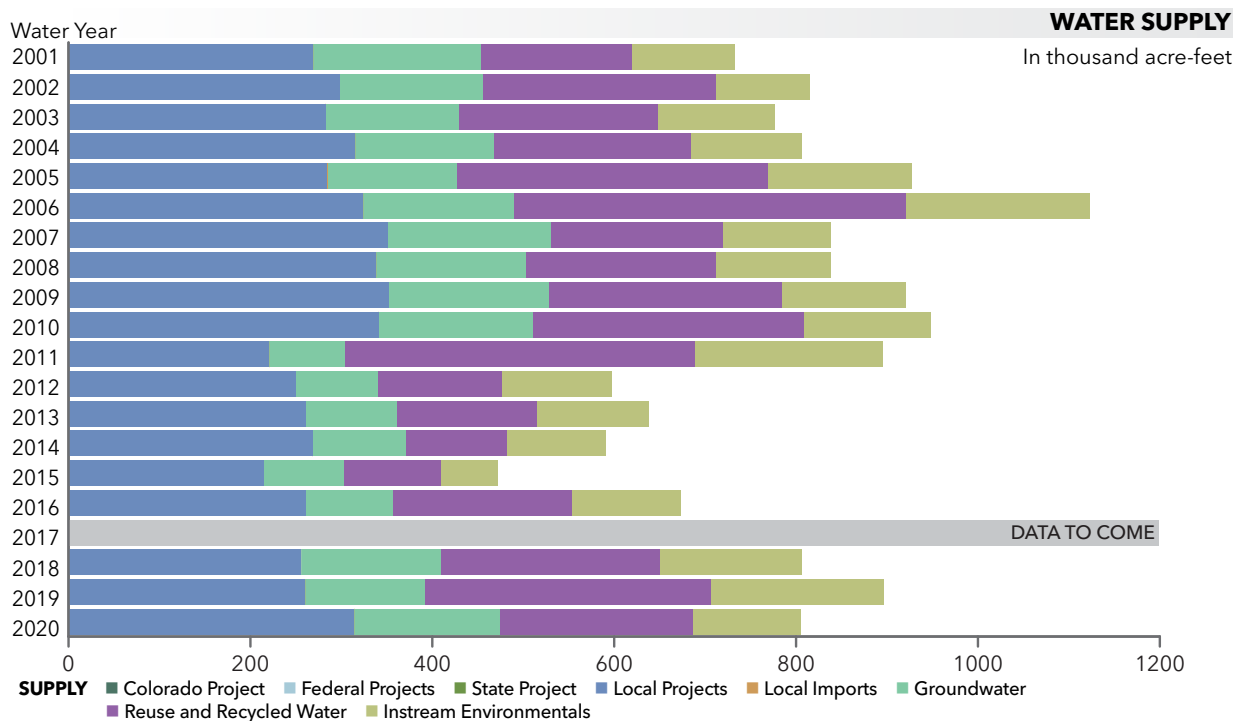


Figure 3-15 North Lahontan Hydrologic Region (continued)

### NORTH LAHONTAN HYDROLOGIC REGION

**FUTURE CLIMATE RISKS**

Current Population: 94,000  
2070 Population: 69,000



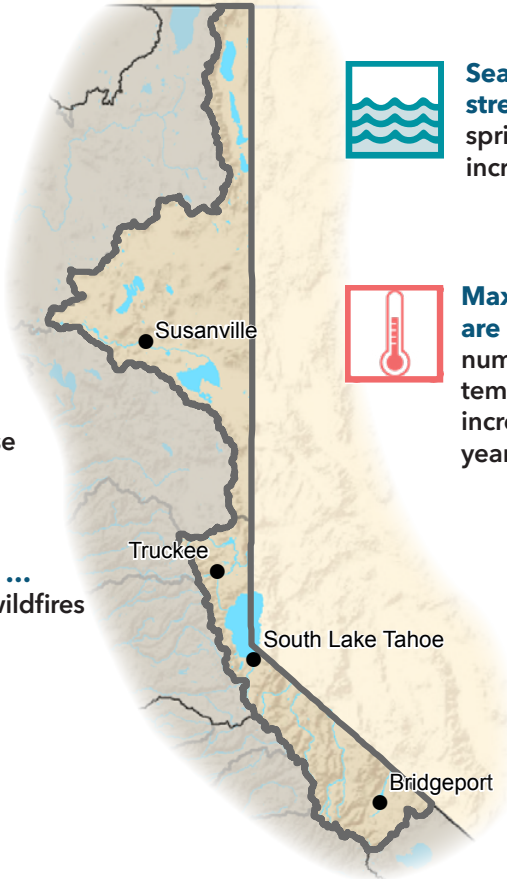
**Increasing air temperatures ...**  
Average daily air temperature likely to increase by 6 degrees F or more by late-century.



**Increasing flood risk ...**  
Flood flows may increase by more than 70%.



**Increasing wildfire risk ...**  
Probability and size of wildfires will increase.



**Seasonal shifts in streamflow ...** Declining spring and summer flows, increasing winter flows.



**Maximum temperatures are increasing ...** number of extreme temperature days increasing by 37 days per year by late-century.

**REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY**

The North Lahontan hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management, ecosystem management, and recreation impacts are assessed at higher vulnerability.

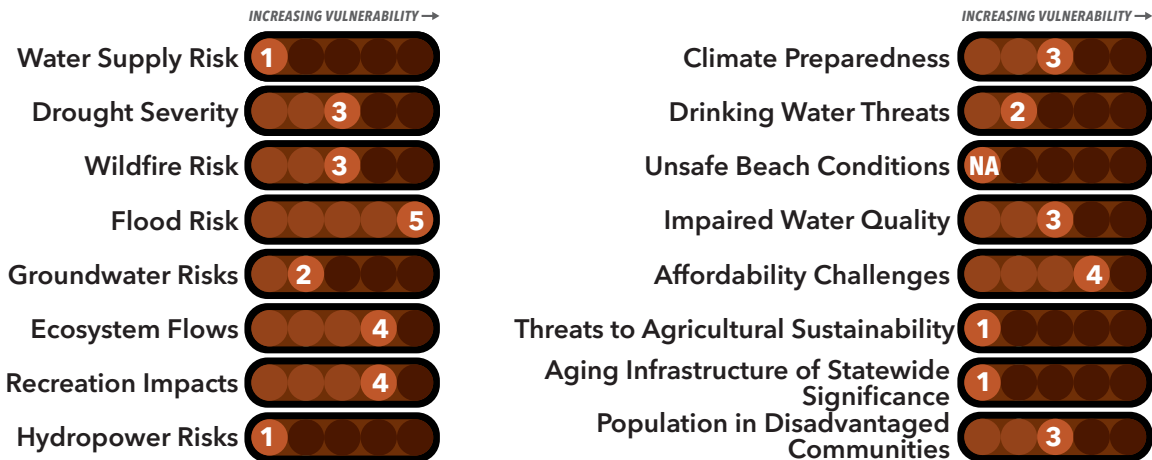
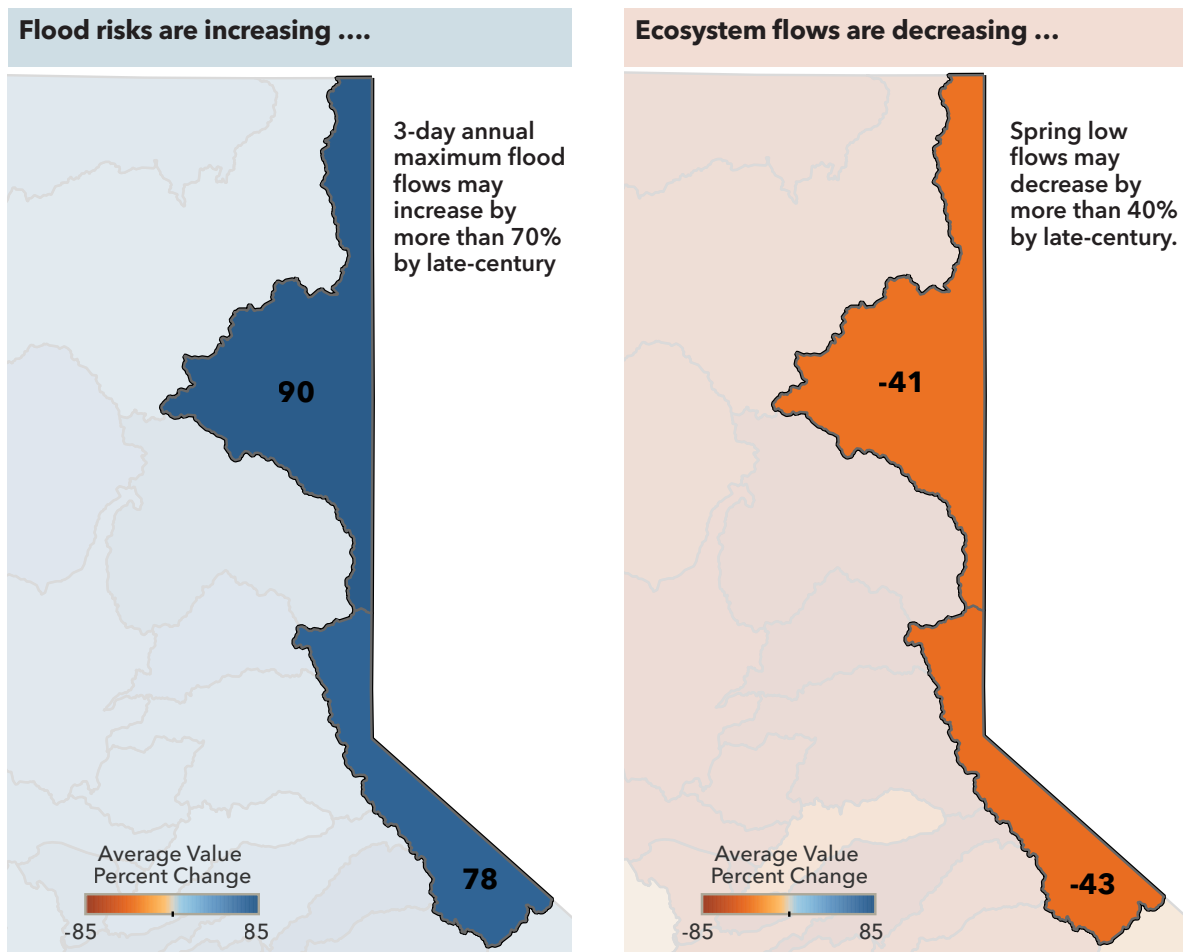


Figure 3-15 North Lahontan Hydrologic Region (continued)

KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT



**HIGHLIGHTS OF MAJOR ACTIONS Being Taken by State and Partners to Address Challenges**

- Lake Tahoe Environmental Improve Program has completed over 30 forest health and hazardous fuels reduction projects in the Lake Tahoe area treating 17,870 acres to reduce wildfire threat and improve forest resilience
- Lake Tahoe Environmental Improve Program has completed 35 storm water projects to protect lake clarity within the greater Upper Truckee watershed
- Upper Truckee Marsh, Tahoe Pines, and Trout Creek restoration projects
- Ongoing mitigation efforts at the Leviathan Mine Superfund Site to reduce environmental impacts
- Ongoing coordination between State, federal, and local agencies to implement the Cannabis Regulatory Program focusing on vulnerable watersheds subject to significant illegal cultivation activities

Figure 3-16 South Lahontan Hydrologic Region

**SOUTH LAHONTAN HYDROLOGIC REGION**

**HYDROLOGIC REGION DESCRIPTION**

The South Lahontan hydrologic region covers approximately 27,000 square miles in eastern California. It includes the lowest and highest points in the state (Mount Whitney and Death Valley) and in 2020 was home to an estimated 1 million people. Annual rainfall averages 10 inches or less for most of the region. Groundwater accounts for roughly two-thirds of the agricultural and urban supply. The city of Los Angeles controls rights to much of the region’s largest river, the Owens. Some water districts in the region import Northern California water from the State Water Project.

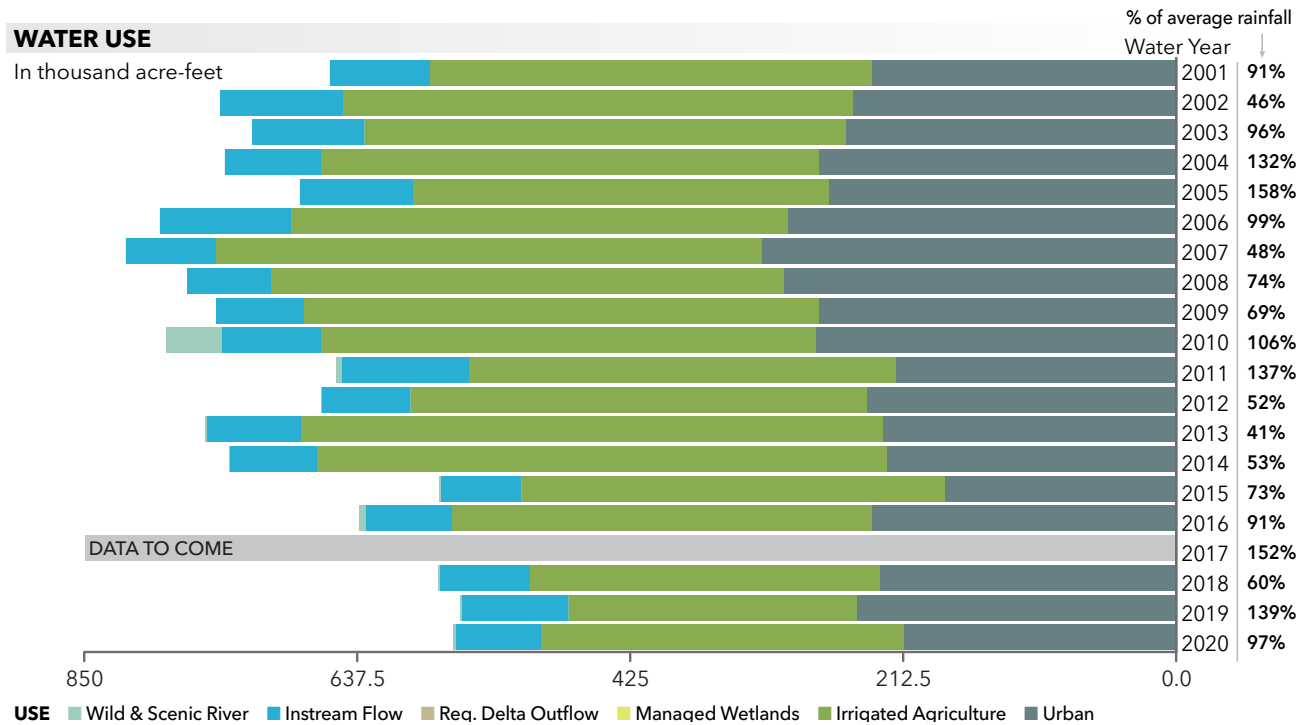




Figure 3-16 South Lahontan Hydrologic Region (continued)

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Flood management in the Antelope and Mojave River valleys
- Meeting federal and State drinking water standards for groundwater contaminants
- Groundwater salinity in closed basins as recycled water increases
- Drought, water shortages, groundwater overdraft, and reliability of SWP water supplies
- Elevated impacts from climate change and wildfire
- Impacts from invasive non-native species, including quagga and zebra mussels
- Protecting, restoring, and conserving fish habitat, riparian corridors, and wetlands, and improving water quality to support healthy ecosystems
- Owens and Mono Lake sustainable management

- Limited capacity for proposal development, data management, and climate change adaptation
- The region seeks to restore ecological balance in the watersheds and resolve existing environmental justice issues

**Tribal**

- Water rights, and water that may be accessible, but quality is not acceptable for use
- Lack of access to easements along river corridors for Tribal beneficial uses
- Pesticides, herbicides, and other chemicals support invasive plant species and threatens the health of the watershed, restricting Tribal access to culturally important resource
- Groundwater depletion and surface water diversions are drying up historical springs and ancient agricultural water systems, while increasing concentrations of surface water contaminants
- Urban, agriculture, and industry diversions decrease instream flows and stream health

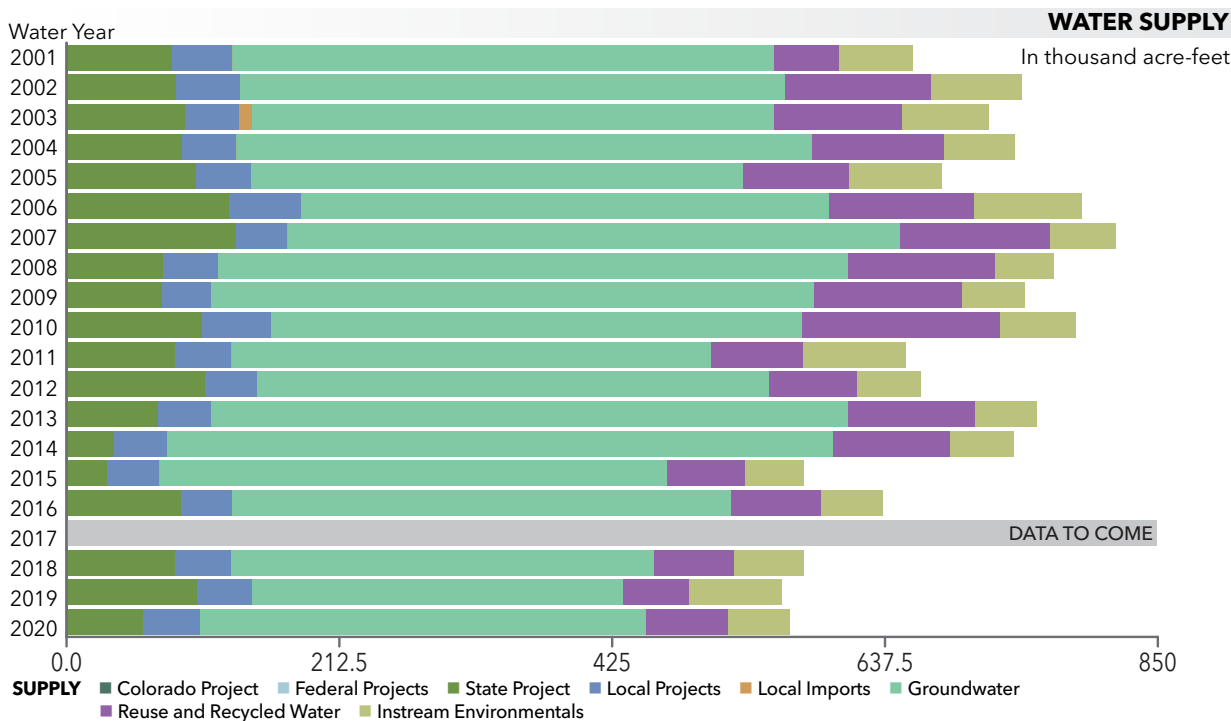


Figure 3-16 South Lahontan Hydrologic Region (continued)

### SOUTH LAHONTAN HYDROLOGIC REGION

#### FUTURE CLIMATE RISKS

Current Population: 1 million  
2070 Population: 850,000



**Increasing air temperatures ...** Average daily air temperature likely to increase by 6 degrees F or more by late-century.



**Maximum temperatures are increasing ...** number of extreme temperature days increasing by 45 days per year by late-century.



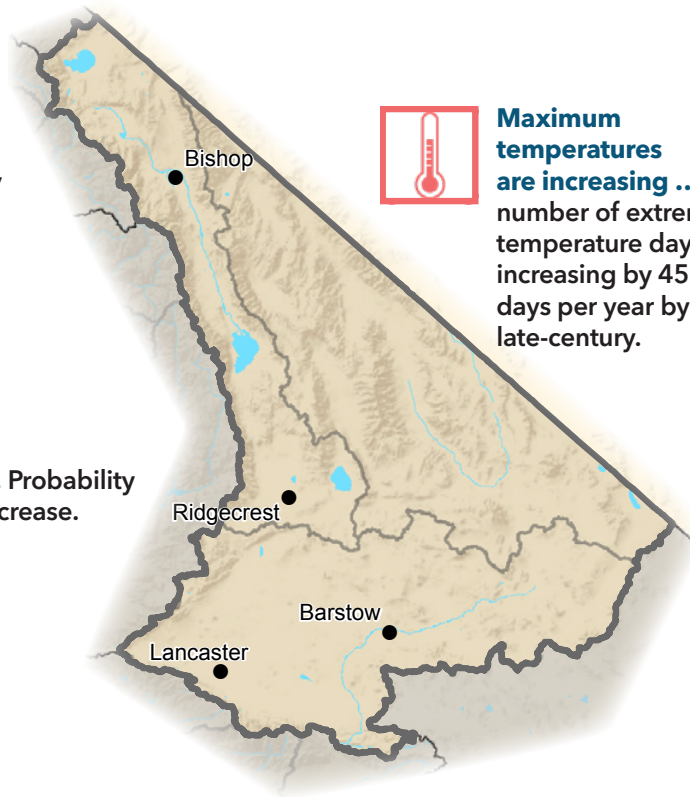
**Increasing flood risk ...** Flood flows may increase by more than 40%.



**Increasing wildfire risk ...** Probability and size of wildfires will increase.



**Seasonal shifts in streamflow ...** Declining spring and summer flows, increasing winter flows.



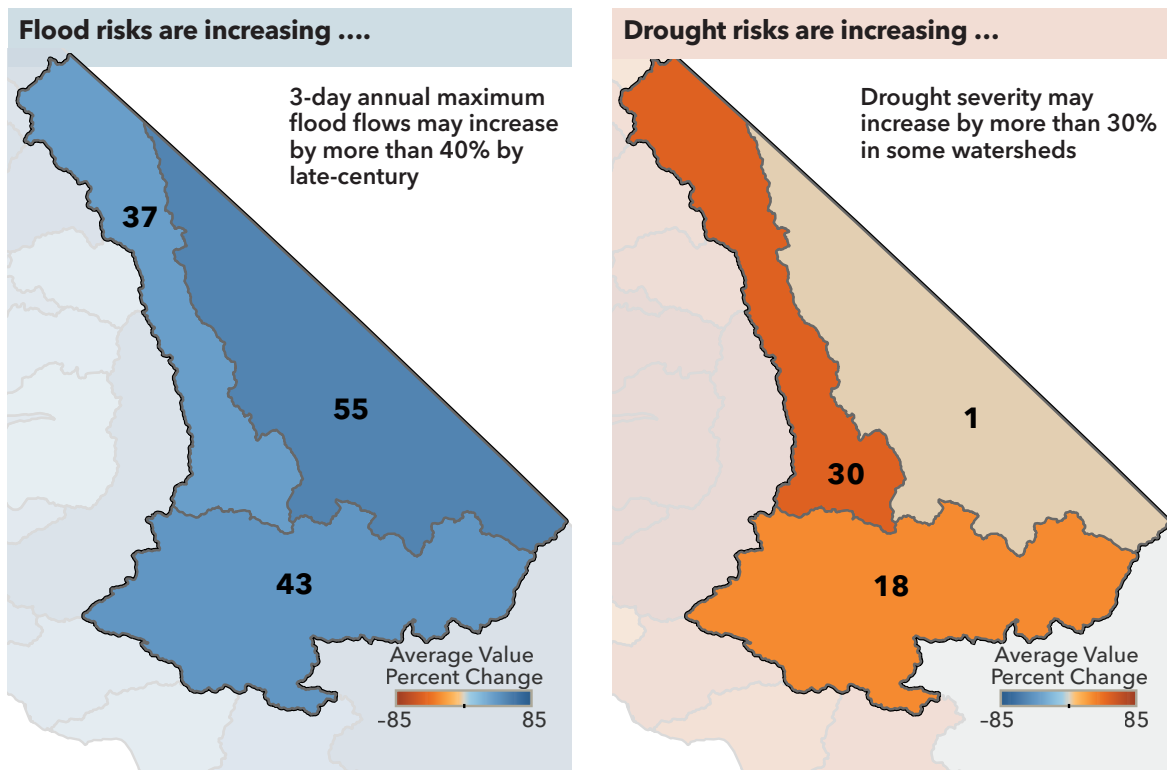
#### REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY

The South Lahontan hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management, ecosystem management, and infrastructure are assessed at higher vulnerability.



Figure 3-16 South Lahontan Hydrologic Region (continued)

KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT



**HIGHLIGHTS OF MAJOR ACTIONS**  
Being Taken by State and Partners to Address Challenges

- Owens River and Mono Basin restoration projects
- Floodplains projects for Rush and Lee Vining creeks to restore fisheries and riparian vegetation
- Owens River environmental restoration projects establishing 2,000 acres of wetland and riparian habitat, providing a warm water fishery environment, and maintaining permanent flow in the southern portion of the Owens River
- Owens Lake Dust Mitigation Program, which has improved habitat for shorebirds and waterfowl
- Reuse and groundwater recharge projects in the Mojave River groundwater basin
- Mojave River groundwater basin recharge facilities and most of the basin is no longer in overdraft
- Recycled water use is increasing in the region and new conservation programs improve efficiencies

Figure 3-17 Colorado River Hydrologic Region

**COLORADO RIVER HYDROLOGIC REGION**

**HYDROLOGIC REGION MAP**



**HYDROLOGIC REGION DESCRIPTION**

The Colorado River hydrologic region covers approximately 20,000 square miles in southeastern California. The average annual precipitation is about six inches, making it the most arid region of California. An estimated 770,000 people lived in the region in 2020. It is known for year-round agricultural production, with alfalfa the leading crop. The largest body of water in the region is the Salton Sea, a hyper-saline inland lake fed largely by agricultural runoff. About 75 percent of the region’s urban and agricultural water supply comes from the Colorado River. Groundwater provides about eight percent of the supply in normal years.

**CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS**

**Water Management**

- Colorado River drought severity increasing with climate change
- Conflicts in protecting threatened or endangered species on the Colorado River main

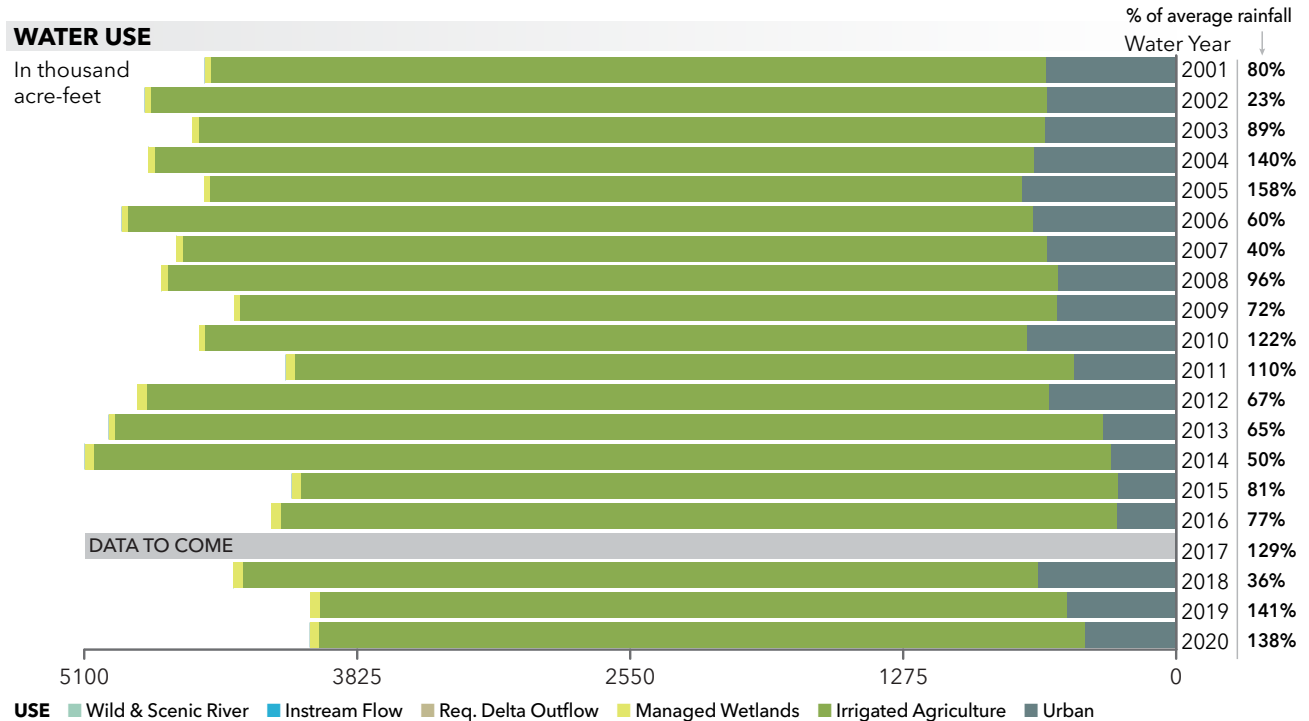


Figure 3-17 Colorado River Hydrologic Region (continued)

- stem and maintaining agricultural and urban water supplies
  - Land use changes and new water demands
  - River under extreme pressure to meet all regional water use demands
  - Cities and unincorporated communities geographically disbursed over large areas resulting in high projects costs and more difficult outreach to remote communities
  - Salton Sea habitat values are declining due to salinity and receding water levels.
  - Saline intrusion from Salton Sea contribute to ground water quality degradation
  - Over-drafted groundwater basins are causing land subsidence
  - Water quality contaminants and impaired water bodies, including arsenic in the groundwater
  - Salt management from recharge and irrigation from the Colorado River
- Equity**
- Lack of adequate quality and quantity of water for domestic and irrigation supplies
- Lack of access to public water and sewer infrastructure
  - Unreliable, undersized, deteriorating small rural water and wastewater systems, and failing private wells and septic
  - Affordability issues and many front-line communities scattered over a large area
- Tribal**
- Water rights, and water that may be accessible, but quality is not acceptable for use
  - Lack of access to easements along river corridors for Tribal beneficial uses
  - Pesticides, herbicides, and other chemicals support invasive plant species and threatens the health of the watershed, restricting Tribal access to culturally important resource
  - Groundwater depletion drying up historical springs and surface water contamination
  - Urban, agriculture, and industry diversions decrease instream flows and stream health
  - Avoiding or mitigating negative environmental effects during natural resources extraction (e.g., mineral and geothermal)

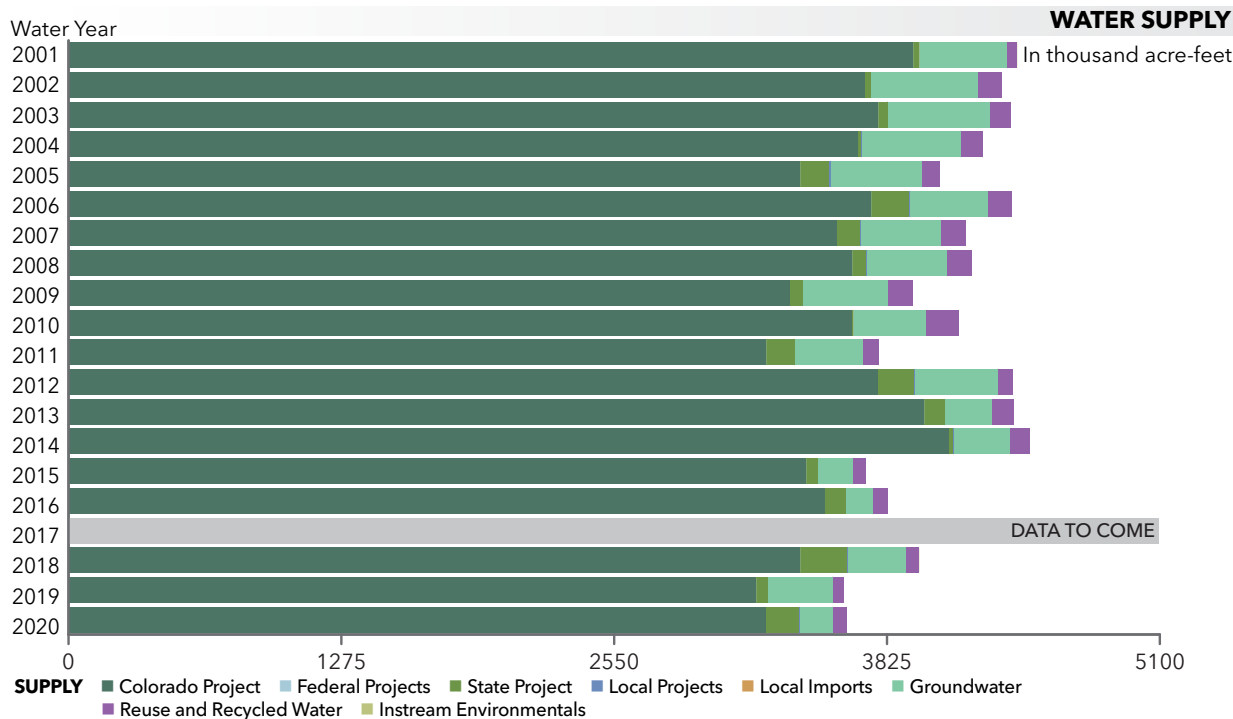


Figure 3-17 Colorado River Hydrologic Region (continued)

### COLORADO RIVER HYDROLOGIC REGION

#### FUTURE CLIMATE RISKS

Current Population: 771,000  
2070 Population: 736,000



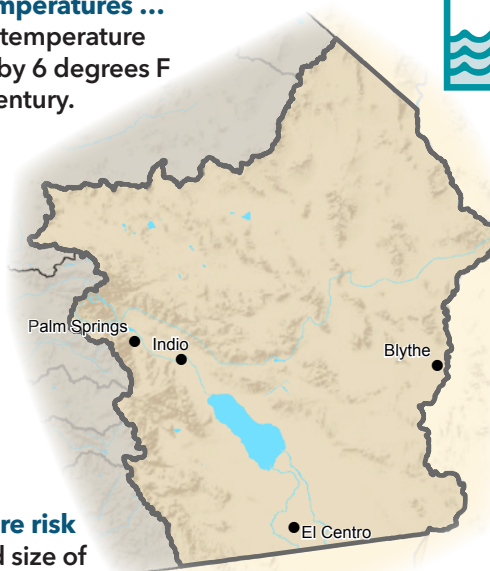
**Increasing air temperatures ...**  
Average daily air temperature likely to increase by 6 degrees F or more by late-century.



**Seasonal shifts in streamflow ...**  
Declining spring and summer flows, increasing winter flows.



**Increasing flood risk ...**  
Flood flows may increase by more than 70%.



**Maximum temperatures are increasing ...**  
number of extreme temperature days increasing by 42 days per year by late-century.



**Increasing wildfire risk ...**  
Probability and size of wildfires will increase.

#### REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY

The Colorado River hydrologic region is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management, ecosystem management, and infrastructure are assessed at higher vulnerability.

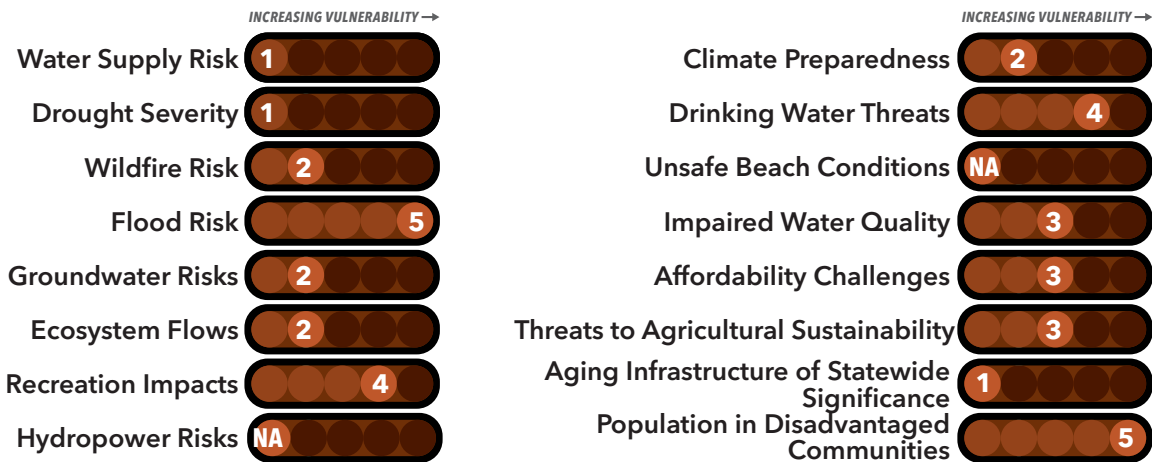
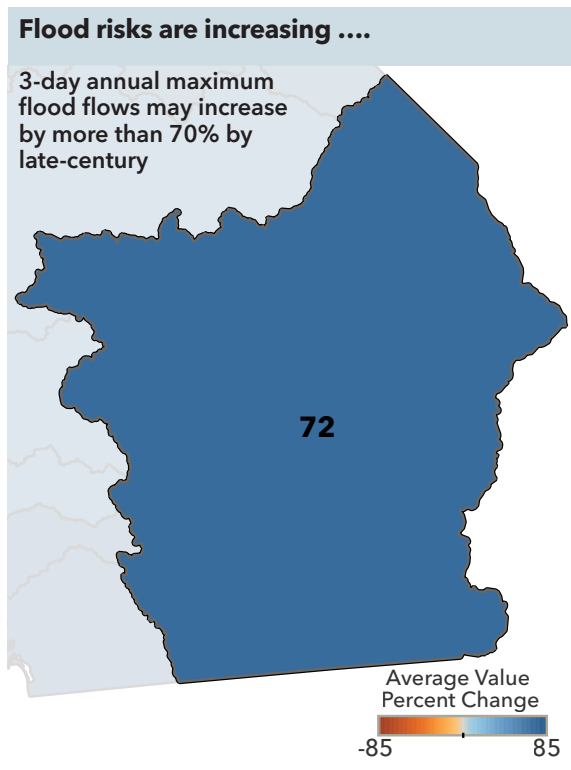


Figure 3-17 Colorado River Hydrologic Region (continued)

**KEY FINDINGS FROM WATERSHED RESILIENCE ASSESSMENT**



**Drought risks are increasing ...**  
Drought severity in the Colorado River Basin is increasing and has significant impacts to this region in California

**HIGHLIGHTS OF MAJOR ACTIONS Being Taken by State and Partners to Address Challenges**

- **Continued implementation of Lower Colorado River Multi-Species Conservation Program** (habitat restoration, fish augmentation, species research, and system monitoring); Several mitigation programs underway per CRWDA requirements.
- **Salton Sea Species Conservation Habitat Project** addressing near-term losses and degradation of habitat to protect Salton Sea fish and wildlife species
- **Coachella Valley Multiple Species Habitat Conservation Plan** work is ongoing and elements of IID's 2002 Draft HCP are being implemented for water conservation and transfer projects.
- **Colorado River Basin Salinity Control Program** has reduced salt load of Colorado River by 1.2 million tons annually to offset increases in salinity levels.
- **USBR's Colorado River Basin Study** examines watershed hydrology under historical conditions with emphasis on conditions impacted by climate change.
- **New River Improvement Project** that establishes 3 wetland sites, a strategic plan identifying actions addressing public health, environment, and water quality for Salton Sea.
- **Groundwater Storage** include the advanced storage agreement between CVWD, DWA, and MWD regarding Colorado River supplies
- **Ames Valley Recharge Project in San Bernardino County** is recharging this groundwater basin using SWP supplies

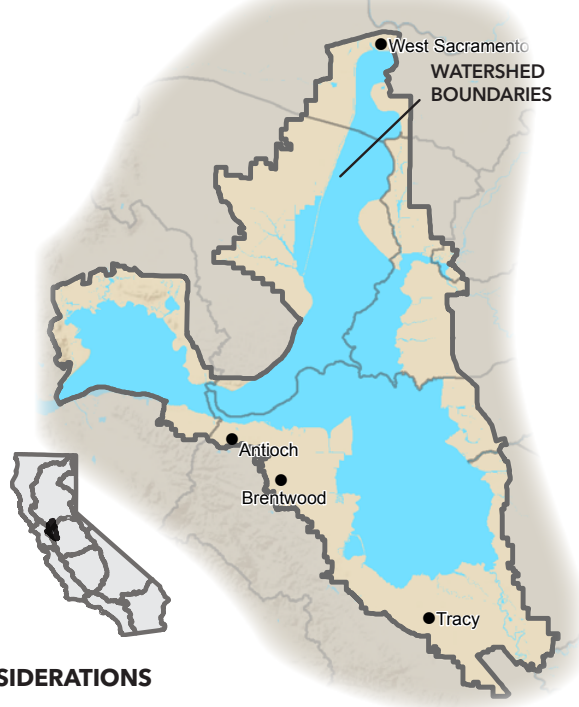
Figure 3-18 Sacramento-San Joaquin Delta Overlay Area

## SACRAMENTO-SAN JOAQUIN RIVER DELTA OVERLAY AREA

### OVERLAY AREA DESCRIPTION

The Delta and Suisun Marsh are at the confluence of the Sacramento River and San Joaquin River basins, which drain about 40 percent of California. Collectively, they cover about 1,315 square miles in portions of six California counties and are part of the largest estuary on the West Coast of the United States. Covering about 1 percent of California’s area the Delta serves as a hub for the federal Central Valley Project and the State Water Project, the two largest water systems in the California. A large part of the State is dependent on water exported from the Delta to meet agricultural and urban needs. Approximately two-thirds of the state’s population in urban areas receive at least some of their water supply from the Delta. About 3 million acres of agricultural land are irrigated with exported water.

HYDROLOGIC REGION MAP



### CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS

#### Water Management

- Balancing upstream diversions and in-Delta water use
- Climate change impacting management of ecosystems, endangered species, flood, water quality and water supply
- More variable hydrologic regime,
- Sea-level rise and salinity intrusion
- Increased levels of pests and disease
- Aging infrastructure
- Potential for catastrophic levee failure from seismic activity
- Delta conveyance reliability
- Multiple pollutants degrade water quality throughout the Delta
- Preserving the Delta as a place
- Subsidence and Delta Island sustainability

#### Equity

- Water contaminants, impaired water bodies, water related health and safety risks
- Limited capacity for proposal development,

data management

- Climate change impacts related to drought, forest health, and flooding
- Access to adequate quality and quantity of water for domestic and irrigation supplies
- Small rural water systems are deteriorating and unreliable, require maintenance and leak repairs, and have systemwide problems

#### Tribal

- Tribes have identified the Delta as a Tribal Cultural Landscape that portrays culturally important interrelated features.
- Water rights and Tribal beneficial uses
- Improvements needed regarding access, co-management, and stewardship opportunities
- Conflicts regarding land access, future development, community and land protections, and the conservation of plant and animal species
- Natural infrastructure reconciliation conflicting with engineered infrastructure maintenance, improvement, and replacement needs



Figure 3-18 Sacramento-San Joaquin Delta Overlay Area (continued)



The Dutch Slough Tidal Marsh Restoration Project site, located in the Sacramento-San Joaquin Delta near Oakley, California.

The restoration project implemented by the California Department of Water Resources will restore 1,187 acres into a tidal marsh to provide habitat for salmon and other native fish and wildlife. Photo taken May 18, 2023.



Construction vehicles work on the Shag Slough levee on the northeast side of the Lookout Slough Tidal Restoration Project within the southern part of the Yolo Bypass in unincorporated Solano County on May 5, 2023. Approximately 3000 acres of tidal wetlands will be restored through California EcoRestore.



This aerial photograph shows construction crews working on removing this Emergency Drought Salinity Barrier on the West False River in the Sacramento-San Joaquin Delta in Contra Costa County. Photo taken November 2, 2022.



Habitat surrounding the future location of the Lookout Slough Tidal Restoration Project, located in the Cache Slough complex within the southern part of the Yolo Bypass in Solano County on October 13, 2020. Approximately 3000 acres of tidal wetlands will be restored through California EcoRestore.

Figure 3-18 Sacramento-San Joaquin Delta Overlay Area (continued)

### SACRAMENTO-SAN JOAQUIN RIVER DELTA OVERLAY AREA

**FUTURE CLIMATE RISKS**

Current Population: 692,000  
2070 Population: 879,000



**Increasing air temperatures ...**  
Average daily air temperature likely to increase by 7 degrees F by 2075.



**Increasing flood risk ...**  
Flood flows may increase by more than 40%. Delta flood risk exacerbated by sea level rise.



**Increasing wildfire risk ...**  
Probability and size of wildfires will increase.



**Seasonal shifts in streamflow ...**  
Declining spring and fall flows, increasing winter flows.



**Maximum temperatures are increasing ...**  
Number of days with extreme temperature increasing by 20 days per year.

**REGIONAL AREAS OF FUTURE CLIMATE VULNERABILITY**

The Sacramento-San Joaquin River Delta Overlay Area is projected to experience a range of future climate vulnerabilities. Vulnerabilities in the flood management, ecosystem management, and infrastructure are assessed at higher vulnerability.



Figure 3-18 Sacramento-San Joaquin Delta Overlay Area (continued)

### **HIGHLIGHTS OF MAJOR ACTIONS Being Taken by State and Partners to Address Challenges**

- Delta Plan, Delta Adapts and Delta Levees Investment Strategy
- Bay Delta Conservation Plan, Bay-Delta Water Quality Control Plan Update, Strategic Workplan for Activities in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, Suisun Marsh Plan
- Central Valley Flood Protection Plan
- USFWS and NMFS Biological Opinions for SWP and CVP operations, and habitat restoration requirements of the CDFW Longfin Smelt Incidental Take Permit for SWP Delta Operations
- Ecosystem Restoration Program and ongoing habitat restoration projects (e.g., Big Notch at Tisdale Weir, Lower Yolo Ranch and Flyway Farms, Lookout Slough, Tides End, Prospect Island, Wildlands Liberty Island)
- Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern
- Delta Risk Management Strategy
- Delta Conveyance project
- Yolo-Bypass Cache Slough Partnership - Master Plan Program

Figure 3-19 Western Slope Sierra Nevada Overlay Area

## WESTERN SLOPE SIERRA NEVADA OVERLAY AREA

### OVERLAY AREA DESCRIPTION

The Western Slope Sierra Nevada and Cascade Regional Overlay area encompasses the western slope foothills and mountains of the Sierra Nevada and the Southern Cascade Ranges and extends eastward into the Modoc Plateau in Modoc County in the north and extending south to the Western Slope of the Sierra Nevada in Tulare County. It overlays the eastern portions of the Sacramento River and San Joaquin River hydrologic regions. There are 26 counties, or portions thereof, in the area including Alpine, Amador, Butte, Calaveras, El Dorado, Fresno, Lassen, Madera, Mariposa, Modoc Nevada, Placer, Plumas, Sacramento, San Joaquin, Shasta, Sierra, Siskiyou, Tulare, Tuolumne, Tehama and Yuba. These counties range in elevation from 100 feet near the edge of the valley floor to nearly 14,000 feet at peaks along the crest of the southern Sierra Nevada.

### HYDROLOGIC REGION MAP



### CRITICAL WATER RESOURCE CHALLENGES AND CONSIDERATIONS

#### Water Management

- Water supply challenges include watershed health, aging critical infrastructure, long-term drought, catastrophic fire, climate change, ecosystem functions, and Delta issues
- Large, catastrophic wildfires that devastate both human and ecological communities and the overall health of forested watersheds that is vital to California's economy
- Climate change impacts of warmer spring and summer temperatures, reduced precipitation associated with warmer temperatures, reduced snowpack, and earlier spring snowmelts, and longer, drier summer fire seasons
- Long-term drought exacerbates problems to reserve water supplies for firefighting; isolated small water systems are dependent on groundwater from fractured rock, small surface streams or reservoirs have difficulty building system inerties to other supplies

- Hydrologic changes impact upstream ecosystems, local water supplies, and hydropower generation, and operation of the major multipurpose dams for flood and supply needs

#### Equity

- High proportions of front-line communities experience constrained revenue and economic development or limited job sector opportunities
- About one-third of census block groups in the Area meet the front-line community's definition. The central portion of the area appears to be doing better than the far north and south
- Limited finances of front-line communities make it difficult to adjust water rates to fund aging infrastructure improvements
- Technical assistance is needed to support front-line communities

Figure 3-19 Western Slope Sierra Nevada Overlay Area (continued)

- Water contaminants and impaired water bodies

**Tribal**

- Many of the Tribes, federally recognized and non-federally recognized, within the Western Slope Sierra Nevada Overlay Area face complex issues related to water that have culminated over many years. These include unascertained water rights, access to clean

potable water, access to and protection of sacred sites near water, changes in water flows and landscapes that support plants and animals of cultural significance, and many contamination issues including mercury in fish and plants

- Isolation, language barriers, lack of funding and resource, and climate change impacts

**FUTURE CLIMATE RISKS**

Current Population: 920,000  
2070 Population: 942,000



**Increasing air temperatures ...**  
Average daily air temperature likely to increase by 7 degrees F by 2075.



**Increasing flood risk ...**  
Flood flows may increase by more than 40%. Delta flood risk exacerbated by sea level rise.



**Increasing wildfire risk ...**  
Probability and size of wildfires will increase.



**Seasonal shifts in streamflow ...**  
Declining spring and fall flows, increasing winter flows.



**Maximum temperatures are increasing ...**  
Number of days with extreme temperature increasing by 20 days per year.

**HIGHLIGHTS OF MAJOR ACTIONS**

**Being Taken by State and Partners to Address Challenges**

- Development of a new "restoration economy"
- Industrial parks for biomass processing
- Adaptive forest management practices, effective fuels reduction programs, and enhanced watershed protection practices to protect natural resources
- Developing biomass resources to help meet greenhouse gas reduction and renewable energy goals
- State and Federal agencies are identifying and implementing research driven projects in the upper watersheds to enhance water storage and delivery throughout the Sierra Nevada and Cascade ranges
- Continuing to establish new and maintain existing partnerships between State and federal agencies, Tribes, and others, to develop comprehensive strategies for creating resilient watersheds



# 4

## State's Role in Creating a Resilient and Equitable Future

This chapter describes the multiple efforts underway by Governor Gavin Newsom; the Legislature; and multiple State agencies, departments, boards, councils, and commissions to improve climate and **watershed resilience** and advance equity across California. The **resilience** of water resource systems and **watersheds** is inherently associated with broader climate resilience. Although this Water Plan primarily focuses on water resources, the State's broader water-related activities to address climate resilience are also addressed in this chapter.

### Introduction

The scale of climate-related human and resource challenges facing California demands a timely, thorough, and coordinated response from State government and local jurisdictions. That response must include a combination of oversight and regulations, visionary and tactical policies, long-term resilience planning, and continued investments. To be effective, these actions must be coordinated closely among State agencies and departments, federal partners, and local agencies and stewards. This chapter describes the activities being undertaken by the State to improve the resilience of water resources and systems.

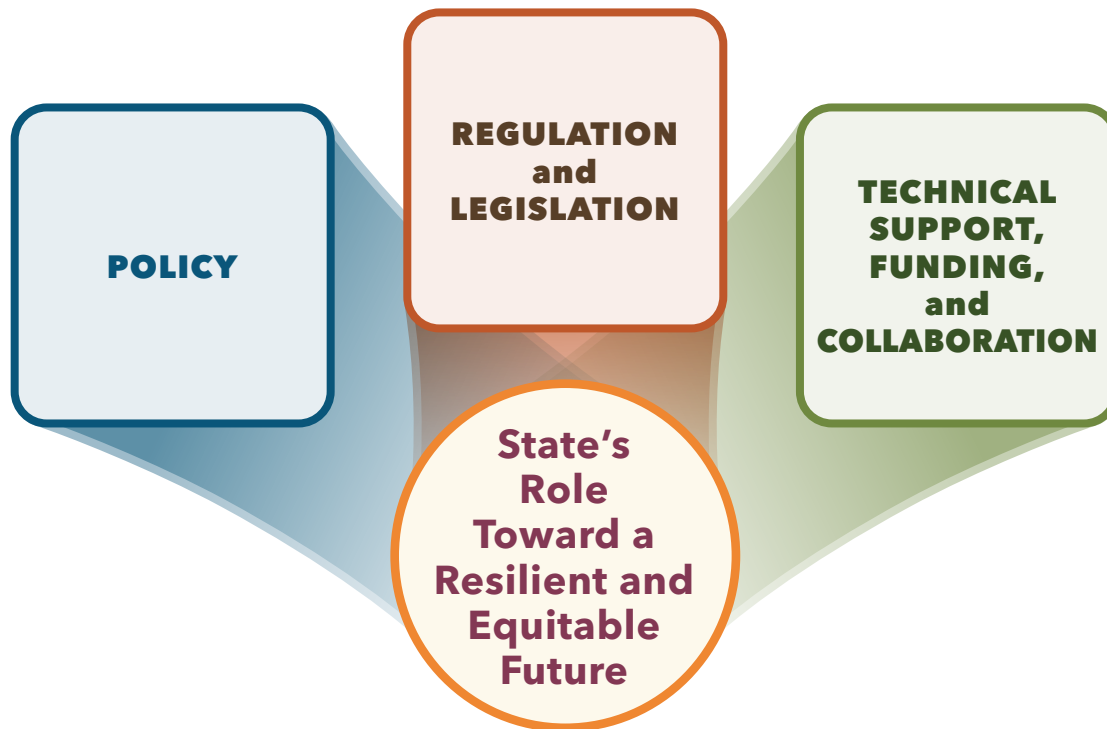
The State has traditionally served specific roles in water resources management, including regulatory development and oversight; setting and implementing policies; providing technical, data, and financial support when possible, and collaborating on incentive-based planning efforts. Each of these roles, shown in Figure 4-1, is crucial independently, and it is the interplay between them that must be optimized to respond to the climate emergency.

Recent examples of how these three roles work together to make progress on water resources issues include groundwater management and water use efficiency (WUE). For decades prior to the passage of the Sustainable Groundwater Management Act (SGMA) in 2014, the State had been engaged in policies that supported and enabled locally initiated groundwater management such as State-incentivized groundwater

## State’s Role in Creating a Resilient and Equitable Future

management through expansion of the monitoring network, a water quality program, and development of management plans. But groundwater levels continued to decline to the extent that sufficient support was rallied to pass SGMA, mandating a process to mitigate overdraft within 20 years. SGMA relies on technical support, funding, and collaboration for implementation. If local groundwater sustainability cannot be collaboratively achieved, the backstop is regulation and oversight through the intervention process.

Figure 4-1 The State Plays Three Major Roles in Support of Water Resilience



In a similar vein, the State has a long history of implementing statewide urban and agricultural WUE policies through efforts that have included technical and local assistance through partnerships, grants, and loan programs. These programs along with locally driven efforts and investments have been very effective for many water agencies. But, with the expectation of a future with extended drought periods, there was a need to bring all urban water users to common levels of baseline water use improvements. In 2018, legislation (SB 606 and AB 1668) was approved to establish a new foundation for long-term water conservation, water use efficiency, and drought planning. The 2018 legislation required DWR to coordinate with the State Water Resources Control Board (State Water Board) to conduct studies and develop recommendations for advancing WUE through the [\*Making Conservation a California Way of Life\*](#) regulatory framework. The framework is currently under consideration by the State Water Board and is anticipated to become effective in summer 2024. If adopted, the framework will cover a range of outdoor residential and commercial, industrial, and institutional water use standards and guidelines, and methodologies for calculating urban water use objectives.



### State Water Policy

With the increasing intensity of **climate change**, the Newsom administration has issued policies to guide State and local responses to water-sector challenges associated with the climate emergency, including the [Water Resilience Portfolio](#) (Portfolio) and the [Water Supply Strategy](#) (Strategy). Under these policies, the State is investing billions of dollars in climate resilience-related strategies and programs while agencies, departments, boards, and commissions are planning and acting to ensure a resilient future.

### Water Resilience Portfolio

During his first months in office, Governor Newsom issued an executive order calling on State agencies to create the comprehensive Portfolio. On July 28, 2020, the governor released the final version of the Portfolio, the administration's blueprint for equipping California to cope with more extreme droughts, floods, and rising temperatures. The Portfolio addresses long-standing challenges that include declining fish populations, over-reliance on groundwater, and lack of safe drinking water in many communities. In January 2022, the administration released a progress report documenting its efforts to implement the Portfolio. With the Portfolio as a blueprint, the administration has made major progress over the last two years. It has supported local agencies to work toward bringing groundwater basins into balance; update infrastructure to move water throughout the state; restore river systems, including the Klamath River with the nation's largest dam removal project; and improved water management through new voluntary agreements and technology investments (California Department of Water Resources 2020). *California Water Plan Update 2023* (Update 2023) advances the Portfolio's principles and actions in collaboration with other State agencies and interested parties.

Although the actions in the Portfolio are the responsibility of State agencies to implement, those actions emphasize the need for local, regional, Tribal, federal, and private entities to coordinate across watersheds in building a resilient "water system of systems" across California. As detailed in the *2022 Water Resilience Portfolio Progress Report*, State agencies are making significant progress carrying out the 142 separate actions in the Portfolio, and coordination is underway across the state to address water challenges.

### Water Supply Strategy

In August of 2022, the governor released the Strategy, which builds on the Portfolio. The Strategy was developed in response to the severity of the drought and a predicted reduction of existing water supply of as much as 10 percent by 2040, resulting from hotter and drier weather brought about by climate change (California Department of Water Resources 2022).

The Strategy, designed to fill the projected supply gap, is depicted in Figure 4-2 and includes these four elements (California Department of Water Resources 2022; California Department of Water Resources 2023):

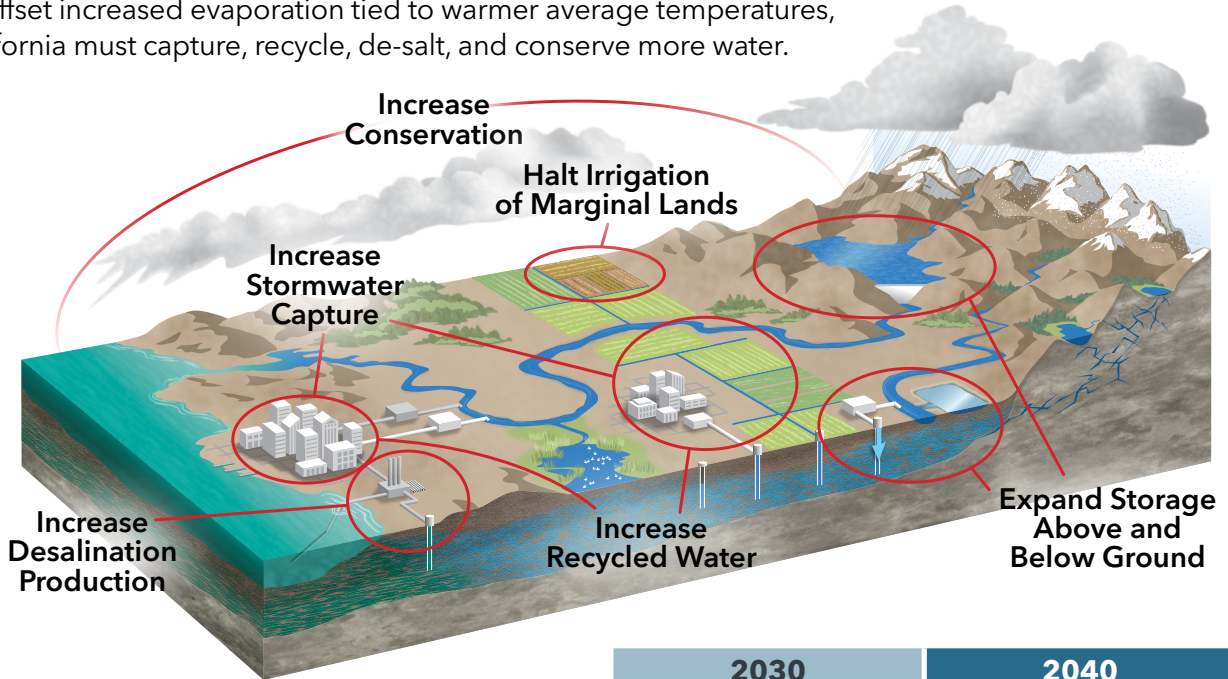
1. Develop new water supplies.
2. Expand water storage.

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3. Reduce demand.
4. Improve forecasting, data, and management, including water rights modernization.

**Figure 4-2 Closing the Evaporative Gap**

To offset increased evaporation tied to warmer average temperatures, California must capture, recycle, de-salt, and conserve more water.



|   | 2030           |                | 2040           |                |
|---|----------------|----------------|----------------|----------------|
| Increase Recycled Water   | .8 MAF         | About<br>5 MAF | 1.8 MAF        | About<br>7 MAF |
| Increase Desalination Production  | 28,000 AF      |                | 84,000 AF      |                |
| Increase Stormwater Capture   | .25 MAF        |                | .5 MAF         |                |
| Increase Conservation   | .5 MAF         |                | .5 MAF         |                |
| <b>Subtotal for Recycled, Desalination, Stormwater and Conservation</b> | <b>1.6 MAF</b> |                | <b>2.9 MAF</b> |                |
| <b>Expand Storage Above and Below Ground*</b>                           | <b>3.7 MAF</b> |                | <b>4 MAF</b>   |                |
| <b>Total</b>  | <b>4.8 MAF</b> | <b>6.9 MAF</b> |                |                |

\*Additional storage capacity does not equate to a similar volume of new water supply. MAF - million acre-feet.

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The Strategy includes ambitious **acre-feet** targets for increasing available supplies from a range of sources, including storage, water recycling and reuse, water conservation, stormwater capture, desalination, and water use efficiency. Specifically, the State is advancing targeted investments and aggressive action to:

- Fast-track **groundwater recharge** projects by streamlining groundwater recharge permits and investing in groundwater recharge capacity.
- Maximizing stormwater capture by investing and incentivizing these projects.
- Expanding storage above and below ground by advancing Proposition 1 storage projects and expanding San Luis Reservoir.
- Modernizing water conveyance infrastructure through the Delta Conveyance Project and San Joaquin Valley conveyance projects.

Importantly, the Strategy includes detailed steps to facilitate implementation of projects to achieve these targets, including actions required by State agencies to identify, support, and permit these projects. The Strategy directs State agencies to improve regulatory processes within State government to assist local project proponents prepare for and overcome water supply shortages, increased flood risks, extreme heat, wildfire risk, and other impacts of climate change in their watersheds. Expansion of water storage and demand reduction will supplement the new water supplies to address the projected gap. Additionally, improvements in a range of aspects of water management are an essential part of the Strategy, which will ensure that investments made are put to the most effective use. The [One-Year Progress Report](#) for the Strategy released in October 2023, describes actions taken over the previous 12 months to execute the key priorities (California Department of Water Resources, 2023). To further reinforce actions proposed in the Strategy, Governor Newsom signed several Executive Orders, N-4-23, N-6-23 and N-7-23, to help expand the state's capacity to capture flood and urban stormwater runoff by facilitating groundwater recharge projects, continuing conservation measures, and allowing the State Water Board to reevaluate requirements for reservoir releases and diversion limitations to maximize water supplies north and south of the Sacramento-San Joaquin Delta while protecting the environment.

The Water Plan has compiled more than 30 resource management strategies (RMSes) to guide local agencies and governments manage their water and related resources. Update 2023 includes updates to eleven of the RMSes related to implementation of Strategy actions.

### Implementation of Water Supply Strategy and Water Resilience Portfolio

The State and federal governments each operate large water delivery systems in California, but local water districts and counties have the primary responsibility for getting supplies to homes and businesses. In California, thousands of local and regional entities play a role in water management. Implementation of the Strategy will require decisive State action with respect to improving regulatory processes. This will also require partnerships, given that local agency leaders, federal partners, farmers, other business owners, and individual

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Californians are critical to achieving the explicit goals in the Strategy and the Portfolio. The Strategy, Portfolio, and related administration initiatives offer multiple State tools for facilitating the implementation of robust **adaptation** strategies, including streamlined permitting processes, expedited project funding, and technical assistance for project identification. To ensure successful implementation in such a decentralized system, the State must lead, set goals, improve permitting processes, provide support and incentives, invest in backbone infrastructure, and be prepared to enforce existing regulations.

Promoting watershed resilience across State efforts, can catalyze the implementation of the Strategy by funding robust, science-driven climate vulnerability and risk assessments at the watershed scale. While an outcome of a watershed resilience approach will be to identify water supply targets around the state, it will also help identify the risks and vulnerabilities of the full range of climate hazards. These involve not just drought, but flooding from extreme precipitation, heat impacts, fire, and sea level rise. This comprehensive understanding of climate risks will allow prioritization of the areas at greatest risk as well as the identification and implementation of the most important multi-benefit and multi-sector adaptation strategies.

Backbone infrastructure of statewide importance needs to be improved, restored, and modernized to create more resilient watersheds and increase equity in water management. Understanding future risks and increasing the resilience and operational flexibility of the state's built and **natural backbone infrastructure** – such as the State Water Project, the Central Valley Project, the State Plan of Flood Control, and other water infrastructure of statewide importance – are a key State priority to help adapt to future drivers of climate change, land subsidence, and aging infrastructure.

## State Climate Resilience Actions

The following sections and accompanying tables highlight plans and actions by multiple State agencies, departments, commissions, councils, and boards with similar, aligned objectives toward achieving water resilience through their respective organizational missions. These actions include developing new water supplies, improving water use efficiency, recharging groundwater basins, protecting water quality, improving soil health for food security, improving biodiversity, conserving landscapes, treating source watersheds to reduce fire risk, protecting coastal areas from sea level rise, decarbonizing the energy sector, and more. Many of these efforts are in response to the policy directives in the Strategy and the Portfolio, while others are ongoing efforts that are core to each agency's, department's, or board's mission. All are reflective of this administration's commitment to respond to climate change with mitigation actions and adaptation strategies as the most effective means of securing a resilient and equitable future for Californians.

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The climate resilience and equity efforts of more than 24 State agencies, departments, commissions, boards, and councils are represented. The focus of their efforts can be organized into three major categories:

- Climate resilience planning.
- Taking action on resilience.
- Accelerating implementation of resilience programs and projects.

Figure 4-3 depicts the complexity of resilience efforts underway across these entities and an approach to thinking about how they are organized around a common objective.

The State actions referred to in this section include:

- Executive orders and legislation that direct agency and departmental actions.
- Plans and strategies developed by State agencies that chart a path toward equity and climate resilience.
- Programs and projects driving resilience and equitable outcomes across sectors.

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Figure 4-3 Multiple State Agencies are Engaging in Resilience Actions



### Climate Resilience Planning: Data and Science

The State plays an essential leadership role in the development and sharing of climate science and related data to advance understanding of how climate change is affecting all economic and resource sectors.

The State’s climate change science and data efforts, as shown in Table 4-1, are distributed and coordinated across a number of State agencies. The California Governor’s Office of Planning and Research (OPR) is leading implementation of the California’s Fifth Climate Change Assessment in partnership with the California Energy Commission, California Natural Resources Agency (CNRA), and California Strategic Growth Council (SGC). The California Air Resources Board (CARB) is leading ongoing efforts to mitigate greenhouse gases through Assembly Bill 32 implementation. The California Ocean Protection Council leads efforts on sea level rise, in cooperation with the California Coastal Commission and the Bay Conservation and Development Commission. The California Department of Water Resources’ (DWR’s) efforts are focused on the effects of climate change on the water sector.

**Table 4-1 Climate Resilience Planning: Science and Data**

| Science and Data Activities   | Descriptions   |
|---|--|
| <b>Executive Orders/Legislation</b>   |  |
| <a href="#"><u>California Air Resources Board–<br/>Assembly Bill 32 Climate Change<br/>Scoping Plan</u></a> | Actionable blueprint for aligning action to achieve California’s climate goals. The State is currently implementing strategies in the 2022 Scoping Plan Update to reduce its GHG emissions by 40% below 1990 levels by 2030.   |
| <a href="#"><u>Assembly Bill 1755–Open and<br/>Transparent Data</u></a>                                     | Assembly Bill 1755 (Dodd 2016) requires the Department of Water Resources, along with other State agencies, to create, operate, and maintain a statewide integrated water-data platform in addition to developing protocols for data sharing, documentation, quality control, public access, and promotion of platforms. |
| <b>Plans and Strategies</b>   |  |
| <a href="#"><u>Office of Planning and Research–<br/>State Guidance Resources</u></a>                        | Office of Planning and Research investigates and provides resources for future research and planning needs, guidance for State partners and local communities, and promotes goal-driven collaboration with a focus on climate resilience.  |
| <a href="#"><u>Office of Planning and Research–<br/>Fourth and Fifth Climate Change<br/>Assessments</u></a> | Climate assessments contribute to the scientific understanding of climate change at the local level and inform resilience actions, while also promoting State policies, plans, programs, and guidance for integrated action to address climate change.   |

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| <b>Science and Data Activities</b>   | <b>Descriptions</b>  |
|--|--|
| <a href="#"><u>Department of Water Resources–<br/>Urban Water Management Plans</u></a>                                 | These plans support long-term resource planning to ensure sufficient water supplies to meet existing and future water needs. Information collected from these plans informs local, regional, and statewide water planning.   |
| <a href="#"><u>Department of Water Resources,<br/>California’s Groundwater<br/>(Bulletin 118)</u></a>                  | California’s Groundwater, and related informational products, provide the State’s most up to date compendium of statewide data and information on the occurrence, nature, use and conditions of California’s groundwater resources and its management.   |
| <a href="#"><u>California State Water Resources<br/>Control Board–California<br/>Environmental Flows Framework</u></a> | This framework provides technical guidance for managers to employ a functional flows approach to develop scientifically accurate and defensible environmental water flow recommendations throughout the state.   |
| <b>Programs</b>  |  |
| <a href="#"><u>Department of Water Resources–<br/>Office of the Climatologist</u></a>                                  | The Office of the Climatologist collects and interprets climate data throughout California and provides climate data and information through various means.  |
| <a href="#"><u>Department of Water Resources–<br/>Climate Change Program</u></a>                                       | The Department of Water Resources’ Climate Change Program engages climate mitigation and adaptation measures to ensure that Californians have adequate water supply, reliable flood control, and healthy ecosystems. The program performs a range of activities to support climate change analysis and adaptation planning by local and regional water managers, fund climate monitoring and research, and develop water sector policies and management practices. Provides science-based leadership to help build resilience and equity in the management of water resources. |



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| <b>Science and Data Activities</b>   | <b>Descriptions</b>  |
|--|--|
| <a href="#"><u>California Tahoe Conservancy–Climate Change Adaptation Program</u></a>                      | The California Tahoe Conservancy’s strategic plan includes a goal to foster basin-wide climate change adaptation and sustainable communities. To achieve this goal, the conservancy focuses on four areas: developing the Lake Tahoe Climate Adaptation Action Portfolio, providing grants to support climate change adaptation, adapting conservancy programs and land management to changing climate conditions, engaging partners, and collaborating with scientists. |
| <a href="#"><u>California Ocean Protection Council–Climate Change Program</u></a>                          | This Climate Change Program seeks to prepare for and reduce harmful impacts of climate change on ocean and coastal resources by encouraging adaptation, mitigation, and engaging decision-makers at all levels of government.  |
| <a href="#"><u>Department of Water Resources–K-12 Educators Climate Literacy Training</u></a>              | Department of Water Resources staff facilitate workshops throughout California that highlight regional climate change conditions in the area where each event takes place. Educators participate in hands-on activities and learn about climate science basics and how Department of Water Resources addresses impacts.  |
| <a href="#"><u>Department of Water Resources–Water Plan/Water Budget Team</u></a>                          | This team works to produce a strategic water plan that meets California Water Code requirements, guides State investments in innovation, and advances integrated water management.   |
| <a href="#"><u>Department of Water Resources–Extreme Symposium</u></a>                                     | This symposium addressed extreme climate events and how California is responding. This event was attended by more than 500 people around the world.  |
| <b>Projects</b>  |  |
| <a href="#"><u>Department of Water Resources–Roadmap for a Climate Resilient Forecasting Framework</u></a> | This project is an effort to upgrade forecasting tools and approaches to improve the availability and quality of forecasting throughout the state.   |
| <a href="#"><u>U.S. Geological Survey/Department of Water Resources–Arkstorm</u></a>                       | This effort is an exercise in weather event modelling to help State departments better plan for, and respond to, flood events resulting from extreme storm scenarios.  |

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DWR collaborates closely with OPR and other agencies and institutions to project and prepare for the impacts of climate change on the water sector and implements climate mitigation and adaptation measures to ensure that Californians have an adequate water supply, reliable flood management, and healthy ecosystems.

Early efforts include the Atmospheric Rivers Research, Mitigation, and Climate Forecasting Program (AR Program), a collaboration between DWR and the Center for Western Weather and Water Extremes at Scripps Institution of Oceanography, UC San Diego, which is managed by DWR's Division of Flood Management. The goal of the AR Program is to enable substantially greater water supply reliability and flood mitigation capacity across the state. To achieve this, the AR Program requires innovations in meteorology, hydrology, climate science, oceanography, civil engineering, water resources management, fisheries management, and decision support systems (Center for Western Weather and Water Extremes 2023). DWR has also partnered with NASA's Jet Propulsion Laboratory (JPL) to develop the Airborne Snow Observatory. From this collaboration, DWR established the statewide Aerial Remote Sensing of Snow program which utilizes the technologies developed at NASA-JPL to better understand California's snowpack accumulation, how much water it contains, and the timing and rate of snowmelt. In addition, DWR has provided financial and technical support to the ArkStorm 2.0 effort, a flood emergency response exercise led by the U.S. Geological Survey's Science Applications for Risk Reduction Program. The update to the original ArkStorm effort carried out a decade earlier includes a scenario with storm characteristics based on climate change projections and an ability to mimic forecasting of the event (U. S. Geological Survey 2018). Through expanded partnerships, new modeling capabilities are being pursued to illustrate the potential impacts of the extreme storm scenario, which is expected to test the limits of current flood management capabilities. Additionally, this effort will develop community engagement exercises with the intent of understanding and addressing social inequities in flood emergency response in the Arkstorm extreme storm scenario.

DWR's observation and forecasting programs have a long history of partnerships with the research community to bring relevant research advances into program operation. The pace and scale of novel climate extremes necessitates acceleration of recent advances to ensure a resilient observing and forecasting framework that can adapt at the pace of a changing climate. DWR has recently released a roadmap for a climate-resilient forecasting framework to inform needed adaptation to changing conditions. The goals of the framework are twofold (California Department of Water Resources 2023a):

1. Transition from index-based statistical forecasting tools to spatially explicit, physically based, and climate-informed modeling tools that can take advantage of emerging technologies in observing systems and modeling capabilities.
2. Create a linked, integrated forecast platform that allows easier visual inspection of observed conditions for situational awareness and a customizable decision-support dashboard that connects observations, high-resolution near-term forecasting, standard weather forecasting, two- to four-week outlooks, sub-seasonal to seasonal outlooks, and water year outlooks. To achieve these goals, DWR has identified

several significant upgrades to observation, forecasting, and decision-support capabilities which are underway.

Through its Climate Action Plan (CAP), DWR addresses climate change in its programs, projects, and activities. For its ongoing work under the CAP to address California's changing climate and evolving water management challenges, DWR was inducted into the Climate Leadership Awards Hall of Fame during the 2022 national Climate Leadership Conference. The CAP is divided into three parallel phases to address mitigation, adaptation, and consistency in the analysis of climate change (California Department of Water Resources 2023b).

1. Phase I: **Greenhouse Gas Emissions Reduction Plan** – The plan lays out DWR's greenhouse gas (GHG) emissions reduction goals and strategies for the near term (present to 2030) and long term (2045) (California Department of Water Resources 2020). These efforts are consistent with State GHG emission goals and are a critical component of DWR's overall adaptation strategy. These goals and strategies should be a priority for any water resources management entity.
2. Phase II: Climate Change Analysis Guidance – This planning phase develops a framework and guidance for consistent incorporation and alignment of analyses for climate change impacts in DWR's project and program planning activities. This ongoing process includes the development of data, tools, and guidance for project and watershed-based climate vulnerability and adaptation analyses, including those described in Chapters 2 and 5. DWR's analytical activities include the development of a "weather generator" that will depict increased temperature effects on droughts and floods (especially **atmospheric rivers**), which can be used to better understand and prepare for the effects on water resources. This new tool was developed in partnership with U.S. Army Corps of Engineer's Engineer Research and Development Center, Turlock Irrigation District, Cornell University, and Center for Western Weather and Water Extremes at Scripps Institution of Oceanography, UC San Diego. The weather generator is especially useful for stress-testing water resource systems to identify vulnerabilities and provides a significant benefit to water resource decision-makers who are trying to ensure their systems can manage plausible but previously unobserved extreme events. DWR is leveraging past State Water Project stress testing, the use of the weather generator, and new downscaled climate-model data developed for the California's Fifth Climate Change Assessment to develop risk-informed climate scenarios for California's water systems. These new scenarios will provide actionable risk-informed water supply conditions for public water agencies throughout the Bay Area, Central Valley, and Southern California.
3. Phase III: Climate Change Vulnerability Assessment – The assessment describes, evaluates, and quantifies DWR's assets and business vulnerabilities to potential climate change impacts. The Phase III: Adaptation Plan prioritizes DWR resiliency

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efforts, such as infrastructure improvements to the State's backbone infrastructure, enhanced maintenance and operation procedures, revised health and safety procedures, and improved habitat management.

### Climate Resilience Planning: State and Local Collaborative Planning

Alongside the development of climate science, the State is also leading collaborative planning efforts between State agencies and local and regional entities to better understand the vulnerabilities and risks across the state and identify appropriate adaptation strategies (Table 4-2).

The California Climate Adaptation Strategy, mandated by AB 1482 (Gordon 2015), interconnects the State's existing and planned climate adaptation efforts, showing how they fit together to achieve California's six climate resilience priorities. The adaptation strategy is organized around outcome-based priorities, enabling a coordinated, integrated approach to building climate resilience. An implementation progress report was developed in 2022 to summarize the State's overall progress.

The priorities and goals of the Climate Adaptation Strategy are shown in Table 4-3.

**Table 4-2** Climate Resilience Planning: State and Local Collaborative Planning

| <b>State and Local Collaborative Planning Activities</b>   | <b>Descriptions</b>  |
|--|--|
| <b>Plans and Strategies</b>  |  |
| <a href="#"><u>Department of Water Resources–Integrated Regional Water Management</u></a>  | Integrated regional water management is a collaborative effort to identify and implement water management solutions on a regional scale that increase regional self-reliance and manage water to achieve social, environmental, and economic objectives.   |
| <a href="#"><u>California Natural Resources Agency, Office of Planning and Research–California Climate Adaptation Strategy</u></a>   | Outlines the State’s key climate resilience priorities, includes specific and measurable actions., It serves as a framework for collective efforts across sectors and regions in California.   |
| <a href="#"><u>California Coastal Commission–Sea Level Rise Coastal Adaptation Planning Guidance for Critical Infrastructure</u></a> | This guidance addresses transportation and water by presenting six key considerations for successful adaptation planning. This guidance includes recommendations for interested parties on how to plan effectively for sea-level-rise impacts on coastal infrastructure.   |
| <a href="#"><u>California Department of Fish and Wildlife–State Wildlife Action Plan</u></a>   | The State Wildlife Action Plan examines the health of wildlife and prescribes actions to conserve wildlife and vital habitat. In the latest update, the California Department of Fish and Wildlife incorporated climate change impacts and adaptation, including dozens of strategies and targets for California’s ecoregions. |
| <a href="#"><u>California Governor’s Office of Emergency Services–California Adaptation Planning Guide (APG)</u></a>                 | The APG, developed by the California Emergency Management Agency and California Natural Resources Agency, introduces the basis for climate change adaptation planning and details a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development.                          |
| <a href="#"><u>Office of the Governor/California Natural Resources Agency–California Water Resilience Portfolio</u></a>              | This initiative was created to fulfill Governor Newsom’s executive order calling for a portfolio of actions to guarantee long-term water resilience and ecosystem health.  |

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| <b>State and Local Collaborative Planning Activities</b>  | <b>Descriptions</b>  |
|---|--|
| <b>Programs</b>   |  |
| <u><a href="#">Department of Forestry and Fire Protection–Climate and Energy Program</a></u>                    | This program promotes healthy and resilient forests by supporting active forest restoration and reforestation, enhancing wood products infrastructure, promoting Traditional Ecological Knowledge, and supporting legal compliance for climate programs.   |
| <u><a href="#">Department of Conservation–Watershed Coordinator Program</a></u>                                 | This program supports State-funded coordinators to develop plans and projects to improve watershed health and to achieve State and local natural resources goals.  |
| <u><a href="#">California Biodiversity Collaborative</a></u>  | This effort unites key environmental experts and community leaders to conserve California’s globally renowned natural heritage. This effort is a key partner of the 30x30 conservation initiative.   |
| <u><a href="#">California State Water Resources Control Board–Climate Adaptation and Resiliency Program</a></u> | Created by Assembly Bill 109, this program provides local assistance through Wildlife Conservation Board efforts for conservation projects through grant funding projects on natural and working lands. Projects must be consistent with the State’s climate adaptation strategy and contribute to carbon sequestration. |
| <u><a href="#">California Department of Conservation–Regional Forest and Fire Capacity Program</a></u>          | Seeks to increase regional capacity to prioritize, develop, and implement projects that improve forest health and fire resilience, facilitate greenhouse gas emissions reductions, and increase carbon sequestration in California forests.  |
| <u><a href="#">Department of Forestry and Fire Protection–FRAP</a></u>  | Fire and Resource Assessment Program is designed to assess the amount and extent of forest and rangelands within California.   |

| <b>State and Local Collaborative Planning Activities</b>   | <b>Descriptions</b>   |
|--|---|
| <p><a href="#"><u>Office of Planning and Research–Integrated Climate Adaptation and Resiliency Program (ICARP), Adaptation Clearinghouse, State Guidance Resources (Adaptation Planning Guide, General Plan Guidelines, Cal-Adapt)</u></a></p> | <p>Drives California’s response to climate impacts, prioritizing equitable approaches that integrate mitigation and adaptation. ICARP coordinates across local, regional, and State efforts to support cohesive climate strategies. ICARP develops the California Climate Change Assessment at least every five years. The program also supports resiliency planning by providing grant funding for adaptation planning and implementation for eligible entities. To support planning efforts by local jurisdictions, ICARP includes an adaptation clearinghouse and extensive guidance resources for adaptation and planning. ICARP also manages three new climate resilience grant programs. Chapter 4 of OPR’s General Plan Guidelines discusses water laws in all mandatory elements of the General Plans in addition to water quality, accessibility and affordability related to the Environmental Justice Element, 2020. The Wildfire Planning Technical Advisory discusses water and wildlife planning.</p> |
| <p><a href="#"><u>California State Water Resources Control Board/ Environmental Protection Agency–Healthy Watersheds Partnership</u></a></p>   | <p>This partnership is committed to monitoring and assessing California stream flow conditions and river ecosystems and making that information available to the public.</p>  |
| <p><a href="#"><u>California Department of Public Health–Climate Change and Health Equity Program</u></a></p>  | <p>The Climate Change and Health Equity (CCHE) Section embeds health and equity in California climate change planning and embeds climate change and equity in public health planning. CCHE works with local, state, and national partners to assure that climate change mitigation and adaptation activities have beneficial effects on health while not exacerbating already existing unfair and preventable differences in health status of some groups (health inequities). CCHE implements California’s climate change laws and executive orders, contributing health equity considerations</p>   |

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| <b>State and Local Collaborative Planning Activities</b>   | <b>Descriptions</b>   |
|--|---|
| <a href="#"><u>Office of the Governor/California Natural Resources Agency–Protecting Californians from Extreme Heat: A State Action Plan to Build Community Resilience</u></a> | Governor Newsom and the Legislature released a set of State actions to adapt and strengthen resilience to extreme heat throughout California. |

**Table 4-3 California Climate Adaptation Strategy Priorities and Goals Build Climate Resilience**

| <b>Priority</b>  | <b>Goals</b>  |
|--|---|
| Strengthen Protections for Climate Vulnerable Communities                    | <ul style="list-style-type: none"> <li>• Engage with and build capacity in climate vulnerable communities.</li> <li>• Improve understanding of climate impacts on California’s communities, including what drives vulnerability.</li> <li>• Build resilience in climate vulnerable communities through state programs.</li> </ul> |
| Bolster Public Health and Safety to Protect Against Increasing Climate Risks | <ul style="list-style-type: none"> <li>• Reduce urgent public health and safety risks posed by climate change.</li> <li>• Consider future climate impacts in governmental planning and investment decisions.</li> <li>• Improve infrastructure’s climate resilience to protect public health and safety.</li> </ul>               |
| Build a Climate Resilient Economy  | <ul style="list-style-type: none"> <li>• Expand economic opportunities for California by building climate resilience.</li> <li>• Deepen understanding of climate change effects on California’s economy.</li> </ul>   |



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| Priority   | Goals   |
|--|---|
| Accelerate Nature-Based Climate Solutions and Strengthen Climate Resilience of Natural Systems | <ul style="list-style-type: none"> <li>• Increase the pace and scale of nature-based climate solutions.</li> <li>• Increase landscape connectivity and establish climate refugia.</li> <li>• Integrate nature-based climate solutions into relevant infrastructure and investments.</li> <li>• Accelerate state processes to support implementation of nature-based climate solutions.</li> </ul> |
| Make Decisions Based on the Best Available Climate Science                                     | <ul style="list-style-type: none"> <li>• Support actionable climate science.</li> <li>• Operationalize climate science into decision making.</li> </ul>   |
| Partner and Collaborate to Leverage Resources  | <ul style="list-style-type: none"> <li>• Collaborate to build climate resilience across sectors and regions.</li> <li>• Increase awareness of climate adaptation and resilience issues.</li> </ul>  |

The California Adaptation Strategy addresses all sectors of California's economy by integrating sector-specific plans, including the [Natural and Working Lands Climate Smart Strategy](#), [California's Wildfire and Forest Resilience Action Plan](#), [Climate Action Plan for Transportation Infrastructure](#), and the [Water Resilience Portfolio](#). The strategy includes areas of focus for 2023 including delivering on climate action, leveraging federal funds, increasing technical support, ongoing partnerships and engagement. Additionally, the California Adaptation Strategy contains a focus on California Native American Tribal priorities.

Collaborative planning efforts are occurring across multiple State entities to address climate impacts across sectors and scales. These include targeted plans and programs, such as the California Department of Fish and Wildlife's (CDFW's) [California State Wildlife Action Plan](#), the California Department of Conservation's [Regional Forest and Fire Capacity Program](#), the California Coastal Commission's (CCC's) [Sea Level Rise Coastal Adaptation Planning Guidance for Critical Infrastructure](#), and others. Collaborative planning action includes broader guidance and programs specifically intended to support local and regional entities in conducting climate resilience planning, including DWR's watershed resilience-focused enhancements for IRWM (Chapter 5), Department of Conservation's Watershed Coordinator Program, the State Water Board and U.S. Environmental Protection Agency's [Healthy Watersheds Partnership](#), and OPR's [Integrated Climate Adaptation and Resiliency Program](#), among others.

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### Taking Action on Climate Change and Water Resilience

As climate change increases the severity and duration of stressors on water management systems, integrated approaches that deliver multiple benefits are increasingly understood to be more likely to withstand these stressors. For example, **floodplain** restoration projects can support increased groundwater recharge and thus improve water supply while delivering flood control and ecosystem benefits. Additionally, water reuse and stormwater capture projects, as included in the *Water Supply Strategy*, can divert potentially harmful discharges and create drought-resilient water supplies.

Multiple State entities with local and regional partners are crafting plans and focused on projects and programs to deliver on resilience across multiple sectors. These efforts are implementing integrated solutions that ensure safe and affordable water supplies across the state, protect and restore valuable ecosystems, keep people and property safe from flooding, and protect the security of food and energy. Alongside these efforts are targeted policies, programs, and funding that focus on integrating Traditional Ecological Knowledge and needs and overall equitable outcomes for **frontline communities**. See Chapter 6, "Understanding and Addressing Equity in the Management of California's Water Resources," for a discussion of frontline communities.

To deliver on the commitments and goals in the *Water Supply Strategy*, multiple agencies have formed a strike team to facilitate expedited permitting and planning for reuse, desalination, and storage projects. In addition to ensuring future water supplies are developed, the State is focused on assuring the resilience of existing built and natural backbone infrastructure, which is critical to providing Statewide water supplies. This work includes vulnerability assessments of critical infrastructure (e.g., built infrastructure of the State Water Project and its source watersheds), such as addressing the subsidence affecting the California Aqueduct (California Department of Water Resources 2022). This work includes safeguarding critical groundwater supplies through the important efforts of the Sustainable Groundwater Management Act and related initiatives (Table 4-4).

**Table 4-4 State Resilience Actions Support Safe and Affordable Water for All**

| Resilience Actions   | Descriptions   |
|--|--|
| <b>Executive Orders/Legislation</b>  |  |
| <a href="#"><u>Senate Bill 552–Drought Planning and Minimum Resiliency Measures</u></a>  | This law directs State and local governments to share responsibility in preparing and acting in the event of a water shortage.   |
| <a href="#"><u>Senate Bill 659–Water Supply Solutions Act of 2023</u></a>                | This law requires DWR, as part of the 2028 Water Plan Update, and each subsequent update, to provide actionable recommendations to develop additional groundwater recharge opportunities that increase the recharge of the state’s groundwater basins. The bill requires the department to consult with the State Water Resources Control Board, the nine regional water quality control boards, and the advisory committee. The bill also requires recommendations to identify immediate opportunities and potential long-term solutions to increase the state’s groundwater supply, and include, among other things, best practices to advance all benefits of groundwater recharge.   |
| <a href="#"><u>Assembly Bill 1668 and SB 606–2018 Water Conservation Legislation</u></a> | In 2018, landmark water conservation legislation was signed into law laying out a new long-term water conservation framework for both urban and agricultural sectors. The legislation directed DWR to propose new residential indoor water use efficiency standards to the Legislature and recommend other standards and measures for adoption by the State Water Board. DWR and State Water Board joint recommendations to the legislature was enacted into law by passage of SB 1157 setting new residential indoor water use efficiency standards as 55 gallons per capita per day (GPCD) for 2023, 47 GPCD for 2025 and 42 GPCD for 2030 (Hertzberg 2022). DWR in coordination with the State Water Board developed proposed standards for efficient use of water for urban retail water suppliers for consideration by the State Water Board. |
| <a href="#"><u>Assembly Bill 1668–County Drought Advisory Group</u></a>                  | Directs Department of Water Resources to identify small suppliers and rural communities at risk of drought and water shortage vulnerability and develop recommendations for improving drought contingency planning for those areas.  |

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| <b>Resilience Actions</b>  | <b>Descriptions</b>   |
|--|---|
| <a href="#"><u>Proclamation–Drought State of Emergency (April 2021)</u></a>                  | This proclamation identified one of the first areas (Sonoma and Mendocino counties) affected by water supply shortage conditions and drought impacts. The resulting heightened state of awareness of dry, arid conditions, as well as diminishing water supply, culminated in development of California Water Watch.  |
| <a href="#"><u>Proclamation–Drought State of Emergency (May 2021)</u></a>                    | This proclamation added 29 counties under the state of emergency. It prioritized moving water through in-basin water transfers and provided a minimal water supply for health and safety and the environment. Also, a CEQA exemption to implement projects supporting drought preparedness and response was enacted.  |
| <a href="#"><u>Proclamation–State of Emergency in Nine Counties (July 2021)</u></a>          | Governor Newsom declared a state of emergency for drought conditions, based on current water shortages, in nine counties in an attempt to reduce the impacts of drought.  |
| <a href="#"><u>Executive Order N-10-21–15% Reduction in Water Use</u></a>                    | This order called on Californians to voluntarily reduce water consumption by 15% compared with 2020 levels. It expanded the state of drought emergency in nine counties.  |
| <a href="#"><u>Proclamation–Drought State of Emergency (October 2021)</u></a>                | A major extension of the July 2021 proclamation, this proclamation added eight more densely populated counties, and for the first time required that urban water shortage contingency plans and agricultural drought plans be implemented. It called on Californians to voluntarily reduce water consumption by 15% compared with 2020 levels and was designed to protect water supplies in the event another dry or extremely dry water year occurred in 2022. |
| <a href="#"><u>Executive Order N-7-22–Drought Well Permitting Requirements</u></a>           | This order seeks to protect domestic and shallow wells from going dry by restricting new groundwater well permits, directing the Department of Water Resources to assist small community water systems with dry wells, and requiring State agencies to collaborate with Tribes.   |
| <a href="#"><u>Executive Order N-3-23–Build Water Resilience into Current System Use</u></a> | This executive order maintained the state of emergency in California counties but eased restrictions on groundwater wells for individual users.   |
| <a href="#"><u>Executive Order N-4-23–Floodwater Capture and Recharge Improvements</u></a>   | This executive order facilitates offstream strategies for floodwater capture, recharge, and flood-risk reduction.   |

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| <b>Resilience Actions</b>  | <b>Descriptions</b>  |
|--|--|
| <a href="#"><u>Executive Order N-5-23–Easing of Drought Restrictions</u></a>   | This executive order ends the voluntary 15% water consumption reduction but maintains a state of emergency in all California counties to allow for continued efforts to reduce drought.  |
| <a href="#"><u>California State Water Resources Control Board–Emergency Water Conservation Regulation</u></a>  | These regulations include additional water conservation measures in addition to Governor Newsom’s executive orders on water conservation.  |
| <a href="#"><u>Sustainable Groundwater Management Act</u></a>  | This act, passed in 2014, created a framework for local agencies to form groundwater sustainability agencies that regulate groundwater consumption and mitigate overdraft. Since its passage significant progress has been made by local agencies toward the goal of ensuring sustainable groundwater conditions over the next 50 years. |
| <b>Plans and Strategies</b>  |  |
| <a href="#"><u>Office of the Governor/California Natural Resources Agency–California Water Supply Strategy</u></a>   | This strategy proposes investments in new water supply sources, accelerating projects in the pipeline, and modernizing State water management by using new technology.   |
| <a href="#"><u>California State Water Resources Control Board Resolution 2022-0002–Emergency Regulation to Prohibit Wasteful Water Use</u></a>   | This resolution acknowledges that there is a need to adhere to California regulations on reduced water usage. It provides recourse to disseminate water conservation methods in the public.  |
| <a href="#"><u>California State Water Resources Control Board–Order Conditionally Approving Temporary Urgency in Light of Drought Conditions (June 2021)</u></a>   | This strategy proposes investments in new water supply sources, accelerating projects in the pipeline, and modernizing State water management using new technology.  |
| <a href="#"><u>Department of Water Resources/California State Water Resources Control Board–Groundwater Management Principles &amp; Strategies to Monitor, Analyze and Minimize Impacts to Drinking Water Wells: A Framework for State Action to Support Drought Resilient Communities</u></a> | This framework was developed in response to the governor’s directives and builds up on the State’s drought response to provide direction and deliver solutions to support groundwater-dependent communities for drinking water purposes.   |

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| Resilience Actions   | Descriptions   |
|--|--|
| <a href="#"><u>California Water Commission–<br/>Conveyance and Groundwater<br/>Trading White Papers</u></a>                      | These white papers describe conveyance and groundwater trading as options for long-term supply solutions.  |
| <b>Programs</b>  |  |
| <a href="#"><u>California State Water<br/>Resources Control Board–<br/>Drinking Water Partnerships<br/>and Consolidation</u></a> | These partnerships include formal and informal agreements between water systems and communities that strengthen the ability of the State Water Board to ensure safe and sustainable drinking water.  |
| <a href="#"><u>Department of Water<br/>Resources–Climate Action<br/>Plan, Phase 3: Vulnerability<br/>Assessment</u></a>          | This assessment describes, evaluates, and quantifies the vulnerabilities of DWR assets and business to potential climate change impacts. This effort is intended to provide a first-of-its-kind evaluation for use by Department of Water Resources facilities.  |
| <a href="#"><u>Department of Water<br/>Resources–California Aqueduct<br/>Subsidence Program</u></a>                              | This program seeks to reduce future subsidence in the San Joaquin Valley and to develop and implement the most beneficial and affordable corrective actions to mitigate the adverse effects of current and future subsidence on the California Aqueduct.   |
| <a href="#"><u>Department of Water<br/>Resources, State Water Board–<br/>Sustainable Groundwater<br/>Management Program</u></a>  | The historic passage of the Sustainable Groundwater Management Act (SGMA) in 2014 set a statewide framework to help protect groundwater resources over the long term. In signing SGMA, then-Governor Jerry Brown emphasized that “groundwater management in California is best accomplished locally.” The Department of Water Resources serves two roles to support local SGMA implementation: (1) regulatory oversight through the evaluation and assessment of groundwater sustainability plans (GSP), and (2) providing ongoing technical and financial assistance to locals. If DWR determines that a GSP is inadequate, state intervention by the State Water Board is triggered. State intervention is a process that could result in the Water Board temporarily managing and protecting groundwater resources until local agencies are able and willing to do so adequately. |
| <a href="#"><u>Department of Water<br/>Resources–Dry Well Reporting<br/>System</u></a>   | This system allows owners of groundwater wells to notify DWR if wells have gone dry so that the department can geographically track water reduction in the aquifer.  |

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| <b>Resilience Actions</b>  | <b>Descriptions</b>   |
|--|---|
| <a href="#"><u>Office of Environmental Farming and Innovation– State Water Efficiency and Enhancement Program</u></a>          | Provides financial assistance in the form of grants to implement irrigation systems that reduce greenhouse gases and save water on California agricultural operations. Eligible system components include (among others) soil moisture monitoring, drip systems, switching to low-pressure irrigation systems, pump retrofits, variable frequency drives, and installation of renewable energy to reduce on-farm water use and energy.                          |
| <a href="#"><u>California State Water Resources Control Board– Groundwater Ambient Monitoring &amp; Assessment Program</u></a> | This program seeks to improve statewide comprehensive groundwater monitoring and increase the availability to the general public of groundwater quality and contamination information.  |
| <a href="#"><u>Department of Conservation - Multi-benefit Land Repurposing Program (MLRP)</u></a>                              | The MLRP supports regions in adapting land uses to improve sustainability of groundwater basins. Regions are supported to increase capacity to repurpose agricultural land, thereby reducing reliance on groundwater and increasing groundwater sustainability.   |
| <b>Projects</b>  |   |
| <a href="#"><u>Multi-Agency Coordination to Support Water Supply Strategy Goals for Reuse and Desalination Projects</u></a>    | State Water Board staff convened a working group comprised of representatives from all partner agencies listed in the Seawater Desalination Interagency Memorandum of Agreement. The Desalination Interagency Group identified criteria for siting seawater desalination facilities to facilitate approval under the existing desalination requirements, as well as recommendations for potential changes to the requirements to further streamline permitting. |
| <a href="#"><u>California Water Commission– Water Storage Investment Program (WSIP)</u></a>                                    | Proposition 1 of 2014 dedicated \$2.7 billion for investments in water storage projects. The California Water Commission is administering the Water Storage Investment Program to fund the public benefits associated with the eight selected projects, such as flood control, ecosystem improvement, water quality improvement, emergency response, and recreation.  |

Multiple state entities are investing significant resources to advance large-scale multi-benefit ecosystem restoration projects and programs, and advance nature-based solutions (Table 4-5). Many of these efforts, such as the [Agreements to Support Healthy Rivers and Landscapes](#) (voluntary agreements) and Klamath River Dam Removal, are

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aimed at resolving long-standing resource conflicts. The California Natural Resources Agency’s (CNRA’s) 30x30 Natural and Working Lands Climate Strategy is accelerating land conservation and elevating the role of natural and working lands in responding to climate change. CDFW is also focused on supporting the resilience of salmon populations throughout the state and addressing the obstacles to their survival under climate stress. Multiple other efforts are focused on the role of forests resilience and biodiversity.

The importance and scale of these ecosystem restoration efforts cannot be overstated. Ecosystem restoration and conservation of highly managed and manipulated lands and waterways in the face of a changing climate require an evolution in thinking about restoration goals. Returning to a pre-human state of nature is not a realistic, or even desirable, target. The State, through these many projects and programs, is providing leadership to focus on the restoration of critical geomorphic, hydrologic, and ecological processes as the foundation for building resilience for human and natural communities. Examples of these efforts include reconnecting floodplains, managing rivers to reflect natural flows to support salmon and other species, and managing forests to encourage natural succession for resilience. Indeed, these large-scale ecosystem restoration efforts present an opportunity to acknowledge and embrace Traditional Ecological Knowledge. This can be done by including Tribal participation in the design, implementation, and co-management of these projects to support and restore Tribal land management practices, that have developed over centuries, to keep the land ecosystems in balance.

State actions to prepare for and act on inland flood protection and coastal flood from sea level rise are led primarily by DWR and the Ocean Protection Council, respectively. The State Lands Commission and the State Coastal Conservancy also have initiatives focused on preparing for the impacts of climate change on their jurisdictional lands (Table 4-6).

**Table 4-5 State Resilience Actions Advance Ecosystem Restoration and Nature-Based Solutions**

| Resilience Actions  | Descriptions   |
|---|--|
| <b>Executive Orders/Legislation</b>   |  |
| <a href="#"><u>Assembly Bill 2193–Habitat Restoration and Enhancement Act</u></a> | The Habitat Restoration and Enhancement Act (HREA) of 2014 has proven to be an excellent tool for restoration proponents looking for a streamlined permitting process for small projects. All HREA projects must be eligible for an exemption under California Environmental Quality Act for small habitat restoration projects not exceeding 5 acres in size to assure the maintenance, restoration, enhancement, or protection of habitat for fish, plants, or wildlife. California Department of Fish and Wildlife approved 93 projects pursuant to HREA from 2015 to 2020. |



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| <b>Resilience Actions</b>  | <b>Descriptions</b>   |
|--|---|
| <a href="#"><u><i>Executive Order N-82-20–Creates Biodiversity Collaborative to Advance 30x30</i></u></a>                                    | This executive order establishes a goal of conserving at least 30% of California’s land and coastal waters by 2030. Additionally, the order calls for engagement with interested parties across California to prioritize biodiversity.  |
| <b>Plans and Strategies</b>  |   |
| <a href="#"><u><i>Coachella Valley Mountains Conservancy Climate Change and Desert Resiliency Policy</i></u></a>                             | This policy describes methods and strategies for the conservancy to respond to climate change and promote resiliency within the desert region of the Coachella Valley.  |
| <a href="#"><u><i>California Natural Resources Agency–30x30 Strategic Pathways, Accelerating Conservation of California’s Nature</i></u></a> | This document sets California on the path to successfully implement the 30x30 conservation goal. This strategy describes the key objectives and core commitments, establishes a current baseline of conserved areas, outlines strategic actions necessary, and introduces a suite of applications to identify conservation opportunities.   |
| <a href="#"><u><i>California Natural Resources Agency–Natural and Working Lands Climate Smart Strategy</i></u></a>                           | Helps implement the governor’s Executive Order N-82-20 and expand climate action in this sector, which has been called for in California’s Climate Change Scoping Plan and California’s recently updated Climate Adaptation Strategy. The Climate Adaptation Strategy also identifies priorities for areas of near-term State focus to increase climate action on California’s natural and working lands  |
| <a href="#"><u><i>Forest Management Task Force–California Wildfire and Forest Resilience Action Plan</i></u></a>                             | Accelerates efforts to restore the health and resilience of California forests, grasslands, and natural places; improve the fire safety of communities; and sustain the economic vitality of rural forested areas. The action plan serves as a roadmap for implementing the Agreement for Shared Stewardship of California’s Forest and Rangelands with the USDA Forest Service, and for aligning the State’s efforts with federal, local, Tribal, regional, and private organizations. |
| <a href="#"><u><i>California Air resources Board–California Forest Carbon Plan</i></u></a>   | This plan lays out recommended actions to achieve healthy and resilient forests based on what is known about our forests and how climate change will evolve in California.  |

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| <b>Resilience Actions</b>   | <b>Descriptions</b>   |
|---|---|
| <a href="#"><u>Delta Stewardship Council–Delta Adapts.</u></a>  | The Delta Stewardship Council is working with partners to undertake a regional vulnerability assessment and develop a regional climate adaptation plan.   |
| <a href="#"><u>Delta Stewardship Council–The Delta Plan</u></a>   | The Delta Plan seeks to achieve the goals of a reliable statewide water supply and a protected, restored Delta ecosystem. The plan includes 14 regulatory policies and 95 recommendations.  |
| <b>Programs</b>   |   |
| <a href="#"><u>Department of Conservation–Working Lands and Riparian Corridors Program</u></a>                        | Funds watershed restoration projects and conservation projects on agricultural lands.   |
| <a href="#"><u>Sierra Nevada Conservancy–Watershed Improvement Program</u></a>  | This is a large-scale restoration program designed to restore the health of California’s primary watershed and create resilient Sierra Nevada communities.  |
| <a href="#"><u>California Department of Fish and Wildlife–Climate Change Initiatives</u></a>                          | The California Department of Fish and Wildlife is safeguarding natural resources in the state by building resilience of the natural landscape, promoting carbon storage, and coordinating with other State agencies.  |
| <a href="#"><u>Tahoe Conservancy–Climate Adaptation and Biodiversity Program and Landscape Resilience Program</u></a> | The California Tahoe Conservancy’s strategic plan includes a goal to foster basin-wide climate change adaptation and sustainable communities. To achieve this goal, the conservancy focuses on four areas: developing the Lake Tahoe Climate Adaptation Action Portfolio, providing grants to support climate change adaptation, adapting conservancy programs and land management to changing climate conditions, and engaging partners and collaborating with scientists. |
| <a href="#"><u>Multi-Agency–Agreements to Support Healthy Rivers and Landscapes (Voluntary Agreements)</u></a>        | Voluntary agreements, approved by the State Water Board, are a means to implement an updated Bay-Delta Plan. These agreements would help restore 45,000 acres of aquatic habitat for fish and other animals.  |

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| <b>Resilience Actions</b>  | <b>Descriptions</b>   |
|--|---|
| <a href="#"><u>Yolo Bypass Cache Slough Partnership</u></a>  | This partnership jointly plans and collaborates to implement projects capable of delivering multiple benefits to support interests in agriculture, flood, habitat, recreation, water quality, and water supply improvements across the shared 40-mile-long Yolo Bypass and Cache Slough region.   |
| <a href="#"><u>Office of Environmental Farming and Innovation–Pollinator Habitat Program</u></a>             | Pollinators are essential to many of California’s agricultural crops and to the vast biodiversity of California’s natural ecosystems. Pollinator Habitat Program works directly with farmers and ranchers to install habitat and implement management practices that support pollinators.   |
| <a href="#"><u>Department of Forestry and Fire Protection–Urban and Community Forestry Grant Program</u></a> | Through the Urban and Community Forestry Grant Program, the Department of Forestry and Fire Protection works to optimize the benefits of trees and related vegetation through objective-based projects. The mission of the program is to lead the effort to advance the development of sustainable urban and community forests in California.   |
| <b>Projects</b>  |   |
| <a href="#"><u>State-Co-Licensee–Klamath River Dam Removal</u></a>   | The Klamath River Renewal project will remove four hydroelectric dams along the Klamath River to restore native salmon populations and improve water quality. It is the largest dam removal project in U.S. history. The project is led by the Klamath River Renewal Corporation (KRRC) with substantial funding from the State of California. Additionally, the State is acting as co-licensee of the hydroelectric project with the KRRC and the State of Oregon for purposes of decommissioning and restoration between 2023 and approximately 2030. |
| <a href="#"><u>Department of Water Resources–Salton Sea Management Program</u></a>                           | The Salton Sea Management Program is a 10-year plan that under State Water Board order is required to construct 30,000 acres of habitat and suppression of dust and particulates around the Salton Sea. The program is researching the feasibility of utilizing local groundwater resources and evaluating water importation.   |

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| <b>Resilience Actions</b>   | <b>Descriptions</b>  |
|---|--|
| <a href="#"><u>California Department of Fish and Wildlife–San Joaquin River Restoration Program</u></a> | The San Joaquin River Restoration Program is a long-term effort to restore flows in the San Joaquin River from Friant Dam to the Merced River confluence. The program also hopes to restore self-sustaining Chinook salmon fisheries in the river. |

**Table 4-6 State Resilience Actions Support Flood Preparedness**

| <b>Resilience Actions</b>   | <b>Descriptions</b>  |
|---|--|
| <b>Plans and Strategies</b>   |  |
| <a href="#"><u>Department of Water Resources and Central Valley Flood Protection Board–Central Valley Flood Protection Plan</u></a> | Strategic blueprint for Central Valley flood risk management, guiding State’s policies, investments, and partnerships  |
| <a href="#"><u>California Ocean Protection Council–California Sea-Level Rise Guidance</u></a>                                       | The guidance is used by California’s coastal zone management agencies to support planning and permitting activities. The 2018 update incorporated advances in ice-loss science and projections of sea level rise and includes guidance to address the needs of State agencies and local governments.   |
| <a href="#"><u>Department of Water Resources–State Plan of Flood Control Descriptive Document</u></a>                               | This is a descriptive document that details the infrastructure and operation of the State-federal flood management system that includes 1,600 miles of infrastructure. There are multiple separate projects as part of the State Plan of Flood Control.  |
| <a href="#"><u>California Ocean Protection Council–Strategic Plan to Protect California’s Coast and Ocean 2020-2025</u></a>         | Provides a roadmap for protecting and adapting coastal and ocean ecosystem resources in the face of sea level rise, ocean acidification and hypoxia, ocean warming, and other climate-driven stressors. The strategic plan also prioritizes understanding the role of California’s network of marine protected areas in providing ecosystem resilience to climate change and ensuring fisheries and fishing communities can adapt and thrive in changing ocean conditions. |

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| <b>Resilience Actions</b>  | <b>Descriptions</b>  |
|--|--|
| <a href="#"><u>California Ocean Protection Council– State Agency Sea-Level Rise Action Plan for California</u></a> | Roadmap toward coastal resiliency for California.  |
| <a href="#"><u>California State Lands Commission– Efforts to Address Sea Level Rise</u></a>                        | The State Lands Commission facilitates sea level rise preparedness, with an emphasis on protecting California’s public trust lands and the public’s right to access and enjoy these lands. Assembly Bill 691 (Muratsuchi 2013) Chapter 592, Statutes of 2013, involves sea-level-rise impacts on granted public trust lands. Specifically, larger trustees are required to prepare and submit an assessment of how they propose to address sea level rise to the commission.   |
| <a href="#"><u>California Coastal Conservancy– Climate Change Initiatives</u></a>                                  | The Coastal Conservancy’s Climate Ready Program is helping natural resources and human communities along California’s coast and San Francisco Bay adapt to the impacts of climate change. The conservancy is also working to capture greenhouse gases from the atmosphere through the conservation of natural and working lands. Additionally, the conservancy adopted a climate change policy that informs all aspects of its work and amended its project selection criteria to ensure that all conservancy projects are designed with climate change in mind. |
| <a href="#"><u>California State Lands Commission– Assembly Bill 691 Synthesis Report</u></a>                       | This report synthesizes the sea-level-rise vulnerability assessments that were submitted to the California State Lands Commission. The report identifies major findings from these assessments related to sea-level-rise vulnerability and adaptation strategies.  |

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| <b>Resilience Actions</b>   | <b>Descriptions</b>  |
|---|--|
| <p><a href="#"><u><i>Bay Conservation and Development Commission–Bay Adapt, Regional Strategy for a Rising Bay Joint Platform</i></u></a></p> | <p>San Francisco Bay Conservation and Development Commission works with interested parties around the Bay Area to understand their vulnerability to sea level rise and how future flooding will affect communities, businesses, infrastructure, and natural systems. Since 2011, the Adapting to Rising Tides (ART) Program has conducted research and provided tools, guidance, and information to local cities and counties to help support complex decision-making around climate adaptation. ART has conducted projects at the regional, local, and sectoral scales.</p> |
| <p><b>Programs</b></p>  |  |
| <p><a href="#"><u><i>Department of Water Resources–Urban Flood Protection Grant Program</i></u></a></p>                                       | <p>California Natural Resources Agency’s Urban Flood Protection Grant Program funds multi-benefit projects in urbanized areas to address flooding. Projects include stormwater capture and reuse, planning and implementation of low-impact development, restoration of urban streams and watersheds, and increasing permeable surfaces to help reduce flooding.</p>   |
| <p><a href="#"><u><i>Sacramento and San Joaquin Delta Conservancy–Carbon Management Program</i></u></a></p>                                   | <p>The Delta Conservancy incentivizes landowners to convert to practices that reduce carbon emissions and land subsidence that result from oxidation of highly organic peat soils in the Sacramento-San Joaquin Delta. A voluntary market protocol was approved by the American Carbon Registry in 2017 for restoration of coastal and deltaic wetlands in California. In 2020, the program completed the first verification and certification of wetland carbon credits anywhere in the world.</p>  |
| <p><a href="#"><u><i>Department of Water Resources–Regional Flood Maps</i></u></a></p>  | <p>This effort works to develop regional flood maps for different areas within California and to oversee potential mapped changes from climate change.</p>   |

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| <b>Resilience Actions</b>  | <b>Descriptions</b>  |
|--|--|
| <u><a href="#">Bay Area Regional Collaborative– Adapting to Rising Tides Program</a></u> | This program is a regional-scale effort to understand the interconnected vulnerabilities of Bay Area communities, natural systems, and critical transportation infrastructure to increased flooding and sea level rise.  |
| <u><a href="#">California Coastal Commission– Climate Change Program</a></u>             | The commission considers climate change through its planning, regulatory, and educational activities, and works to reduce greenhouse gas emissions and the detrimental impacts of global warming on the California coast. Through its Sea Level Rise Policy Guidance, the commission advances, supports, and helps to fund California’s preparation for these critical challenges to ensure a resilient coast. |

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Through the Office of Environmental Farming and Innovation, California Department of Food and Agriculture is focused on safeguarding the productivity of agriculture in response to climate change. The California Healthy Soils Initiative is a collaboration between State agencies and departments led by the California Department of Food and Agriculture to promote healthy soil development. The initiative utilizes innovative farm and land management practices as well as building adequate organic soil matter to increase carbon sequestration and mitigate the effects and production of greenhouse gases (California Department of Food and Agriculture 2023).

The California Energy Commission and DWR are engaged in the decarbonization and safeguarding of California’s energy systems. Food and energy security actions are shown in Table 4-7.

**Table 4-7 State Resilience Actions Prioritize Food and Energy Security**

| Resilience Actions  | Descriptions   |
|---|--|
| <b>Plans and Strategies</b>   |  |
| <a href="#"><u>California Energy Commission–Integrated Energy Policy Report</u></a>           | The Integrated Energy Policy Report assesses a variety of energy trends and issues to inform decision-making in working to create an energy system that is clean, modern, and safe, while increasing its resiliency to climate change and improving equity in how clean energy benefits are realized. Hydroelectric power sources are especially vulnerable to the extremes of climate change. |
| <a href="#"><u>California Department of Food and Agriculture Strategic Plan 2019-2022</u></a> | This plan outlines the potential to make improvements in programs and services that advance the Department’s vital role in the success of California agriculture across the nation and throughout the world.   |
| <b>Programs</b>   |  |
| <a href="#"><u>California Department of Food and Agriculture–Healthy Soils Initiative</u></a> | This initiative is a collaboration of State agencies and departments to promote the development of healthy soils.  |



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| <b>Resilience Actions</b>   | <b>Descriptions</b>   |
|---|---|
| <a href="#"><u>California Department of Conservation–Carbon Capture and Sequestration Program</u></a> | The California Geologic Energy Management Division (CalGEM), within the California Department of Conservation, prioritizes protecting public health, safety, and the environment in its oversight of the oil, natural gas, and geothermal industries, while working to help California achieve its climate change and clean energy goals. CalGEM facilitates the State’s Carbon Capture and Sequestration Program, which involves the capture, transport, and long-term storage of carbon dioxide in geological reservoirs deep underground that would otherwise be released to the atmosphere. |
| <a href="#"><u>Strategic Growth Council–Sustainable Agricultural Lands Conservation</u></a>           | Facilitates the purchase of agricultural conservation easements, development of agricultural land strategy plans, and other mechanisms that result in greenhouse gas reductions and a more resilient agricultural sector.   |
| <b>Projects</b>   |   |
| <a href="#"><u>Department of Water Resources–State Water Project Energy Production</u></a>            | Energy consumption from the State Water Project ranges from 6 million megawatt hours (MWh) to 9.5 million MWh depending on the water year. Half of the portfolio comes from emission-free hydroelectric power.  |
| <a href="#"><u>California Energy Commission–Roseville State Power Augmentation Project</u></a>        | This project authorizes the use of 60 megawatts of additional capacity at the Roseville power plant with temporary power generators.  |
| <a href="#"><u>California Energy Commission–Climate Change Initiatives</u></a>                        | The California Energy Commission manages numerous programs and efforts that help California meet its climate goals by increasing energy efficiency and conservation, as well as advancing renewable energy and low-carbon technologies.   |

### Accelerating Implementation of Resilience Programs and Projects

Securing State approvals for a wide range of water resources and multi-benefit projects has long been identified as a bottleneck by water districts and other land and water managers. The *Water Supply Strategy* (Strategy) directs State agencies to improve regulatory processes within State government to assist local project proponents prepare for and overcome water supply shortages, increased flood risks, extreme heat, wildfire risk, and other impacts of climate change in their watersheds.

## State's Role in Creating a Resilient and Equitable Future

Related to developing new water supplies through wastewater recycling, the Strategy directs the State Water Board to convene a strike team to identify and resolve permitting and funding obstacles and track the permitting and funding status of recycled water projects with a public, digital dashboard.

To streamline and expedite the permitting process for desalination facilities, the Strategy has directed the State Water Board, the California Coastal Commission, DWR, and other State entities to develop criteria for siting desalination facilities along the coast and recommend new standards to facilitate approval of those facilities. The same agencies also are to identify potential available mitigation sites to facilitate the expedited approval.

For recharge projects receiving DWR grants, or conducted under DWR's **Flood-Managed Aquifer Recharge** (Flood-MAR) Program, the State Water Board and DWR are collaborating to streamline temporary water right permits. Additionally, the administration will pursue legislation to revise the water right application process to deliver decisions more quickly.

### ***Cutting Green Tape Initiative – Improved Permitting for Restoration Projects***

The Cutting Green Tape Initiative is focused on improving interagency coordination, partnerships, and agency processes and policies to allow ecological restoration and stewardship to occur more quickly, simply, and cost-effectively to promote using nature-based solutions. Numerous State and federal agencies and non-governmental partners have been working to break down barriers within the permitting and regulatory fields to increase the pace and scale of restoration work across the state.

Consistent with the Cutting Green Tape Initiative and in response to *Water Resilience Portfolio* Action 13.2, many permitting mechanisms to speed environmental projects have been established by State agencies or are under development. For example, the Habitat Restoration and Enhancement Act (HREA) of 2014 has proven to be an excellent tool for restoration proponents looking for a streamlined permitting process for small projects. CDFW and the State Water Board jointly developed an application and permit review process for projects under HREA, administered by CDFW, and the 401 General Water Quality Certification Order for Small Habitat Restoration Projects, administered by the State Water Board. This collaboration includes the State Water Board's adoption of the Small Habitat Restoration General Order, a consolidated permit process for CDFW restoration activities for these types of projects (which previously required permitting of individual restoration projects). CDFW approved 93 projects pursuant to HREA from 2015 to 2020. In August 2022, the State Water Board adopted the Large Habitat Restoration General Order, a programmatic permit for common habitat restoration activities exceeding 5 acres. The general permit, which is a companion to the Small Habitat Restoration General Order, provides a streamlined pathway for review and approval of an application for larger restoration projects, such as improvements to stream crossing and fish passage, floodplain restoration, and removal of non-native invasive species. These examples are just a subset of the improvements in permitting for restoration underway across the state. A full list of ongoing efforts is included in the [Water Resilience Portfolio status update](#).

## State's Role in Creating a Resilient and Equitable Future

In support of reducing regulatory requirements for restoration projects, in November 2021, the Newsom administration, in cooperation with the Legislature, established a new California Environmental Quality Act (CEQA) statutory exemption until January 1, 2025, for habitat restoration projects that meet certain requirements. CDFW has begun implementation of the Statutory Exemption for Restoration Projects (SERP) and has granted nearly 30 SERPs for restoration projects since the legislation was enacted. As SERP is implemented, and prior to its sunset in 2025, CNRA will evaluate whether any further amendment to the CEQA guidelines is warranted.

Additionally, the Governor's Drought Executive Order N-7-22 of March 2022 allowed State agencies to accelerate water conservation and groundwater recharge projects. Under the order, CNRA has approved CEQA exemptions for eight projects to bolster regional conservation efforts.

### State Funding and Investments

The State is investing significant resources to respond to the ongoing climate crisis and secure its water supply into the future. The 2021 and 2022 Budget Acts committed \$8.7 billion over multiple years to support drought resilience and response programs to help communities and fish and wildlife avoid immediate impacts from extreme drought, while advancing projects and programs that will improve the state's resilience to future droughts and floods. The 2023 budget maintains \$8.1 billion (93 percent) of these investments over multiple years in programs and projects to bolster the capacity of communities and ecosystems to endure droughts and floods and includes an additional investment of more than \$500 million to primarily support flood effects.

The State's climate resilience budget includes more than \$2.7 billion for wildfire and emergency preparedness, \$2.9 billion for extreme heat and sea-level-rise preparedness and community resilience, and more than \$20 billion for transportation projects that align with the State's climate goals or accelerate its zero-emission vehicle goals.

### Coordination with Federal Agencies

Several federal agencies play important roles in the planning, regulation, and management of California's water resources and water-dependent uses. As California responds to the impacts of climate change, these federal agencies are important partners in resource management.

The following federal agencies are primary partners in State water management:

- Environmental Protection Agency (EPA).
  - The EPA provides oversight and funding to the State Water Board and has delegated authority to the State Water Board for enforcement and implementation of both the Clean Water Act and Drinking Water State Revolving Funds.

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- Department of Defense.
  - U.S. Army Corps of Engineers: Plans, designs, builds, and operates water resources projects, such as navigation, flood control, environmental protection, disaster response, and recreation.
- Department of Interior.
  - U.S. Bureau of Reclamation: Operates the Central Valley Project, which is the largest water project in California, and manages the operations and allocations of the Colorado River.
  - U.S. Fish and Wildlife Service: Conserves, protects, and enhances fish, wildlife, plants, and their habitats with emphasis on the major rivers and estuaries of California.
  - U.S. Department of Agriculture Forest Service: Stewards federal lands throughout California that contain extensive forests within headwaters of major watersheds.
  - U.S. Geological Survey: Provides science, data, and measurement of water conditions in support of water resource management.
  - Bureau of Land Management: Manages federal lands for multiple purposes, including energy development, grazing, and recreation. The bureau provides land management in many watersheds.
- Department of Commerce.
  - National Oceanic and Atmospheric Administration: Focuses on the conditions of the oceans, atmosphere, river flow forecasting, and fisheries management.

The State collaborates closely with these agencies on resilience planning, climate science and data, water supply, ecosystem restoration, flood control, hydropower, and forest management and fire protection.

Additionally, the federal government owns approximately 48 percent of the state's acreage (Gorte et al. 2012). This land is primarily located in the forested and Sierra Nevada regions, as well as the southeastern rural areas, such as Inyo and Mono counties. Federal land management within California is of critical importance, as these lands include critical source watersheds with a wide-reaching effect. The primary landowning federal agencies are the part of the Bureau of Land Management, the U.S. Department of Agriculture Forest Service, and the National Park Service. The Department of Defense and the U.S. Fish and Wildlife Service also manage large properties.

### State Efforts to Advance Water Equity

Embedded throughout the work of State agencies focused on climate are numerous policies, strategies, plans, and programs to advance **water equity**.

Executive Order EO-N-16-22 directed State agencies and departments to update strategic plans to advance equity and to respond to identified disparities with changes to the organization's mission, vision, goals, data tools, policies, programs, operations, community engagement, Tribal consultation policies and practices, and other components as necessary to serve all Californians. This executive order also established the state's first Racial Equity Commission.

The [\*Capitol Collaborative on Race and Equity\*](#) (CCORE) is a program of the Public Health Institute and the Government Alliance on Race and Equity (GARE) housed at Race Forward, offered in partnership with the California Strategic Growth Council. GARE is a national network of governments working to achieve **racial equity** and advance opportunities for all. CCORE represents a historic decision by the State of California to begin the work of a whole-of-government approach to racial equity. In 2020–2021, multiple agencies engaged in the state's water resources participated in the CCORE. The list included the DWR, Department of Conservation, CDFW, California Department of Forestry and Fire Protection (CAL FIRE), the Governor's Office of Planning Research, and the Tahoe Conservancy. The 2018–2019 CCORE Learning and Implementation Cohort included the California Coastal Commission, California Environmental Protection Agency, the State Water Board, the State Lands Commission, and many others. As of 2022, approximately 25 percent of State agencies and departments have participated in the CCORE program, and more continue to enroll annually to further build State government competency in racial equity (California Strategic Growth Council 2022).

Multiple actions, plans, and strategies addressing equity across all CCORE participants have stemmed from the CCORE engagement. One prominent example of advancing racial equity is the State Water Board's proactive engagement in addressing the effects of racism on water access. Most recently, in the summer of 2020, the State Water Board publicly acknowledged that the historical effects of institutional racism must be confronted throughout government. In response, State Water Board staff developed a priority plan of action. In November 2021, the State Water Board adopted Resolution No. 2021-0050, "Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access, and Anti-Racism" (Racial Equity Resolution), which affirms the board's commitment to racial equity and directs staff to undertake a variety of actions to achieve racial equity throughout all board programs and activities (State Water Resources Control Board 2021). With this action plan, the State Water Board envisions "a sustainable California where race no longer predicts where clean water is available or who has access to it" (State Water Resources Control Board 2021).

Primary among these actions is the implementation of a racial equity action plan (REAP) FIRE. REAP will impel the State Water Board to progress in three strategic directions (State Water Resources Control Board 2023).

## State's Role in Creating a Resilient and Equitable Future

### 1. **Integrating Racial Equity, Measuring Impact.**

Infusing the Racial Equity Resolution throughout the State Water Board's policies, programs, and practices; measuring progress toward goals and adapting when necessary.

### 2. **Creating and Maintaining Spaces for Inclusion and Belonging.**

Addressing internal and external representation of Black, Indigenous, and people of color at all State Water Board levels; elevating overall understanding of racial equity.

### 3. **Activating Community Wisdom of Black, Indigenous, and People of Color.**

Fostering open communications for voices of Black, Indigenous, and people of color communities; incorporating wisdom from Black, Indigenous, and people of color communities in decision-making processes.

DWR also developed a REAP with the following desired outcomes (California Department of Water Resources 2022):

### 1. **Workforce is Reflective of the People of California.**

To achieve DWR's mission, it is critical that its workforce represents the population that we intend to serve. Attracting, supporting, and retaining employees with diverse lived experiences is more critical than ever as DWR rises to the challenge of creating a resilient water system that serves all communities for generations to come.

### 2. **Improve Community Engagement with Communities Most Affected by Structural Racism.**

This desired outcome intends to improve the level of trust community members associate with government systems that are not designed to support their active engagement.

### 3. **Embed Racial Equity in Projects and Programs.**

To meaningfully change how DWR does business, staff at all levels will apply a racial equity lens to the planning, programming, and implementing of projects. All programs and projects will contribute to the development of training, policies, and program and project design to ensure more equitable outcomes.

Table 4-8 lists the many related executive orders, legislation, plans, strategies, and programs that have been developed and implemented across multiple agencies and departments. This deepening commitment to equity is an acknowledgement that current institutional government systems and programs may not be benefiting all Californians. The examples in Table 4-8 demonstrate a growing dedication to increasing State capacity and improving institutional culture to better respond to the needs of all Californians.

**Table 4-8** State Resilience Actions Incorporate Tribal Knowledge and Needs, Equitable Outcomes, and Human Right to Water

| Resilience Actions  | Descriptions  |
|---|---|
| <b>Executive Orders/Legislation</b>   |   |
| <a href="#"><u>Assembly Bill 2877–Tribal Water Infrastructure Bill</u></a>  | This law requires the State Water Board to include a Tribal liaison or designee in all discussions with eligible Tribal recipients in the fund. The bill mandates a higher level of active monitoring and diligence in ensuring funding distribution. |
| <a href="#"><u>Senate Bill 998–Limits Water Shutoffs to Low Income Customers</u></a>                                      | This law helps residential water users by allowing procedural protections before residents lose water service because of non-payment.   |
| <a href="#"><u>Executive Order N-42-20–Protects Homes and Businesses from Water Shutoffs During COVID</u></a>             | This executive order prevented public agencies from discontinuing water service during the COVID-19 pandemic.   |
| <a href="#"><u>Executive Order N-16-22–All State Agencies and Departments Integrate Equity in All Strategic Plans</u></a> | This executive order directs State agencies and departments to take additional actions to embed equity analysis and considerations into mission, policy, and practice.  |
| <a href="#"><u>Senate Bill 88–State Can Consolidate Water Systems</u></a>   | This bill allows the State Water Board to consolidate water systems that consistently fail to provide sufficient drinking water in front-line communities.  |
| <a href="#"><u>Assembly Bill 1384–Requires Safeguarding California Plan to Prioritize Equity</u></a>                      | The bill requires that each lead agency or group of agencies is informed by specified documents and climate science research in identifying the vulnerabilities to climate change.  |
| <a href="#"><u>Assembly Bill 685–Human Right to Water</u></a>   | This bill recognizes that every human has the right to safe, clean, affordable, and accessible water.   |
| <a href="#"><u>Assembly Bill 2108–Environmental Discharge Outreach</u></a>  | Requires the State Water Board to perform outreach to identify environmental issues early in waste discharge permit applications.   |

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| <b>Resilience Actions</b>   | <b>Descriptions</b>  |
|---|--|
| <a href="#"><u>Assembly Bill 923–Intergovernmental Consultation</u></a>   | Requires the development of government-to-government consultation training and encourages State agencies to seek meaningful input from Tribes on policies, programs, and projects that may affect Tribes.              |
| <a href="#"><u>Assembly Bill 401–State Studies Water Affordability</u></a>  | This law required the State Water Board to develop a plan for funding and implementing a low-income water rate assistance program.   |
| <b>Plans and Strategies</b>   |  |
| <a href="#"><u>Central Valley Flood Protection Board–Resolution 2021-15 on Commitment to Diversity</u></a>              | This resolution confirmed the board’s commitment to diversity, equity, and inclusion in the Central Valley.  |
| <a href="#"><u>Strategic Growth Council–Technical Assistance Guidelines/Tribal Guidelines</u></a>                       | This guidance offers best practices to help State agencies evaluate options, make decisions, and avoid challenges as technical assistance programs are developed.  |
| <a href="#"><u>California State Water Resources Control Board–Racial Equity Action Plan</u></a>                         | This action plan sets goals for the State Water Board to address racial inequities and identify metrics to measure progress. More than 200 employees and numerous partners participated in this process.               |
| <a href="#"><u>Strategic Growth Council–Transformative Climate Communities</u></a>                                      | This plan incorporates the inclusion of local communities and empowers those most affected by pollution to identify unique goals, strategies, and projects to reduce greenhouse gas emissions and local air pollution. |
| <a href="#"><u>California Department of Fish and Wildlife–Justice, Equity, Diversity, and Inclusion Action Plan</u></a> | This plan acknowledges that everyone must be involved in preserving California biodiversity and enshrines diversity practices into the department’s efforts internally and externally.                                 |
| <a href="#"><u>California Natural Resources Agency–Environmental Justice Policy</u></a>                                 | This strategy incorporates inclusion and justice into the actions of the agency to restore, protect, and manage natural resources.   |
| <a href="#"><u>California State Lands Commission–Environmental Justice Policy</u></a>                                   | This strategy incorporates inclusion and justice into the actions of the commission to restore, protect, and manage natural resources.   |



## State's Role in Creating a Resilient and Equitable Future

| <b>Resilience Actions</b>  | <b>Descriptions</b>  |
|--|--|
| <a href="#"><u>California Ocean Protection Council–Equity Plan</u></a>   | This plan represents a commitment to advancing equity across ocean and coastal policies and actions in California, as well as strengthening internal efforts to create a more inclusive workplace.                 |
| <a href="#"><u>California Coastal Commission–Environmental Justice Policy</u></a>  | This strategy incorporates inclusion and justice into the actions of the commission to restore, protect, and manage natural resources.   |
| <a href="#"><u>California State Water Resources Control Board–Racial Equity Resolution and Related Actions</u></a>       | This resolution confirmed the State Water Board’s acknowledgement of the historical effects of institutional racism and directed staff to develop a priority plan of action.                                       |
| <a href="#"><u>Strategic Growth Council–Racial Equity Hub</u></a>  | This strategy provides a database of resources, best practices, and tools to help agencies, organizations, and individuals advance racial equity.  |
| <a href="#"><u>Department of Water Resources–Racial Equity Action Plan</u></a>   | This plan highlights the need for DWR to highlight, identify, and respond to racial inequity within the California State water community.  |
| Programs   |  |
| <a href="#"><u>Department of Water Resources–Disadvantaged Communities and Tribal Involvement Grant Program</u></a>      | This program is designed to ensure the involvement of disadvantaged communities, economically distressed areas, or underrepresented communities in planning efforts.   |
| <a href="#"><u>Department of Water Resources–Urban and Small Community Drought Relief Programs</u></a>                   | These programs prioritize drought relief for urban and small community areas, utilizing funding approved by the Legislature to promote drought relief.   |
| <a href="#"><u>Department of Water Resources/California State Water Resources Control Board–Human Right to Water</u></a> | DWR and the State Water Board acknowledge a human right to water and work with local, State, federal, and Tribal governments along with non-governmental organizations and businesses to build long-term capacity. |

## State’s Role in Creating a Resilient and Equitable Future

| Resilience Actions   | Descriptions  |
|--|---|
| <a href="#"><u>California State Water Resources Control Board– Safe and Affordable Funding for Equity and Resilience (SAFER) Program</u></a> | This program is designed to guarantee that Californians who lack safe, adequate, and affordable drinking water receive it as quickly as possible and that the infrastructure supplying these communities establish sustainable solutions. |
| <a href="#"><u>California Department of Food and Agriculture–California Underserved and Small Producer Program</u></a>                       | Provides drought and flood relief grants to socially disadvantaged, small-scale, and medium scale producers to address immediate drought relief concerns and eligible expenses, as well as technical assistance.                          |
| <a href="#"><u>California Office of Environmental Health Hazard Assessment– CalEnviroScreen</u></a>  | This program provides a mapping tool that helps identify California communities that are most affected by many pollution sources and where people are most vulnerable to the effects of pollution.  |

## State Efforts to Engage California Tribes

California Tribal governments and Tribal communities have a unique relationship with California’s resources. California Tribes and Tribal communities also have distinct cultural, spiritual, environmental, economic, and public health interests and valuable traditional cultural knowledge about California resources.

The Governor’s Office of Tribal Affairs was originally established as the Governor’s Office of the Tribal Advisor by Executive Order (EO) B-10-11 and codified through AB 880. In 2019, Governor Newsom issued EO N-15-19, which acknowledges and apologizes on behalf of the State for the historical “violence, exploitation, dispossession, and the attempted destruction of Tribal communities” which dislocated California Native Americans from their ancestral land and sacred practices. This executive order also established the California Truth and Healing Council (Newsom 2019). EO N-15-19 reaffirms principles of government-to-government engagement by establishing that every State agency and department under executive control should encourage communication and consultation with **California Tribes**.

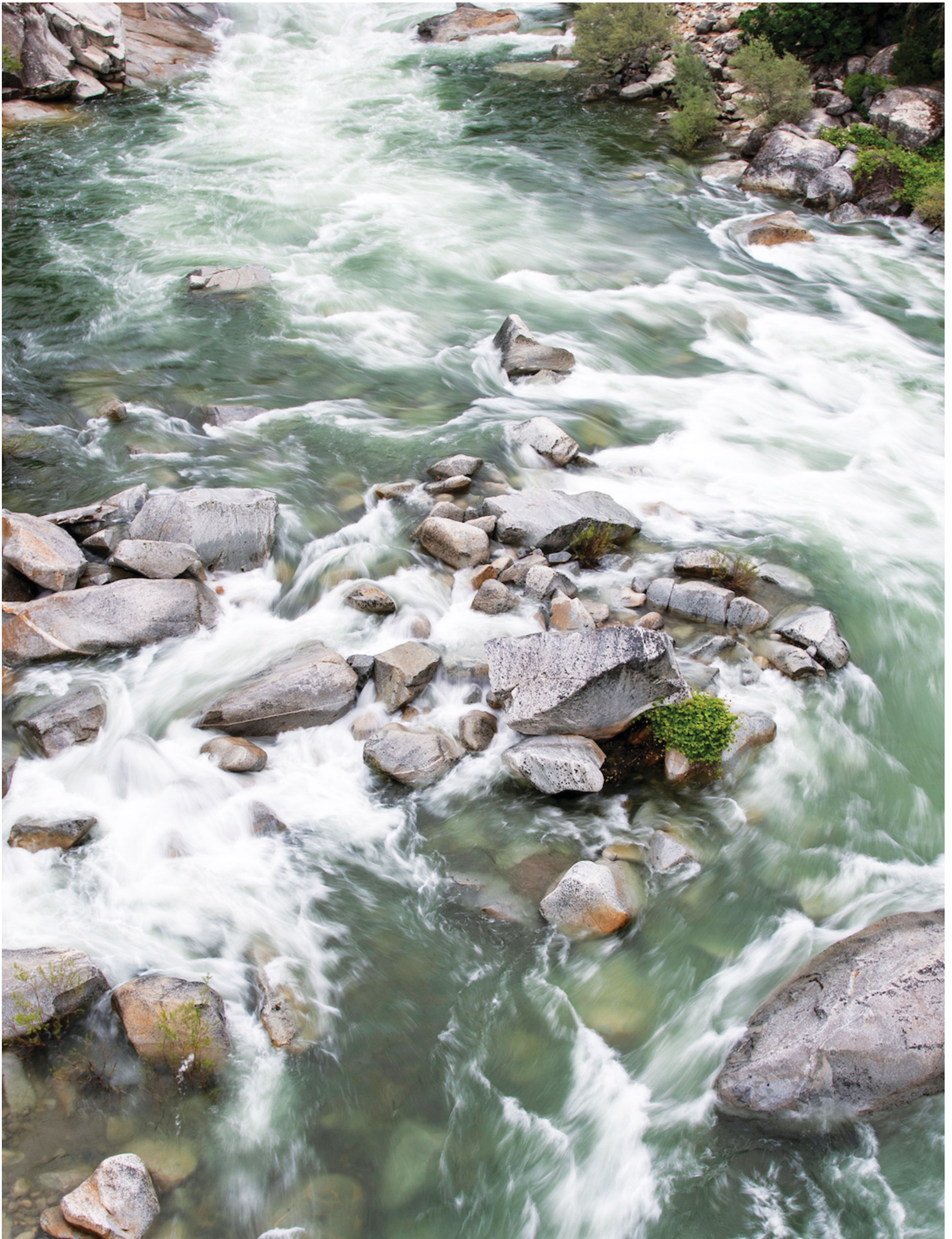
On September 25, 2020, the governor released a Statement of Administration Policy on Native American Ancestral Lands to encourage State entities to seek opportunities to support California Tribes’ co-management of and access to natural lands that are within a California Tribe’s ancestral land and under the ownership or control of the State of California. The statement also encourages those entities to work cooperatively with California Tribes that are interested in acquiring natural lands in excess of State needs (Newsom 2020).

## State's Role in Creating a Resilient and Equitable Future

DWR's Office of the Tribal Policy Advisor is the central point of coordinated communication and consultation with California Tribes to ensure proactive and meaningful consultation on water issues. This includes dedicated communication and outreach such as meetings, workshops, and advisory committees. DWR strives to continue effective collaboration and informed decision-making where all parties share a goal of reaching a decision together with common values such as:

- Working to restore, protect, and manage the State's natural resources for current and future generations.
- Use creative approaches and solutions based on science and **Tribal Ecological Knowledge**.
- Develop strategies for supporting California Tribes' water rights and providing for the sustainable management of California's sacred waters.
- Demonstrate a respect for all communities, resources, and interests and an open and free exchange of information, while respecting the principles of Tribal data sovereignty.

Additionally, the California Adaptation Strategy Report includes a focus area for 2023 to deepen the integration of California Tribal priorities into California climate policies and programs and support Tribal partnership and collaboration through funding Tribal climate projects.



# 5

## Focus on Supporting Watershed Resilience

Previous chapters demonstrated how all water-related sectors are at risk and becoming more vulnerable with **climate change**. The State is responding to the climate crisis with plans and actions by multiple agencies, departments, commissions, councils, and boards toward increasing climate **resilience**.

This chapter describes the need for climate resilience planning at the **watershed** scale and implementation through regional cross-sector initiatives. It highlights State and local efforts that have advanced regional resilience and introduces a **watershed resilience** program administered by DWR. The program will build on existing collaborative relationships, planning, and investments to improve regional climate resilience and invest in natural and **built backbone infrastructure**.

### A Statewide Vision for Watershed Resilience

Watersheds throughout the state support multiple water sectors that allow California's communities, economies, and ecosystems to thrive. These watersheds provide water supply, flood management, ecosystem, hydropower, recreation, and other benefits to those within and connected to them. These same watersheds are also at the forefront of the impacts of climate change. Each watershed is experiencing effects of climate change unique to its geography, hydrology, socioeconomics, land use patterns, subsurface features, and built infrastructure. As such, effective climate **adaptation** strategies will vary between watersheds. Past Water Plan updates, as well as the [Water Resilience Portfolio](#) and [Water Supply Strategy](#) acknowledge this diversity, highlighting the importance of State incentives for local collaborative water resources management at regional and watershed scales.

Water management in California occurs at many different scales, from individual residences and communities (e.g., water use efficiency standards and drinking water regulations) to interregional infrastructure, such as the State Water Project and the Los Angeles Aqueduct.

## Focus on Supporting Watershed Resilience

While there are critically important ongoing efforts and new opportunities to address these challenges at each scale, the watershed scale continues to emerge as an important focal point for water resilience planning.

Update 2023 underscores the importance of supporting programs to incentivize robust watershed-specific climate vulnerability analyses and adaptation plans, followed by investments in multi-sector collaborations and solutions at the watershed- and regional-scale. Complementing ongoing regulatory frameworks and program approaches, this expanded watershed-scale focus is intended to empower communities with the data, technical expertise, and financial resources to build water solutions resilient to climate change and other uncertainties that lie ahead.

The State of California has made resilience to climate change a priority. As shown in Chapter 4, the State Legislature and the administration have developed many programs that help regions improve their climate resilience. A few examples include the Sustainable Groundwater Management Act, Department of Conservation's Regional Forest and Fire Capacity Program, Office of Planning and Research's Integrated Climate Adaptation and Resilience Program, and Department of Fish and Wildlife's programs for landscape conservation planning, as well as the overall mission of the Wildfire and Forest Resilience Task Force. These programs and initiatives demonstrate the State's focus and role in promoting local collaboration at regional scales to respond to climate change risks.

## Watershed Resilience Principles

Strong approaches to watershed resilience incorporate fundamental principles of integrated watershed management (State Water Resources Control Board 2008; California Department of Water Resources 2023b; Pegram et al. 2013; Public Policy Institute of California 2019). These principles encourage robust planning and implementation in the face of uncertainty and recognize that water supports, and is managed for many interdependent resources:

1. **Promote Multi-Sectoral, Multi-Benefit Resilience Strategies:** Seek coordinated resilience solutions that provide multiple benefits to multiple water-related sectors, the environment, and communities.
2. **Integrate and Prioritize Equity and Inclusiveness:** Promote equity and inclusiveness as integral parts of the planning and implementation process.
3. **Focus on Watersheds and Interdependencies of Natural Resource and Engineered Systems:** Watersheds are an appropriate scale for adopting a holistic systems-focused approach for organizing multi-sector resilience planning that includes nature-based and engineered solutions.
4. **Build and Strengthen Watershed Networks:** Promote collaboration, relationships, and trust among a wide diversity of participants and engagement with those historically excluded from water management decisions.

5. **Apply Best Available Science and Promote Best Practices, Approaches, and Tools for Climate Resilience Planning:** Apply best available science and provide recognized and defensible approaches to inform planning.
6. **Build a Robust Understanding of Climate Risks and Embrace Uncertainty:** Ensure that system risk resulting from climate change is understood and that a range of plausible future conditions and uncertainty is considered.
7. **Promote Outcomes-Based Management:** Manage watersheds for outcomes with performance indicators and metrics to assess climate risk, measure improvements in watershed resilience, and track the effectiveness of adaptations.
8. **Move the Needle:** Focus on implementing on-the-ground, measurable, and complementary resilience actions through coordinated and sustained investments.

The principles of the watershed resilience approach support Newsom administration policies and priorities, including the governor's *Water Resilience Portfolio*, and *Water Supply Strategy*, focusing on climate urgency, building regional resilience through multi-benefit projects, integrated resource management, nature-based solutions – all with a strong focus on resilience and equity.

Implementation of these watershed resilience principles would result in robust multi-sector vulnerability and risk assessments, **water budgets** on a watershed scale, watershed climate resilience plans, multi-benefit adaptation strategies and projects, and tracking of watershed outcomes over time.

It should be noted that water and other natural resources are managed across many jurisdictional levels and scales that do not always align with watersheds. Issues and project actions occur at a wide variety of scales. The watershed resilience planning efforts do not assume all water management issues can be resolved at a watershed scale. Local, State, federal, and Tribal governments and agencies and other partners will need to continue working across a variety of scales and jurisdictions to address complex, multi-faceted water issues. Nonetheless, the State views watersheds as an appropriate scale for forming regional networks to collaborate across water-related sectors, conduct multi-sector climate vulnerability assessments, formulate multi-benefit adaptation strategies, and track and report on system-scale outcomes.

### Watershed Resilience Planning Case Studies

The following watershed resilience case studies demonstrate multi-sector, climate resilience planning at the watershed scale from a wide variety of regions throughout the state. Each case study highlights where local agencies and their partners have built regional or watershed-scale efforts around at least some of the principles noted above. These include science-driven climate vulnerability assessments, inclusive networks, collaboration across multiple water-related sectors, and forward-looking management of backbone infrastructure which represent many best practices that can be applied in other parts of the state.

### Case Study Highlight: Merced Flood-MAR Reconnaissance Study

Watershed: Merced River

Partners Involved: Merced Irrigation District, DWR

Key Watershed Resilience Principles:

- Apply Best Available Science and Promote Best Practices, Approaches, and Tools for Climate Resilience Planning and Analysis.
- Build a Robust Understanding of Climate Risks and Embrace Uncertainty.
- Focus on Watersheds and Interdependencies of Natural and Engineered Systems.
- Promote Multi-Sectoral, Multi-Benefit Resilience Strategies.

**Summary of Planning Effort:** DWR, in partnership with Merced Irrigation District, is studying the climate change vulnerability and use of floodwaters for managed aquifer recharge (also known as **flood-managed aquifer recharge** [Flood-MAR]) that can support climate change adaptation and reduce flood risk, increase supply reliability, support groundwater sustainability, and enhance ecosystems in the Merced River Basin. The Merced study uses a watershed vulnerability and adaptation assessment approach, first assessing climate change vulnerabilities in flood management, water supply, ecosystems, and groundwater sustainability. Performance of Flood-MAR and other adaptations are then evaluated with potential climate change futures.

The Merced study found that analyzing a wide range of water sector vulnerabilities in a watershed helps to balance tradeoffs and identify new opportunities for multi-sector climate adaptation. Study results indicate that even low levels of Flood-MAR implementation achieve benefits in all sectors. The benefits substantially increase with an increase in scale (i.e., land area) of implementation, including the addition of reservoir reoperation concepts and new infrastructure. With a combination of Flood-MAR and reservoir reoperation, study results show climate-change-induced peak flood flows in the Merced River can be reduced by 65 to 85 percent. Multi-sector headwater to groundwater adaptation measures can significantly reduce vulnerabilities for communities and ecosystems.

The Merced Flood-MAR watershed study is an illustration of how climate change causes region-specific impacts and the need to better understand climate vulnerabilities across water supply, groundwater, flood management, and ecosystem sectors at a watershed scale. Findings from this watershed-scale vulnerability assessment informed development of Executive Order N-4-23 to use floodwater to recharge and store groundwater statewide.



### Case Study Highlight: Sonoma Water Climate Adaptation Plan

Watershed: Russian River

Partners Involved: Sonoma Water, County of Sonoma, Santa Rosa Water, Valley of the Moon Water District, City of Petaluma, City of Sonoma, North Marin Water District, and Marin Water

Key Watershed Resilience Principles:

- Apply Best Available Science and Promote Best Practices, Approaches, and Tools for Climate Resilience Planning and Analysis.
- Build a Robust Understanding of Climate Risks and Embrace Uncertainty.
- Promote Multi-Sectoral, Multi-Benefit Resilience Strategies.

**Summary of Planning Effort:** Sonoma Water and partners developed a comprehensive climate adaptation plan that seeks to improve resilience across the integrated water, flood, and sanitation management sectors in Sonoma, Marin, and Mendocino counties. The climate adaptation plan, completed in late 2021, includes an assessment of climate risks to water supply, sanitation, and flood management infrastructure and operations, and serves as a guide for achieving climate resilience across Sonoma Water’s systems.

The climate adaptation plan utilized a robust science-based approach to regional climate change, including evaluation of historical climate trends and a range of future climate projections to develop scenarios of climate threats in the region. Climate threats to Sonoma Water’s water systems were comprehensively assessed and included extreme precipitation, severe droughts, wildfire, and water quality changes. Climate change downscaling for the region was conducted, followed by water supply and flood modeling on the Russian River and Santa Rosa Creek. Major water facilities were studied and assessed for vulnerabilities to future climate change. Vulnerability and risk assessments were conducted for all major components of the systems.

A wide range of adaptation concepts and strategies to improve resilience were identified through a series of interactive workshops. Approximately 80 adaptation concepts were evaluated according to more than a dozen criteria covering economic, environmental, and social elements. Several common, integrated concepts were identified, and some are in process of being implemented. A regional water supply resilience study is following the climate adaptation plan to investigate risks beyond climate change and identify integrated regional solutions to the water supply sector. challenges.

### Case Study Highlight: American River Basin Study

Watershed: American River

Partners Involved: Regional Water Authority, Placer County Water Agency, U.S. Bureau of Reclamation, City of Roseville, City of Sacramento, El Dorado County Water Agency, City of Folsom, Sacramento Area Flood Control Agency

Key Watershed Resilience Principles:

- Apply Best Available Science and Promote Best Practices, Approaches, and Tools for Climate Resilience Planning and Analysis.
- Build a Robust Understanding of Climate Risks and Embrace Uncertainty.
- Focus on Watersheds and Interdependencies of Natural and Engineered Systems.
- Promote Multi-Sectoral, Multi-Benefit Resilience Strategies.

**Summary of Planning Effort:** The American River Basin Study is a comprehensive watershed-level look at projected climate change impacts on the Sacramento region. The study identifies future climate and hydrology projections and outlines gaps among water supplies, projected urban and agricultural demands, water quality, and critical habitat in the American River Basin. The study describes regional vulnerabilities and strategies for adaptation designed to address climate vulnerabilities in the American River watershed, which stretches from Sacramento to the Sierra foothills. The study partners evaluated potential strategies to address climate challenges, improve water supply reliability, and enhance the Bureau of Reclamation's flexibility in operating Folsom Reservoir to meet flow and water quality standards in the Sacramento-San Joaquin Delta and ensure environmental protection. Each strategy addresses different sets of climate impacts in the watershed because no one adaptation portfolio can address all the identified vulnerabilities.

The project realized several successes, including expanding from the Lower American River and three counties to include the entire system ("supershed") for their region's water supply. This encompassed the entire American River watershed, portions of Bear and Consumnes watersheds, and two groundwater basins. The effort recognized the need to work on all the components of water resources in an integrated fashion, change the perspective of floods from nuisance to resource, and move from brick-and-mortar improvements to operational improvements.

### Case Study Highlight: Ventura River

Watershed: Ventura River

Partners Involved: Ventura County, Ventura County Resource Conservation District, Ojai Valley Land Conservancy, Watersheds Coalition of Ventura County, Ventura County Watershed Protection District

Key Watershed Resilience Principles:

- Integration of multiple water-related sectors.
- Focus on Watersheds and Interdependencies of Natural and Engineered Systems.
- Promote Multi-Sectoral, Multi-Benefit Resilience Strategies.
- Watershed-scale planning.

**Summary of Planning Effort:** The Ventura River watershed has become increasingly vulnerable to impacts of accelerating climate changes, such as recurring and ever-more severe droughts. There have been a number of important collaborative efforts and planning studies conducted in the watershed in recent years.

- In 2011, the Department of Conservation awarded a three-year watershed coordinator grant to the Ojai Valley Land Conservancy for development of the Ventura River Watershed Management Plan.
- The Wildlife Conservation Board has funded special planning studies in this watershed focused on development of an instream flow framework managed by the Ventura County Resource Conservation District.
- The State Water Resources Control Board is developing a model to better understand the relationship between groundwater and surface water flows in the watershed.

Ventura County conducted the Ventura River Watershed Protection Project designed to integrate and evaluate water supply reliability, groundwater recharge, habitat restoration, water quality, recreation, and flood management under a single watershed-wide plan framework. This project, led by the county's Watershed Protection District, first brought together diverse groups within the watershed such as wholesale water providers, retail water suppliers, environmental organizations, groundwater management agencies, cities, Ventura County, special districts, unincorporated communities, and community members.

### Case Study Highlight: Chollas Creek in the Pueblo San Diego Watershed

Watershed: Chollas Creek in the Pueblo San Diego Watershed

Partners Involved: San Diego IRWM Program, GroundWork San Diego, Jacobs Center for Neighborhood Innovation, San Diego Coastkeeper, City of San Diego, Encanto Planning Group, Urban Corps, Jackie Robinson YMCA, U.S. Green Building Council San Diego, San Diego Sustainable Living Institute, San Diego Unified School District, Civic Communities, and Chollas Creek Coalition.

Key Watershed Resilience Principles:

- Integrate and Prioritize Equity and Inclusiveness.
- Inclusive regional planning networks that prioritize equity considerations.

**Summary of Planning Effort:** The SDIRWM Program funded four integrated projects that address high-priority needs in the Chollas Creek watershed, which is in an urban disadvantaged community (DAC) in San Diego County. Water management challenges in the watershed included impaired water quality, aging and undersized infrastructure, channelized creeks and erosion, invasive species, flooding, and illegal dumping.

The SDIRWM Program has prioritized involvement from disadvantaged and Tribal communities since its inception. A series of workshops were held along with outreach surveys distributed to individuals and organizations within DAC communities. The outcomes of these outreach activities were incorporated into the 2013 and 2019 IRWM Plan Updates. In addition, the San Diego Funding Area conducted a water needs assessment in 2019, to increase DAC participation in the IRWM planning process and better identify and characterize water-related issues. Distinct needs were identified for urban DACs that focused on community development and surface-water quality. Priority projects identified by DAC residents included de-channelization, hydromodification, and low-impact development projects. Regional prioritization criteria were used by a diverse advisory workgroup that included DAC and Tribal representatives.

Chollas Creek projects included habitat restoration, realignment and de-channelization, added recreational spaces, and improved water use efficiency. From planning to implementation, the Chollas Creek projects help support revitalization of the neighboring community while improving water quality and protecting against future climate change impacts. These projects leveraged partnerships across local and State agencies as well as nonprofit organizations and educational institutions.

### Watershed Resilience Program

Inspired by these and many other examples of locally led inclusive and science-driven efforts, DWR is developing important and timely updates to its Integrated Regional Water Management (IRWM) Program with existing resources. The IRWM Program has been one of DWR's flagship local assistance programs over the past 20 years, during which more than \$2 billion in voter-approved bond funds have made possible nearly 1,500 projects by local agencies, leveraging an additional \$5 billion in local contributions. The IRWM Program has incentivized local collaboration, trust-building, creative water management strategies, and inclusive decision-making among local water managers, Tribes, and non-profit organizations, touching more than 90 percent of California's population and land area.

The Budget Act of 2021 and 2022 provided funding for DWR to begin implementing elements of a new Watershed Resilience Program. DWR will administer the Watershed Resilience Program to incentivize the implementation of watershed resilience plans and projects throughout the state. Initially, several pilot watersheds will be selected based on the degree of climate vulnerabilities, potential to address environmental conflicts, and preparedness for success. Selected watersheds will receive guidance and funding from DWR to convene inclusive watershed networks, conduct comprehensive watershed climate resilience planning through a collaborative process, quantify vulnerabilities across sectors, develop adaptation strategies, and identify adaptation pathways. Given the availability of funding, DWR may fund the implementation of adaptation strategies identified through plans.

### Watershed Networks

In support of the Watershed Resilience Program, DWR envisions the formation of local watershed networks built around commitments to inclusive governance and decision-making, cutting edge climate science, and planning at appropriate watershed scales. In some regions, these networks may be new entities formed where there are currently gaps in watershed-scale collaboration. In other regions, networks could be built off existing governance and regional planning efforts, such as IRWM groups, groundwater sustainability agencies (GSAs), regional flood management planning groups, regional forest and fire capacity groups, stormwater management planning groups, water quality collaboratives, sewershed networks, and other regional and Tribal planning efforts.

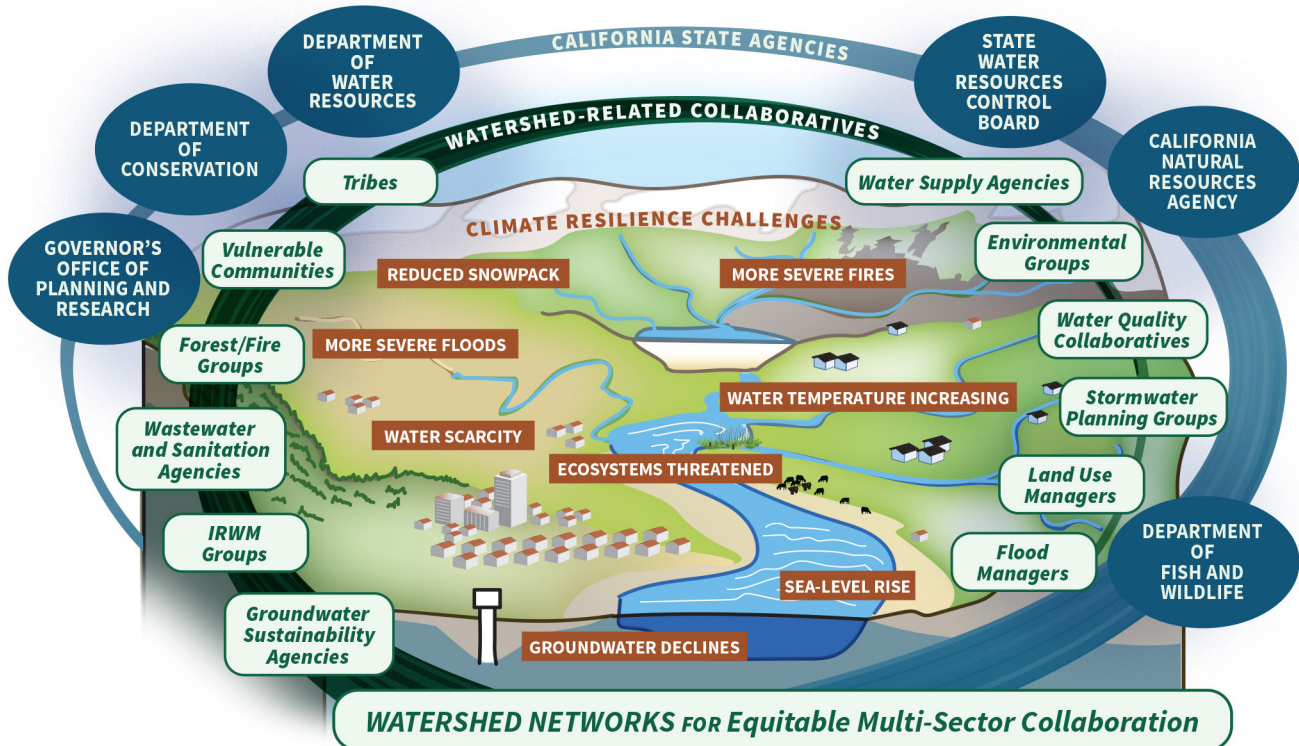
Watershed networks provide all water-related sectors a seat at the table to collaborate on understanding climate vulnerabilities and system function of watersheds and associated aquifers and groundwater basins, formulating multi-benefit adaptation and management strategies, and tracking watershed outcomes for transparency and accountability. Watershed networks will be locally led, State supported, and centered in equity so that underrepresented voices can engage as equals.

Because DWR envisions equity and inclusion as being a critical focus for watershed networks, the networks should have broad and inclusive representation. They will provide enhanced support to underserved and underrepresented communities and Tribes by facilitating their participation, promoting capacity building, and assuring equitable benefits

## Focus on Supporting Watershed Resilience

and impacts. Tribes should play key roles in watershed networks, utilizing **Traditional or Tribal Ecological Knowledge** and practices of watershed-scale management to adapt to climate impacts. Beginning with equity in mind provides underserved communities a genuine seat at the table, ensuring them the opportunity to offer input and shape actions. Efforts to increase equity and inclusion can build off the work of the Roundtable of Regions Disadvantaged Communities and Tribal Involvement Workgroup (Roundtable of Regions 2023).

Figure 5-1 Networks are an Integral Part of Supporting Watershed Resilience



### Guidance and Technical Support

To the extent funding is available, DWR, in collaboration with other State agencies, will provide technical support to watershed networks, recognizing that each region will be starting from a unique level of climate vulnerability and preparedness and will have different technical capabilities and expertise in conducting resilience assessments. DWR will provide watershed networks technical assistance to evaluate climate vulnerabilities and risks, consider uncertainty in the development of adaptation strategies, and establish watershed resilience indicators. Additional assistance may include:

- **Funding Support:** Existing and future DWR financial assistance funding will utilize Watershed Resilience Program funding to support early action toward resilience planning and implementation.
- **Watershed Network Support:** DWR will support expansion and formation of watershed networks with funding, facilitation, collaboration training, and by participating and contributing technical support where appropriate.
- **Watershed Resilience Framework, Toolkit, and Resources:** DWR will disseminate a Watershed Resilience Planning Framework, toolkit, and case studies to support local development of watershed resilience plans.
- **Technical Support:** DWR will provide common climate scenarios; historical and future water budgets; water accounting tools, data, and guidance; case studies; and locally led vulnerability and risk assessments. It also will develop an adaptation strategy database and synthesize regional vulnerabilities to better understand statewide priorities.
- **Regulatory and Policy Support:** DWR will seek permitting and regulatory assistance and support cross-jurisdictional partnering and alignment.
- **Outcome-Based Metrics and Tools:** DWR will develop and maintain a watershed hub for performance tracking and reporting on resilience performance.

### Watershed Resilience Planning Framework

To support DWR's Watershed Resilience Program, the State is preparing planning and implementation resources to support water managers in addressing climate change threats by using an equitable, outcomes-based approach. The State is orienting data and analytics, technical support, and outcomes tracking with a focus on watersheds. To be a successful partner with local agencies, Tribes, and other partners, the State must adapt a watershed-by-watershed approach to meet the unique needs of each watershed.

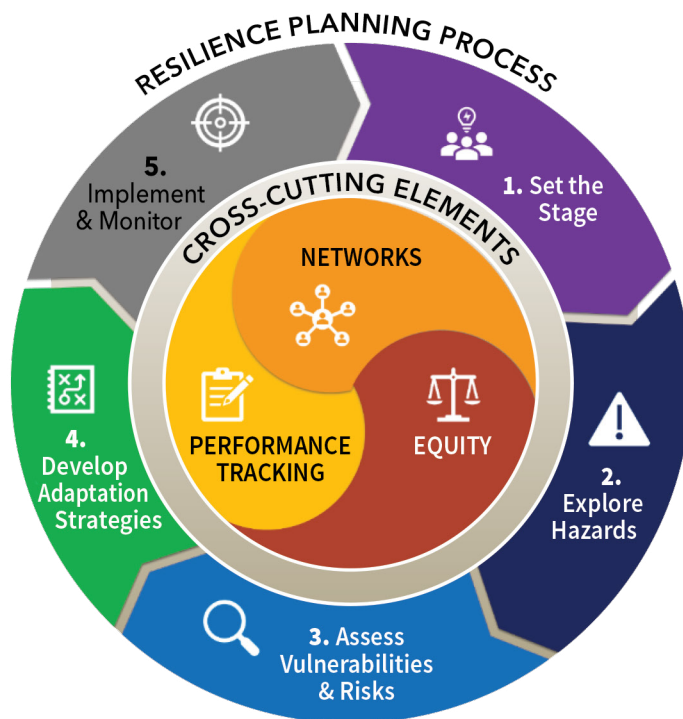
Effective watershed resilience planning requires local and State agencies to effectively work together with clear roles and a shared framework. Update 2023 puts forth a robust and flexible Watershed Resilience Planning Framework (Framework) for watershed networks to conduct watershed resilience planning, evaluate climate vulnerability and risk, evaluate and prioritize adaptation strategies, and track progress toward climate change adaptation

## Focus on Supporting Watershed Resilience

for water-related sectors. The Framework draws from the best practices and innovations currently being implemented around the state to understand climate risk and develop resilient solutions. The Framework consists of five main steps (Figure 5-2).

1. **Set the Stage:** Convene broad-based watershed network; set vision and goals of resilience planning effort; and identify components, interdependencies, and bounds of the planning effort.
2. **Explore Hazards:** Understand the current state of the system, historical climate influences on the system, future projections, and uncertainty.
3. **Assess Vulnerabilities and Risks:** Identify indicators for various watershed resource areas as their associated aquifers and groundwater basins, assess the vulnerability of watershed systems to current climate conditions and a range of plausible future climate conditions, and use the risk analysis to identify high-priority focus areas.
4. **Develop Adaptation Strategies:** Identify and evaluate a wide spectrum of adaptation options for priority focus areas, consider sustainability principles, and recommend no- or low-regret strategies while considering uncertainty.
5. **Implement and Monitor:** Develop a timeline and triggers for implementing selected strategies through on-the-ground actions; fund, implement, and monitor the performance of actions; and adapt strategies as needed.

Figure 5-2 Watershed Resilience Planning Framework Provides a Shared Process



*Figure 5-2 Note: A Watershed Resilience Framework document, including guidance, case studies, and an interactive toolkit, is being prepared to support watersheds in achieving robust resilience.*



Integral to the Framework are three cross-cutting elements: watershed networks, equity, and performance tracking. These three elements integrate across all steps of the Framework and are considered foundational to the success of any watershed resilience planning effort. The Framework has the flexibility to be customized and used in California's diverse watersheds. Each region may choose to focus on different steps within the framework based on their unique needs, capabilities, and leveraging of previous work.

To accompany the Framework, DWR is developing an online, interactive toolkit that will support watershed networks in conducting resilience planning through guidance, tools, and best practices. The guidance and toolkit will serve as a template for watershed networks to conduct resilience planning and develop and customize their own adaptation strategies. The guidance and tools are aligned with best practices in State and national climate resiliency efforts.

### Outcome-Based Metrics and Tools

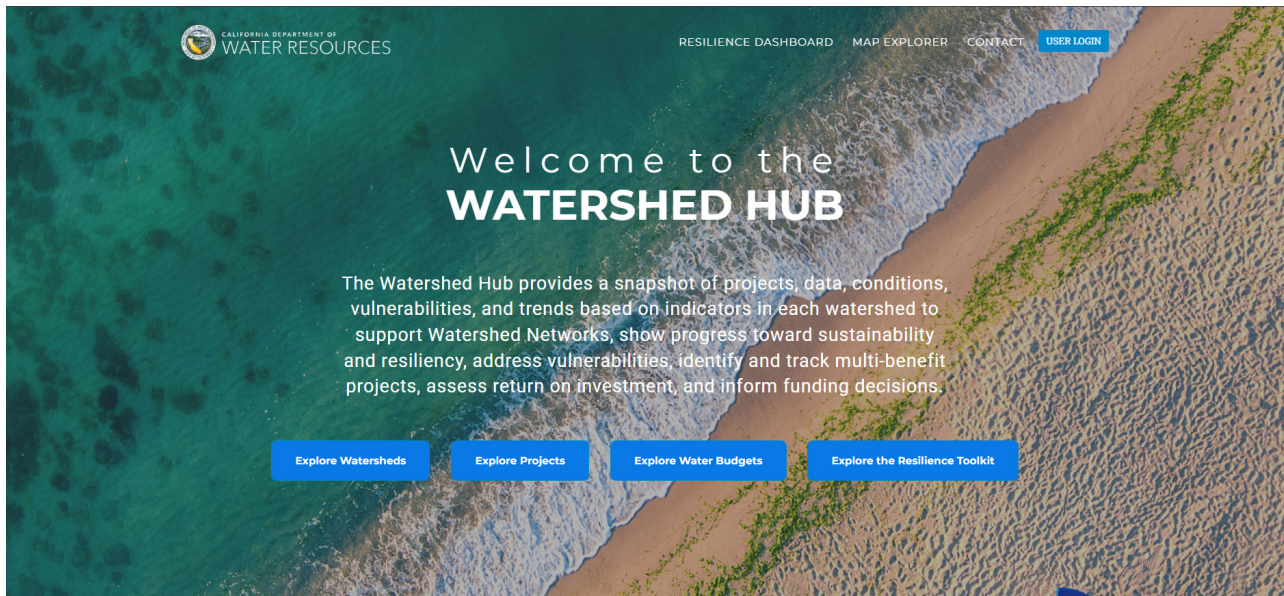
To achieve resiliency and sustainability at the watershed scale, desired outcomes need to be established and progress toward those outcomes needs to be measured over time. The goal of performance tracking is to know whether watershed resilience vital signs are trending in the right direction.

Building from efforts in *California Water Plan Update 2018* and advanced in the *Central Valley Flood Protection Plan (CVFPP) Update 2022*, DWR has developed more than 20 indicators to help measure performance across seven water resource categories: water supply, water quality, groundwater, flood management, ecosystem, recreation, and hydropower. These indicators and metrics were expanded from an initial set identified in the [Sustainability Outlook Indicator Descriptions and Methodology](#) (California Department of Water Resources 2018) and refined based on review of related performance tracking efforts in the CVFPP, Delta Adapts (Delta Stewardship Council 2021), Resilient California Adaptation Planning Map (Office of Policy and Research 2023), CalEnviroScreen (Office of Environmental Health Hazard Assessment 2021), Healthy Watersheds Partnership Assessment (Environmental Protection Agency 2013), and other programs.

DWR is developing, as part of the Watershed Resilience Program, a Watershed Hub performance tracking tool (Figure 5-3). The Watershed Hub will track indicators and metrics across water sectors by watershed. It will allow users to see the current risks and vulnerabilities within each watershed and track how adaptation strategies are improving resilience at the watershed scale across the state. Future releases of the Watershed Hub will provide watershed networks with the ability to upload their unique watershed data, including specific metrics and indicators, project data, and other useful information for their networks.

## Focus on Supporting Watershed Resilience

Figure 5-3 The Watershed Hub



### State Agency Alignment and Assistance

State government has a critical role in setting goals and standards and assisting local water resource managers to meet them with technical, financial, facilitation, and regulatory assistance. This State support includes the provision of the latest climate change science, technical and logistical support to conduct watershed resilience planning, and funding and regulatory assistance to implement adaptation strategies. A strong State role in supporting regional climate resilience and collaboration across watersheds is described in Governor Newsom's *Water Supply Strategy*.

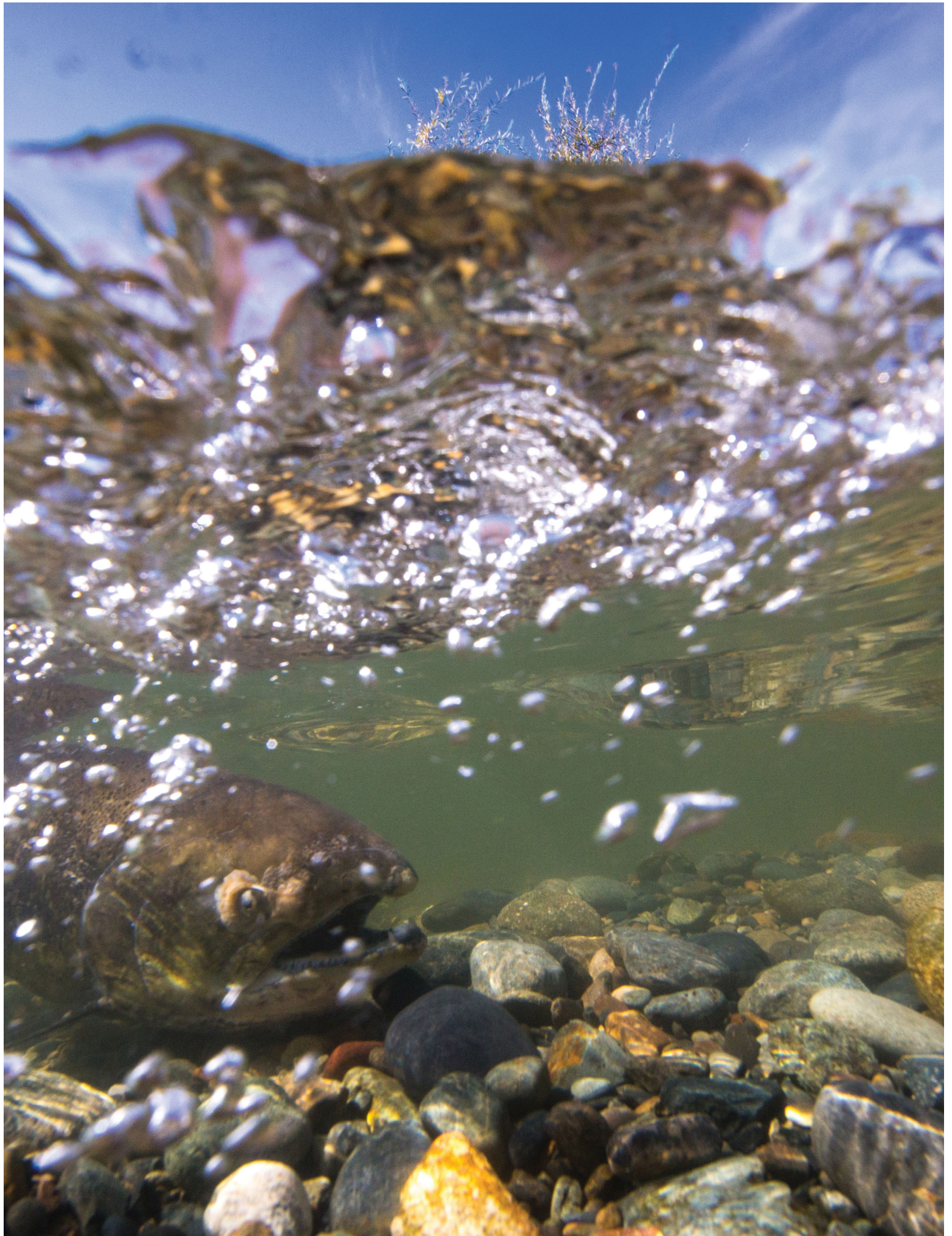
State agency alignment with support for, and participation in, watershed networks is critical for their success. Investment in these networks throughout California would serve to reinvest in the social infrastructure of relationships and trust that are essential to effectively adapt to climate change throughout a watershed. Coordinating State efforts around watersheds will help align State agency policies, plans, programs, regulations, and investments with the things needed for watershed networks to function optimally and succeed in their efforts.

Watershed networks can also serve as a forum to achieve the State's regulatory and policy goals. As articulated in the *Water Resilience Portfolio* and *Water Supply Strategy*, the State "must modernize regulatory structures and expand staff capacity so that State agencies can assess, permit, fund and implement projects at the pace this climate emergency warrants" (California Natural Resources Agency 2022).

State agencies administering regional- or watershed-scale programs should incorporate the watershed resilience principles in Update 2023 to facilitate more consistent and equitable approaches to climate vulnerability and adaptation planning and project implementation.

## Strategies and Recommendations for Moving Forward

This chapter describes the need for climate resilience planning at the watershed scale. It features case studies of watershed-based multi-sector collaboration throughout the State. It also describes a Watershed Resilience Program as an evolution of DWR's IRWM Program that would complement other climate resilience efforts from other State agencies. Achieving resilience in each of the state's diverse watersheds and investing in natural and built backbone infrastructure is essential to collectively build resilience for all of California. This focus on watershed resilience not only seeks to address climate urgency with multi-sector collaboration but also incorporates equity in promoting regional resilience through watershed networks. Objectives, recommendations, and actions related to watershed resilience are presented in Chapter 8, "Roadmap to Resilience."



# 6

## Understanding and Addressing Equity in the Management of California's Water Resources

### Introduction

In 2022, Governor Newsom committed to creating a “California for all” by signing Executive Order N-16-22 which directs state agencies to take critical actions on equity in all strategic plans and updates. *California Water Plan Update 2023* (Update 2023) seeks to embed equity in all its chapters and to create a path toward a California where access to clean, safe, and affordable water for all Californians is achieved. This chapter focuses on understanding the inequities that are present for **frontline communities** – those that experience the “first and worst” of environmental consequences – and how those inequities are revealed in California water management.

First, it must be acknowledged that many Californians experience social, economic, and health disadvantages based on race, gender, age, income level, language, physical or mental abilities, or any combination of those. Water management decisions performed separately from this reality underestimate a community's vulnerability to water shortages, degraded water quality, floods, and other **climate change** impacts. Understanding California's hydrology requires an expanded definition, one that accounts for the inequities that exist within society. Only through this integrated thinking can the process begin to achieve **water equity** for all Californians.

The California Water Plan (Water Plan) remains a reliable and consistent forum for assessment by holding space for a diverse set of partners to jointly examine, ideate, and chart a strategic path forward. This chapter builds upon this integrated watershed management approach, examining imbalances and inequities that affect quality of life

## Understanding and Addressing Equity in the Management of California’s Water Resources

outcomes. Specifically, progress is reviewed in the following categories:

- Access to safe, clean, and affordable drinking water.
- **Resilience** of frontline communities in the face of floods, drought, and other climate risks.
- Elimination of economic, social, and environmental barriers that prevent equitable outcomes within our water systems.

These categories do not reflect all inequities that may exist within the water management sector. These were prioritized for examination based on feedback provided by attendees at Water Plan workshops and State-hosted outreach events. Participants included a wide variety of non-governmental organizations, community-based organizations, academia, State, Tribal, and local representatives, local water agencies, and the public.

There are unique imbalances across different regions of the state that will require a customized strategy that is beyond the scope of this plan. This chapter seeks to discuss strategies and actions that will be applicable across all scales of water management as well as provide some guidance to areas of the state that are faced with significant injustices. As a permanent pillar of the Water Plan, equity will continue to be measured and expanded upon in future updates.

### Understanding Vulnerable Populations

California’s water is managed through a complex governance system – with overlapping and interdependent jurisdictions at the local, regional, and state levels. When taking into account the considerable variation in how each local authority allocates water, assesses rates, and mitigates risks (Dobbin and Fencil 2021), frontline communities are often left to navigate confusing and inconsistent governance systems and processes, making it difficult to actively participate as a decision-maker.

For some Californians, these barriers to participate are further exacerbated when exposed to one, if not all, of the following circumstances: poor water quality, an unsustainable water source, or unaffordable water rates (State Water Resources Control Board 2022a). Understanding existing social structures is crucial to ensuring equitable water management and community resilience. For instance, the top 10 percent of least-polluted neighborhoods are 67 percent White, and the top 10 percent of most-polluted neighborhoods are 90 percent communities of color. Recognizing these environmental disparities, brings validation and urgency to the vision that all people in California are healthy, financially stable, and safe (Office of Environmental Health Hazard Assessment 2021).

### Defining Vulnerability

Water challenges can affect various populations in disproportionate and different ways based on characteristics that have been identified as socially vulnerable populations. These social characteristics include children and the elderly, people of color, economically

## Understanding and Addressing Equity in the Management of California’s Water Resources

disadvantaged residents, those with limited English proficiency, among others (California Office of Emergency Services 2020a). With one or more of these characteristics present, some communities may be more vulnerable to undesirable living conditions, such as air or water pollution and infrastructure underinvestment. These communities may also be less able to recover from natural disasters (U.S. Environmental Protection Agency 2021). There may be intersections and overlaps between these communities and populations, further increasing an individual, household, or community’s burden of water inequities.

Given the historic exclusion of some community voices from policy- and decision-making, many residents continue to be exposed to economic, environmental, and health burdens, resulting in reduced social and economic well-being. It is well documented that the legacy practice of **redlining** has deliberately isolated residents to neighborhoods that were deemed undesirable. When federal and local governments, as well as financial entities, “systematically denied public and private financial services to Black and other people of color,” these communities were faced with negative mental and physical health impacts (Lynch, et al 2021). This has led to long-term isolation from private and public investment, resulting in food deserts and less greenspaces (Nardone, et al. 2020).

Exclusionary practices like these have also led to the marginalization of Californians across generations who remain disproportionately exposed to greater burdens. Among other factors of inequities in affordability discussed in this chapter, housing discrimination has been practiced implicitly, and at times, explicitly, in the United States since the 1930s. For example, overt racial language was included in early editions of the *Federal Housing Administration’s Underwriting Manual*. Although this language was discontinued in 1947, the tactic of keeping people of color and environmentally hazardous land uses, out of white neighborhoods, continued without direct mention of race (California Environmental Protection Agency 2021).

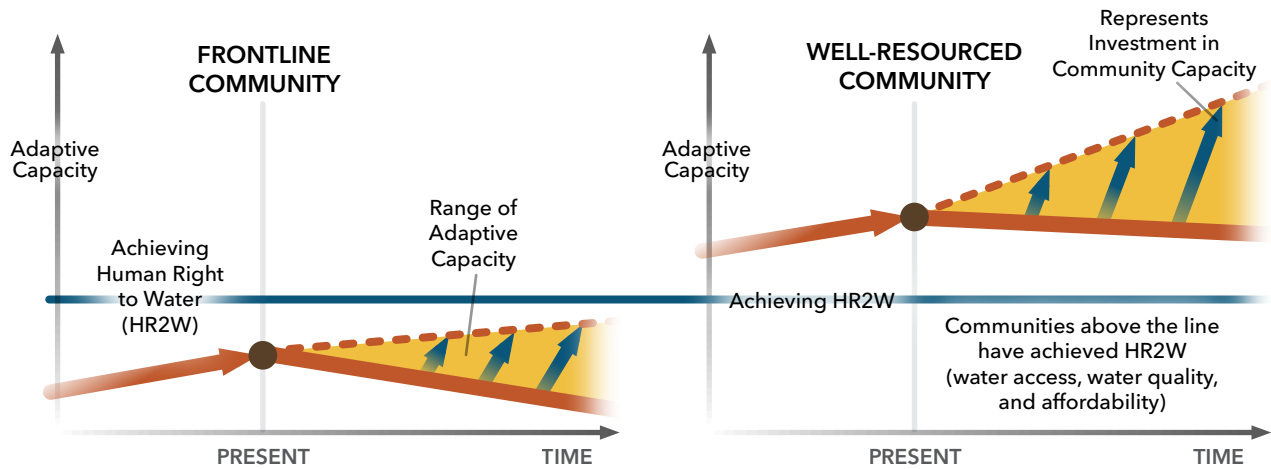
While various definitions for Californians experiencing social vulnerability exist, Update 2023 uses the term “frontline communities” in discussing inequities in water management.

**Frontline communities** are those that experience the “first and worst” of environmental consequences – in other words, these communities are already living with the negative impacts of inequities in water management and are the most susceptible to future negative changes (California Office of Emergency Services 2020b). These residents are more exposed to existing water sector vulnerabilities (e.g., water shortages, water quality issues, or affordability challenges) and future ones, such as the impacts of climate change. To adapt to such change and mitigate negative outcomes for all Californians vulnerable to water challenges, addressing current inequities in these frontline communities will be crucial in future planning and management efforts (Portner et al. 2022).

Figure 6-1 illustrates the fundamental disparity between a frontline community and a well-resourced community. Many frontline communities remain below the minimum threshold that states all Californians have a right to access clean, safe, and affordable water. In the future, where a variety of climate scenarios is predicted, the anticipated range or ability to

adapt to weather extremes is limited as compared to more affluent counterparts. Without continued investment, the ability to adapt to future vulnerabilities will decline.

**Figure 6-1 Improve Frontline Community Adaptation to Future Conditions**



### Measuring Vulnerability

Assessing the inequitable impacts of California water management is intricately linked to understanding a community’s vulnerability. Vulnerability describes the degree to which a system (e.g., natural, built, or human) is susceptible to adverse change or harm (Governor’s Office of Planning and Research 2018). Vulnerability can be measured by these four components (California Office of Emergency Services 2020c):

- Exposure: the extent a system is subject to harm.
- Sensitivity: the extent a system will be affected.
- Risk: potential impacts to a system.
- Adaptive capacity: ability to adjust to change.

### Case Study: Small Community with a Limited Water Supply Located in an Arid Region

The following vulnerability example is presented as a hypothetical community. In this example, a small rural community (less than 1,000 persons) is in an agricultural region of California and has a single 200-foot-deep groundwater well as its sole source of water supply. Of the community’s population, 25 percent is at least 65 years old, while 40 percent of the population speak a language other than English at home. At an average household size of 2.92 people (U. S. Census Bureau 2022a), the median household income is \$27,500, well below the California’s median household income of \$84,097 (2021 dollars).

Assessing this community’s exposure, sensitivity, and risk, as well as its adaptative capacity to respond, and its total vulnerability to extended drought is presented in Figure 6-2.



Figure 6-2 Measuring Vulnerability

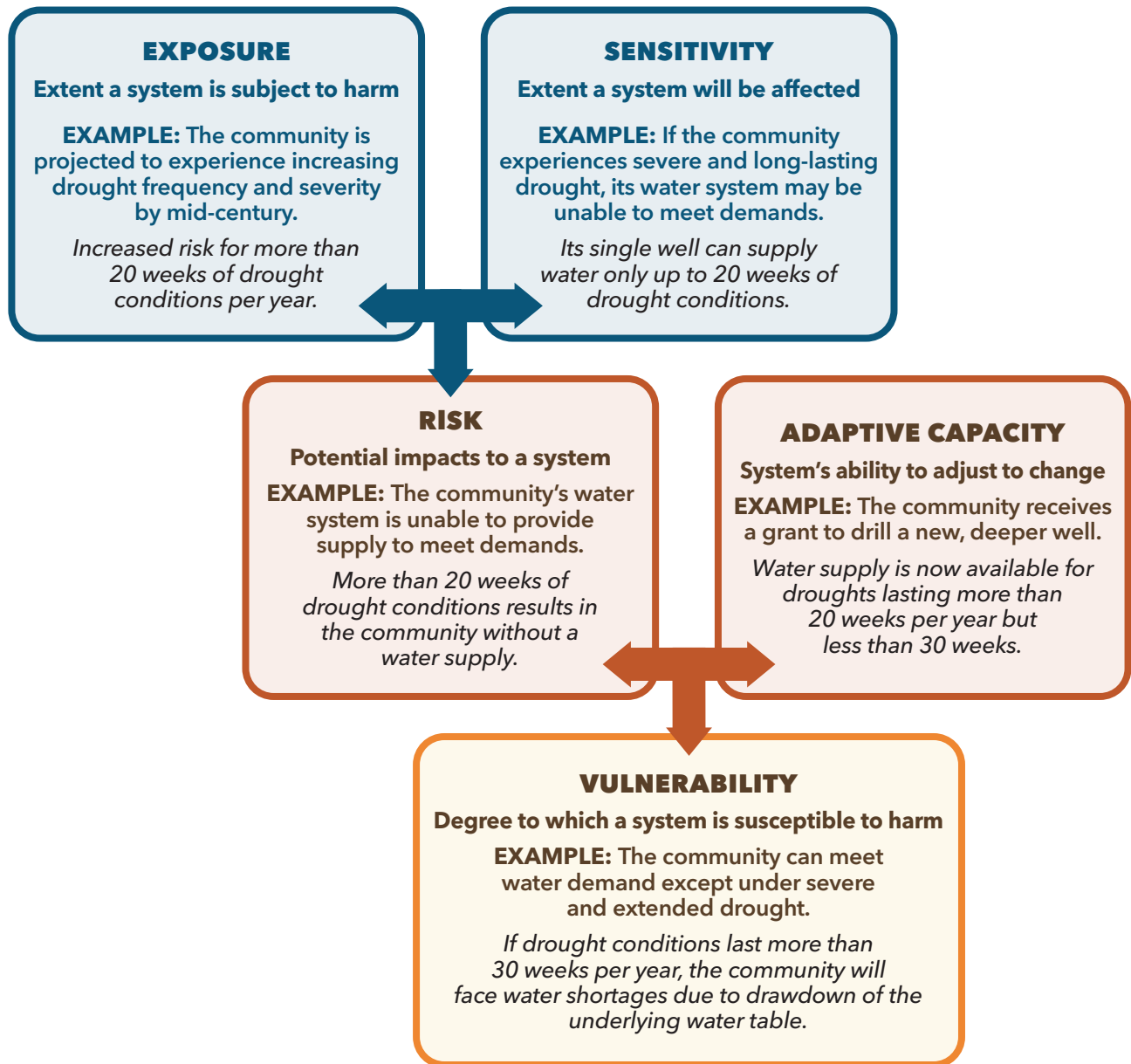


Figure 6-2 Note: Chart adapted from the California Adaptation Planning Guide, Figure 10.

### Adapting to Vulnerabilities

**Adaptation** to existing and future water sector risks is centered on building system resilience. Resilience is the ability of the system to cope with change while maintaining its intended function or previous capacity (Portner et al. 2022). Especially for frontline communities, addressing existing inequities such as societal or institutional barriers are necessary to ensure sufficient adaptation and community resilience. The inclusion of all participants and perspectives in water sector planning and management can yield wider benefits beyond infrastructure that:

- Provides safe, secure, and affordable water.
- Supports equitable water management and fosters community well-being.
- Builds community commitment and participation.
- Reduces long-term vulnerability, especially under the effects of climate change.

This framework of measuring vulnerability could be applied to any community experiencing water management challenges to ensure equitable and resilient water systems. For those communities with little adaptive capacity, there is a need for external support (e.g., State and federal) with technical and financial assistance to improve their role in governance and economic position.

### Understanding Water Inequities in Domestic Use

Grounding equity assessments in quality-of-life outcomes ensures human rights are secured and protected for all Californians. Reviewing the current status with a lens to raise the standards of practice across local, State, and federal agencies is critical to understanding the inequities in water management.

Drinking water comes from precipitation and then is extracted from a variety of sources, depending on where people reside. Some receive their water from groundwater, others receive surface water from streams and rivers. Urban areas rely heavily on municipalities to provide treatment to water sources and operate public water systems, while rural areas can receive water from individual domestic wells, with little to no treatment, and from small, public community wells operated and maintained by local water districts. In this chapter, water systems are categorized as private domestic well users, small water systems, and urban water systems. All community drinking water systems serving more than 15 connections are regulated by the State Water Board's Division of Drinking Water, under State and federal drinking water laws and regulations.

There are several additional inequities that exist across water management, such as access to recreation and safeguarding food for human consumption, that warrant additional dialogue and investigation in future updates to the Water Plan. For the purposes of this section, water inequities for frontline communities will be focused on domestic use.

### Inequities in Water Access

For more than 95 percent of Californians, safe, reliable, and affordable water is perceived to be a daily guarantee, but for approximately 1 million Californians, there is a persistent struggle to access water fit for human consumption. In 2022, approximately 1,500 domestic wells were reported dry throughout California (California Department of Water Resources 2023b). Assuming an average household size of 2.92 persons (U. S. Census Bureau 2022a), at least 4,300 people supplied by domestic wells were potentially left without water in 2022. Limited access to water poses an economic burden to households as they may have to purchase bottled water and costly hauled water. These costly and limited water supplies can impair daily activities such as bathing and cooking. This may result in negative hygiene and sanitation practices which in turn leads to the spread of infectious diseases.

According to data from the [2023 Drinking Water Needs Assessment](#) (State Water Resources Control Board 2022b), 85 percent of California's regulated community water systems, serving approximately 3.1 million people, are considered small water systems (less than 3,300 connections). Small water systems are at higher risk of having less access to safe and reliable water resources and face many challenges to consolidate with larger and more reliable nearby water systems. Consolidation challenges are mainly caused by:

- Being in remote locations where connections to larger systems are not available.
- Limited or no adaptive capacity to manage their water resources.
- A larger system's unwillingness to consolidate.

All water system access improvements, whether drilling a new well, providing treatment for contaminated or lower water quality, consolidation of a water system, or lowering of an intake structure, require large sums of money upfront plus ongoing revenue to operate and maintain. Depending on the size of the public water system, drilling and equipping a new well can cost more than \$2 million according to the State Board's Division of Drinking Water. Water system consolidations have high costs that vary depending on the distance to the nearby water system. For example, based on an average of recent cost estimates reviewed under a California Department of Water Resources (DWR) grant program, the cost to consolidate two water systems that are 1 mile apart will cost a minimum of \$1 million. In addition to cost considerations, the average time it takes to consolidate can range between five and six years. Although cost and implementation timelines continue to be a challenge to address, significant progress has been made. Since 2019, consolidations have accelerated within the State Water Board's Safe and Affordable Funding for Equity and Resilience (SAFER) Program, with more than 100 consolidations benefiting 89,000 people completed in the past four years. Another 253 consolidation projects are in process.

Individual well owners who do not rely on a public water system face similar financial vulnerabilities. In the current California market, because of the high demand for well drillers, the average price of drilling a domestic well is approximately \$80,000, which is a large price to pay relative to the median household income of \$84,097 in California

## Understanding and Addressing Equity in the Management of California’s Water Resources

(U.S. Census Bureau 2022b). According to the SAFER program, as of December 2022, approximately 1,800 households in the Central Valley depended on hauled and bottled water, with as many as 60 new households signing up for the program every month (State Water Resources Control Board and California Department of Water Resources 2023). Small water systems often do not have a lot of cash reserves and may have to increase rates on the end users, something that is not feasible for many water users, as they already have water bills they cannot afford.

### Inequities in Water Quality

For many residents of California, access to safe drinking water is an ongoing struggle. Inequities in water quality stem from (1) reliance on public water systems and domestic well sources that are at risk of not providing safe drinking water, (2) residing near locations that have been polluted or contaminated by other parties, or (3) experiencing challenges in technical knowledge and lack of funding to perform local system operations and maintenance.

The State Water Resources Control Board’s (State Water Board) Drinking Water Needs Assessment Dashboard shows up-to-date risk status of public water systems throughout California (State Water Resources Control Board 2023). As of August 2023, results show that 1,397 public water systems (i.e., non-private wells), serving approximately 8.2 million residents of California, relied on drinking water that exceeded one or more of the identified water quality risk indicator thresholds. For example, the assessment may indicate increasing trends toward a maximum contaminant level. According to the State Water Board’s 2023 Risk Assessment Dashboard – State Small Water Systems and Domestic Wells, almost 700 of the 845 state small water systems were either failing to meet drinking water quality standards or were at risk of failing (State Water Resources Control Board 2023a). Estimates in the 2023 Drinking Water Needs Assessment indicate that approximately 82,000 (30 percent) of known domestic wells are at-risk, based on modeled water quality, water supply, and socioeconomic parameters.

Domestic well water is typically used by single family homeowners for private use and consumption, often in rural areas. Approximately 100,000 domestic wells are either failing to meet drinking water quality standards or are at risk of failing. The State does not regulate domestic well water quality (State Water Resources Control Board 2023a), and as a result, it is the responsibility of well owners to ensure that their domestic well water is safe. Basic sampling of well water to measure its water quality safety can cost from \$100 to \$400. Hiring an outside business to sample and interpret the results of the sampling will likely cost more (State Water Resources Control Board 2023b).

Water can become contaminated or polluted, which may be from naturally occurring processes such as mineral degradation, or human-made and the result of the influence or activities of people (U.S. Environmental Protection Agency 1999). Surface and groundwater sources of drinking water are vulnerable to these situations. Some communities experience polluted waters because of living near pollution sources such as landfills, agricultural runoff, and mining activities, that leach chemicals into the groundwater. Often, these communities

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cannot afford to treat polluted water sources or relocate to an area with less pollution (e.g., because of housing discrimination practices). According to the CalEnviroScreen 4.0 Report released in 2021, “[s]egregation, redlining, and discriminatory land use, permitting and enforcement practices resulted in industrial facilities, landfills, ports and railyards, and high pesticide use clustered around low-income communities of color. Continued discriminatory practices, inequities in decision-making, disinvestment, poverty, and other socioeconomic factors magnify the effects of pollution on these communities.” (August et al. 2021). These and other discriminatory practices have resulted in a disproportionate burden of pollution and poor water quality on frontline communities, Tribes, and people of color. Exposure to impaired drinking water can have negative or even deadly health implications for a community, household, or individual. If drinking water contains unsafe levels of certain elements, it can cause health effects such as gastrointestinal illnesses, and can lead to long-term health outcomes, such as nervous system impacts, and elevated risk of cancer or birth defects. (U.S. Environmental Protection Agency 2023)

### Community Insight: California State Legislator

“California’s disadvantaged and black and brown communities continue to deal with unacceptable and dramatic levels of water pollution. The sad truth is, 50 years after the enactment of the Clean Water Act, we simply have not taken pollution in disadvantaged communities as seriously as in affluent areas. In the Central Coast District I (Robert Rivas) represent – which is more than 60 percent people of color – 160 miles of the Salinas River remain polluted. Overapplication of nitrate-heavy fertilizer and toxic pesticides have leached into the groundwater, contaminating the drinking water for a quarter of a million Californians.” (Rivas 2022)

Given the size of communities that rely on small water systems, there are generally limited resources to apply for grant funding and insufficient technical expertise for water treatment and operations and maintenance of these systems. When there are opportunities for funding, many frontline communities do not have the resources to hire grant writers to apply for State and federal funding, which makes the process to apply and oversee awarded funding very difficult without additional support. Additionally, most State grant opportunities do not provide funding for training, supplies, or the general costs of ongoing system operations and maintenance.

Without ongoing funding, local expertise, or the resources to outsource the necessary technical skills and know-how, these communities are unable to operate and maintain treatment systems to ensure good water quality for drinking, bathing, and cooking. The SAFER Program, administered through the State Water Board seeks to reduce many of these barriers by proactively finding and addressing drinking water system issues. The SAFER Program focuses on community and water system engagement and provision of resources including technical assistance, funding planning, construction, operations, and maintenance assistance.

### Inequities in Climate Change Impacts

Climate change affects all of California's natural and built systems – the state's temperatures are already warming, with increasing extreme heat events, wildfire frequency, rising sea levels, and more variable precipitation swings, including more frequent and intense shifts between wet and dry extremes stressing current and future water management.

While the impacts of worsening extreme drought and flood conditions, sea level rise, and wildfire risk affect all Californians, frontline communities (including unhoused residents, the elderly, children, agricultural workers, and rural residents) are disproportionately affected. Climate change poses an additional peril in which some frontline communities will be unable to protect themselves, evade these rapid shifts, or rebound from the personal and economic aftermath of impacts. This can be attributed to a lack of resources, local infrastructure, and regulation or to lower adaptive capacity resulting from various factors including geographic location, historic injustices, or a combination of these and other factors.

#### Extreme Shifts for Frontline Californians

By the end of 2022, California had been experiencing a third year of extreme drought, affecting the Tulare Lake Hydrologic Region in the southern San Joaquin Valley particularly hard. For several frontline communities in this region dry wells, worsened water quality, and for some, increasingly unaffordable options such as drilling a new well were issues to contend with. Furthermore, many residents working in the agricultural sector were dealing with the resulting economic hardships.

The winter into 2023 saw record snowfall in the surrounding Sierra Nevada Mountain **watersheds** and several large **atmospheric rivers** further affected this region of the state, leading to flooding, in some cases, severe flooding for frontline communities. This sudden shift from extreme dry to extreme wet (**weather whiplash**) resulted in some communities experiencing huge personal and financial losses as flood waters rose, along with concerns on water quality impacts, and the economic uncertainty as the once dry Tulare lakebed refilled over miles of highly productive agricultural lands that employed many residents (CalMatters 2023). While these communities work to recover from these impacts, with State support and resources, such experiences highlight the challenges such communities will face as the century progresses.

### Inequities in Drought Impacts

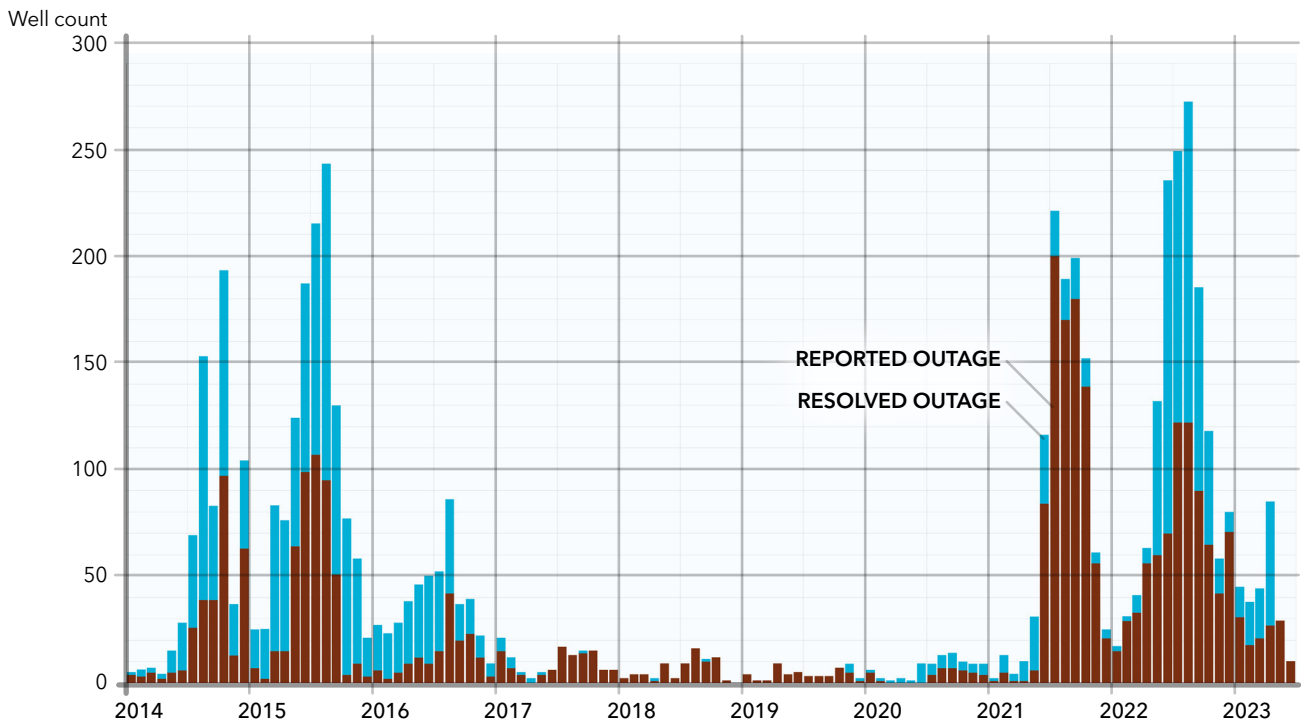
Droughts are happening at greater frequency and magnitude than ever before. For some communities, there are greater vulnerabilities to drought because of their reliance on limited water sources, geographic location, socioeconomic status, and proximity to large farming operations or other large industrial water users. Drought poses many far-reaching health implications when there is not enough water available to dilute existing

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contaminants. An increased concentration of pollutants may lead to increased risk of infectious disease (Centers for Disease Control and Prevention 2020). In California, 1,098 small water systems serving approximately 440,796 people do not have water system redundancy; that is, they rely on a single source of water, such as a single well. Having only one source, without a second or backup source, increases their vulnerability to drought conditions. Additionally, 2,171 small water systems have only a single type of water resource, such as groundwater or surface water, which potentially makes them more vulnerable (California Department of Water Resources 2021b). These vulnerabilities are in large part because of their geographic location. As an example, communities located in non-basin areas, which are defined as any area outside of a defined groundwater basin or subbasin, are at a higher risk of decreasing groundwater levels and water shortage vulnerabilities. According to DWR's *California's Groundwater Update 2020* (California Department of Water Resources 2020), "many residents in the non-basin areas rely on private groundwater wells as their primary source of water. In non-basin areas 90 percent of wells are domestic wells, making the non-basin area residents more susceptible to drinking water shortage during dry periods. Among the small water suppliers and self-supplied communities in the state that are at a high risk of drought and water shortage vulnerability, 68 percent are in non-basin areas."

From August 2021 to September 2022, more than 1,050 wells were reported to the State as "dry." When looking at news reports and requests for aid across the state, it is suspected that many communities underreport their dry wells to the State's voluntary dry well reporting system. The 2023 Drinking Water Needs Assessment estimates that approximately 100,000 domestic wells are at risk of water shortage. This is also very likely to be a significant underestimate, as it is based only on known domestic well locations. Unfortunately, underreporting leads to an inaccurate reflection of actual need for funding and assistance the State can provide. A significant number of State and federal programs appropriate their funding based on data reported by the end user.

**Figure 6-3 Reported Number of Dry Wells**



Many small communities located in the Central Valley are close to large commercial water users (e.g., farming operations and industrial water users). In severe drought conditions where the water table is lowering at an unprecedented rate, these communities are often affected first. In one study, between January 2018 and March 2021, the fossil fuel sector (an industrial water user) used more than 3 billion gallons of freshwater for drilling operations. To put this in perspective, this is the equivalent of 120 million showers for California households. At the same time, fossil fuel operations have polluted California’s aquifers with dirty wastewater (FracTracker Alliance 2021).

**Inequities in Flood Impacts**

Approximately 1 in 5 Californians live in an area that is at risk of flooding (California Department of Water Resources 2023c). Flooding can lead to greater contamination of water resources, as well as pose risk of injuries or drowning, and increase spread of communicable or infectious diseases because of mold or greater concentrations of viruses, bacteria, and protozoa in water supplies. The State acknowledged in the [Central Valley Flood Protection Plan Update 2022](#) that historic flood management policies and investments have contributed to inequities, resulting in a disproportionate risk of flooding for some frontline communities.

A recent example of this disparity played out during the March 2023 storm events when a federally constructed levee broke and flooded the town of Pajaro, a frontline community that for decades has sought funding to improve the levee that protects the town. Prior to the levee break, the levee provided an 8-year level of protection, which is among the lowest of any federal flood control system in California. A project to improve the levee to a 100-year



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level of protection was federally authorized in 1966 only to be followed by six decades of unsuccessful attempts to justify federal investment in the project.

The U.S. Army Corps of Engineers (USACE) uses a benefit-to-cost ratio (BCR) to determine which flood-risk-reduction projects are eligible for federal cost-shares. The current BCR calculations undervalues vulnerable communities, which may be rural with small populations or dense populations with lower property and infrastructure values. These lower values equate to lower BCRs and reduce the likelihood of federal investment for important flood risk reduction projects in these communities. Over time, this has left many frontline communities without the same level of flood protection as more wealthy communities that have higher property and infrastructure values. In the case of Pajaro, low property values resulted in a low BCR.

The State has advocated that the BCR calculations used by the USACE should be adjusted to be more equitable. Monetizing life safety in these communities can provide an equalizing effect in BCR calculations. Other federal agencies have monetized life safety for decision purposes. For example, in 2020, the Federal Emergency Management Agency (FEMA) established an equivalent value of a life at \$7.5 million.

In addition, the amount of the local cost-share proved prohibitive for the Pajaro levee improvement project. The estimated total project cost is \$544 million with a non-federal share of more than \$190 million. The local agency could not afford the local cost-share and worked with the California Legislature to pass Senate Bill 496 (2001). This bill amended the California Water Code to allow the State to cover 100 percent of the non-federal share under the Flood Control Subventions Program. Without this exception, the State could only share up to 70 percent of the non-federal share.

Many frontline communities have trouble meeting local cost-share requirements. Notably, FEMA increased the maximum federal cost-share for 2020 and 2021 disaster Hazard Mitigation Grant projects from 75 percent to 90 percent but has not indicated this increase will be permanent. Local cost-shares typically exceed what many frontline communities can afford, preventing them from applying for these funds.

Although the federal Infrastructure Investment and Jobs Act of 2022 provided initial funding for the construction of the Pajaro levee improvement project in spring 2023 that would help advance this effort, there was not enough time to prevent the damage caused by the 2023 winter storms.

Pajaro illustrates how difficult it is for frontline communities, particularly in rural areas and small communities, to access funding opportunities because of lack of financial means, staffing, and expertise to conceptualize flood risk reduction projects, and completing complex and expensive grant applications. Rural areas are typically represented by their county planning and public works departments, and many small communities also rely on the county resources to initiate the initial conceptualization and refinement of flood risk reduction projects. In many of these communities, professional engineers and scientists are part-time contractors who cannot adequately support the lengthy engagement needed in early project development and advocacy.

### Systemic Challenges

Systemic challenges are deeply embedded in governance structures, policies, laws, practices, and beliefs that prevent progress toward equitable outcomes. Systemic challenges exist within and beyond the water management sector and cannot be resolved in isolation. Challenges such as education and income disparity, degrading air quality, or meeting public health standards are a shared responsibility that require a collective commitment to resolve.

The topics in this section are not a comprehensive list of all systemic challenges that exist within society. Instead, this section offers the beginning of an important collective dialogue that must start within water management and then broaden to multi-sector partnership and commitment.

### Environmental Justice

**Environmental justice** is defined by California statute as “the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of all environmental laws, regulations, and policies.” (Government Code Section 65040.12[e]). Throughout California’s history, there have been many prominent examples of environmental racism (disproportionate environmental burdens on communities of color and other marginalized peoples), including air quality and habitat degradation in and around the Salton Sea, and declining fish populations and water quality with the construction of Klamath Dam.

From 2016 through 2020, the California Environmental Justice Alliance released annual agency assessments of how California State agencies develop, implement, and monitor environmentally related policies that affect low-income communities and communities of color (California Environmental Justice Alliance 2023). During the global pandemic, the 2020 assessment reported an overall decline in agency performance for frontline communities. Agency performance was measured across a number of principles, including impacts to human well-being, respecting community expertise, and meaningful community engagement.

### Affordability

The cost of water is rising at a rate that many Californians are not able to afford, as discussed in sections above. Recent estimates report 1 in 10 California households are falling into arrears on their water payments (Pineda 2022). In addition, there is significant variation in the average water bills paid by urban water system consumers, with 22 percent of consumers paying less than \$40 compared to 21 percent paying more than \$81 (Chappelle and Hanak 2021). With some consumers paying more than double, and sometimes triple, the amount of the lowest average water bill, equitable distribution of water costs comes into question.

In 2022, the State Water Board conducted a drinking water affordability assessment of 2,868 water systems, not including small water systems and domestic wells, to identify

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frontline community water systems that have instituted customer charges that exceed the “affordability threshold.” Exceeding the affordability threshold takes into consideration a customer’s water bill relative to median income and average statewide costs, as well as arrearage occurrences. The State Water Board concluded 555 of 1,408 (39 percent) disadvantaged or severely disadvantaged water systems exceed the affordability threshold (California State Water Resources Control Board 2022c). During periods of extended drought, water supply costs to the consumer may further rise because of:

- Need to purchase new or temporary water supply sources.
- Infrastructure modifications (e.g., drilling new wells, consolidation, lowering of intake structures, installation of treatment plant).

It has been more challenging for public water agencies to assist low-income customers with their water bills with the passage of Proposition 218 (1996), which requires water rates to be aligned with the cost of service. To develop an assistance program, public agencies would have to use non-rate revenue (e.g., property taxes) or seek approval of new taxes by two-thirds of local voters. This institutional barrier prevents public water agencies from directly creating water rate assistance programs for their low-income customers. Additional data need to be collected on small water systems and private domestic wells to better inform assistance program development and policy action related to water affordability.

### Community Insight: San Fernando Valley

“[...] one of the bigger challenges is equitable distribution of resources. Every community, especially affluent communities, get competitive when resources become available and typically those affluent communities have more resources to be more competitive for these monies and that creates the cycle of the highest need communities getting the scraps of resources. We need to change that dynamic. It needs to be a conversation about the highest need communities getting first dibs on these resources because of the historic disinvestment of these communities. It shouldn’t really be a competition. The bottom line is these communities have carried the burden of fossil fuels and redlining, all these policies that have had a negative impact on our communities based on racism a lot of times and that needs to be made right.” (Ramirez 2021)

### Outreach and Engagement

Building authentic and meaningful relationships with communities is critical to advance water management planning and actions. But there are many instances where outreach and engagement efforts to affected communities falls short. Communities and non-governmental organizations have reported that many State outreach strategies are not accessible to diverse populations, including the following:

- Inconvenient meeting times offered for working members of the public.

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- Public meetings that do not provide multiple options (e.g., in-person or virtual) to participate.
- No or limited language services support.
- Public meetings are scheduled with little advance notice.

And beyond providing the fundamental access to participate, there is also an equity gap in water policy when it comes to community-driven outcomes. There needs to be universal acceptance that the expertise of community members' lived experiences is essential to all government planning, design, and implementation decisions that affect their community.

### Community Insight: Cuyama Valley

"I have lived in the Cuyama Valley for six years. I am an artist and teacher with a scientific background, concern for the environment and the people of the Cuyama Valley. I have attended the GSA (groundwater sustainability agency) meetings since the beginning of the process begun by SGMA [(the) Sustainable Groundwater Management Act]. I also attended Waterboard meetings; but then I found the Stakeholders (Standing) Advisory Committee meetings more informative. I have attended them regularly. They represent those in the community most interested in sustainable water use. It has no vote in the GSA. Interestingly, the GSA never accepted ANY of the SAC's suggestions, except technical corrections, i.e., spelling, etc. in the writing of the [groundwater sustainability plan] GSP." (Blackshear 2022)

### Representation and Participation

In California, water management decisions are largely made at the local level through statutorily created "water special districts." These districts are often responsible for water delivery, waste disposal (sanitation), flood control, and water conservation. With 1,286 water special districts in California, there is great variation in services delivered, governance structures, and financing mechanisms that affect their level of influence on a community (Cohen 2002). Elections for positions on these boards, especially for smaller districts, go uncontested for significant periods of time. For example, in November 2020, Omochumne-Hartnell Water District held its first board member election in 43 years (Armstrong 2019). Furthermore, 87 percent of local water boards in the southern San Joaquin Valley had not held an election between 2014 and 2018 (Nájera A. and Paxton A. 2020). Uncontested positions limit the level of public discourse that is expected within a democratic system. Given the various approaches to local water special districts, it may be difficult for the public to understand and participate in the services provided.

Nearly 1.5 million Californians rely on domestic wells and one-third of community water systems rely on only one well for drinking water and other potable uses. As discussed

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above, such circumstances can leave many Californians with dry wells and few options for identifying alternative water sources. The drinking water needs of these communities historically have not been prioritized, in part because members of these communities have sometimes been excluded from decision-making roles or other forms of participation based on land tenure, well permitting, property size, race, language, economic status, or other factors.

In several water-related statutes and grant programs, there are opportunities for representation for **California Tribes** and marginalized populations. For example, the Sustainable Groundwater Management Act (SGMA) states, "The federal government or any federally recognized Indian Tribe, appreciating the shared interest in assuring the **sustainability** of groundwater resources, may voluntarily agree to participate in the preparation or administration of a groundwater sustainability plan or groundwater management plan under this part through a joint powers authority or other agreement with local agencies in the basin." (Water Code Section 10720.3[c]).

There have been documented issues, which have also been discussed during meetings and government-to-government consultations between DWR and Tribes that show limited meaningful engagement at the local level, such as:

- Offering one community or Tribal seat on a groundwater sustainability agency board when there are many Tribes and diverse populations in the region.
- Requesting community or Tribal "buy off" on a grant-funded project when they have not been involved in planning efforts.
- Exclusion of Tribal projects in regional funding grant allotments.

### **California Native American Tribe Insight: Big Valley Band of Pomo Indians**

"Another tribal nation in the Clear Lake watershed, the Scotts Valley Band of Pomo Indians, expressed interest to be on the committee but were passed over as members of the committee while both the [disadvantaged community] DAC and environmental seats were open. They would have been able to represent either perspective well as underrepresented peoples who engage in Tribal traditional uses which rely on ground and surface water." (Ryan 2022)

## **State Efforts to Advance Water Equity**

Since the release of *California Water Plan Update 2018*, there have been new actions to embed **racial equity** and environmental justice principles, policies, and best practices into State government work. This deepening commitment to equity is an acknowledgement that current institutional government systems and programs may not be serving to benefit all Californians. Tables 6-1 through 6-5 include examples that demonstrate a growing dedication to increase State capacity and improve institutional culture to be responsive

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to the needs of all Californians. This is not an exhaustive list of all planning, technical, educational, and financial assistance or State support for equity in water management.

**Table 6-1** Legislation, Executive Orders, and State Strategy Actions

| <b>Program (2018-Present)</b>  | <b>A</b> | <b>Q</b> | <b>C</b> | <b>D</b> | <b>F</b> |
|--|----------|----------|----------|----------|----------|
| <b><i>Assembly Bill (AB) 1668 (2018)</i></b> : directs DWR to (1) Identify small suppliers and rural communities at risk of drought and water shortage vulnerability and (2) Develop recommendations for improving drought contingency planning for those areas. Directs State Water Board to adopt standards.   | X        | X        | X        | X        | -        |
| <b><i>Executive Order N-82-20 (2020)</i></b> : expands equitable outdoor access, advances “equity and opportunity for all regions of California” and informs policies through extensive outreach and equitable engagement.   | X        | -        | X        | X        | X        |
| <b><i>Water Resilience Portfolio (2020)</i></b> : provides a roadmap for building water resilience through a portfolio of various goals and actions, including helping local agencies achieve reliable access to safe and affordable water.  | X        | X        | X        | X        | X        |
| <b><i>Executive Order N-16-22 (2022)</i></b> : requires State agencies to submit a plan to “meaningfully engage” with Tribal governments, nonprofits, and other community organizations to increase access to infrastructure investment; update strategic plans to more effectively advance equity and to respond to identified disparities with changes to the organization’s mission, vision, goals, data tools, policies, programs, operations, community engagement, Tribal consultation policies and practices, and other actions as necessary to serve all Californians. | X        | X        | X        | X        | X        |
| <b><i>AB 923 (2021)</i></b> : requires the development of government-to-government consultation training and encourages State agencies to seek meaningful input from Tribes on policies, programs, and projects that may affect Tribes.  | X        | X        | X        | X        | X        |
| <b><i>California’s Water Supply Strategy (2022)</i></b> : lays out strategies and priority actions to adapt the state’s water resources for a changing climate. It emphasizes the need to modernize the state’s water rights for more equitable and flexible management.   | X        | -        | X        | X        | X        |
| <b><i>Executive Order N-7-22 (2022)</i></b> : seeks to protect domestic and shallow wells from going dry by restricting new groundwater well permits, directing DWR to assist small community water systems with dry wells, and requiring state agencies to collaborate with Tribes.   | X        | -        | -        | X        | -        |

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| <b>Program (2018-Present)</b>   | <b>A</b> | <b>Q</b> | <b>C</b> | <b>D</b> | <b>F</b> |
|---|----------|----------|----------|----------|----------|
| <b><u>AB 1384 (2022)</u></b> : requires the State’s Safeguarding California Plan to prioritize equity and ensure that climate change adaptation efforts prioritize protecting vulnerable communities, rectifying intersectional and systemic inequities, and enhancing low-income and vulnerable communities’ abilities to weather the impacts of climate change. | -        | -        | X        | -        | -        |
| <b><u>AB 2108 (2022)</u></b> : requires the State Water Board to perform outreach to identify environmental issues early in waste discharge permit applications.  | -        | X        | -        | -        | -        |
| <b><u>2022 Central Valley Flood Protection Plan Update</u></b> : recognizes that socially vulnerable populations often face disproportionate flood risk and establishes initial recommendations to reduce inequities in flood management.   | -        | -        | -        | -        | X        |

*Table 6-1 Notes: A = water access, Q = water quality, C = climate change, D = drought, and F = flood  
Not all statewide laws, mandates, orders, or actions are specific to water. If not specifically described, DWR assumes general actions included in this table apply to agencies administering water-related programs and regulations.*

**Table 6-2** State Agency JEDI/DEI Guidance, Policies, and Actions

| <b>Program (2018-Present)</b>  | <b>A</b> | <b>Q</b> | <b>C</b> | <b>D</b> | <b>F</b> |
|--|----------|----------|----------|----------|----------|
| <u><a href="#">State Water Board’s Human Right to Water Resolution No. 2016-0010 (2016)</a></u> and <u><a href="#">DWR’s Human Right to Water Policy (2019)</a></u> : adopts the human right to water as a core value and directs its implementation in programs and activities.   | X        | X        | -        | -        | -        |
| <u><a href="#">California Coastal Commission’s Environmental Justice Policy (2019)</a></u> : implements its environmental justice authority and integrates the principles of environmental justice, equality, and social equity into all aspects of the commission’s program and operations.   | -        | -        | X        | -        | -        |
| <u><a href="#">Recommendations for Implementation of a Statewide Low-Income Water Rate Assistance Program (2020)</a></u> : report submitted to the Legislature by the State Water Board on its findings regarding the feasibility, financial stability, and desired structure of the program, including any recommendations for legislative action.  | X        | -        | -        | -        | -        |
| <u><a href="#">Strategic Growth Council’s Technical Assistance Guidance for State Agencies (2020)</a></u> and <u><a href="#">Racial Equity Resource Hub (2022)</a></u> : best practices and public hub to help State agencies evaluate options, make key decisions, and avoid pitfalls as they develop effective technical assistance programs and advance racial equity.  | X        | X        | X        | X        | X        |
| <u><a href="#">Water Board’s Racial Equity Resolution 2021-0050 (2021)</a></u> , <u><a href="#">Water Board’s Racial Equity Action Plan (2023)</a></u> , <u><a href="#">Central Valley Flood Protection Board Resolution No. 2021-15 (2021)</a></u> , <u><a href="#">DWR’s Racial Equity Action Plan (2022)</a></u> : condemning racism, xenophobia, bigotry, and racial injustice and strengthening commitment to racial equity, diversity, inclusion, access, and anti-racism. | X        | X        | X        | X        | X        |

*Table 6-2 Notes: A = water access, Q = water quality, C = climate change, D = drought, F = flood, DEI = diversity, equity, and inclusion, JEDI = justice, equity, diversity, and inclusion. The guidance, policies, and actions focus on addressing issues related to the water categories noted in the table.*



**Table 6-3 Funding Assistance**

| <b>Program (2018-Present)</b>  | <b>A</b>       | <b>Q</b> | <b>C</b> | <b>D</b> |
|--|----------------|----------|----------|----------|
| <b><i>SAFER Program (Senate Bill 200, 2019)</i></b> : delivers permanent drinking water solutions for all Californians lacking safe, affordable, or reliable water access.   | X              | X        | X        | X        |
| <b><i>Low Income Household Water Assistance Program (2020)</i></b> : federally funded, one-time \$116 million for water systems to provide low-income Californians assistance to pay down outstanding residential water or wastewater bills.   | X <sup>a</sup> | c        | -        | -        |
| <b><i>California Grants Portal (2020, ongoing)</i></b> : State Library website “that provides a centralized location ... to find State grant opportunities,” including those to individuals and Tribes with grant categories that include disadvantaged communities and house, community, and economic development.  | X              | X        | X        | X        |
| <b><i>DWR Grants and Loans (ongoing)</i></b> : grant and loan programs that support integrated watershed management activities addressing environmental stewardship, water supply reliability, flood risk, groundwater sustainability, drought, and more. The <b><i>Grants Best Practices and Tips for Success</i></b> webpage provides information and resources that can help ensure success in the grant process. | X              | -        | X        | X        |
| <b><i>Transformative Climate Communities (Strategic Growth Council, ongoing)</i></b> : funds community-level climate projects that reduce greenhouse gases and builds more climate-resilient disadvantaged communities.  | -              | -        | X        | -        |
| <b><i>California Climate Investments (ongoing)</i></b> : cap-and-trade program proceeds fund investments that reduce greenhouse gasses while delivering economic, environmental, and public health benefits across the state, especially in disadvantaged communities.   | -              | -        | X        | -        |

*Table 6-3 Notes: A = water access, Q = water quality, C = climate change, D = drought, F = flood*  
<sup>a</sup> *The Low Income Household Water Assistance Program focused on the affordability of accessible water.*

**Table 6-4** Technical Assistance and Tools

| <b>Program (2018-Present)</b>   | <b>A</b> | <b>Q</b> | <b>C</b> | <b>D</b> | <b>F</b> |
|---|----------|----------|----------|----------|----------|
| DWR’s <a href="#"><u>Online System of Well Completion Reports (OSWCR)</u></a> is a portal where well owners can find records pertaining to a water well completion report (well log). This can empower well owners to make informed decisions based on details about their domestic wells.  | X        | -        | -        | X        | -        |
| DWR provides the following maps to prepare for floods: <a href="#"><u>Best Available Maps (BAM)</u></a> for floodplains located within the Sacramento-San Joaquin Valley watershed; <a href="#"><u>Central Valley Floodplain Evaluation and Delineation maps</u></a> for areas within the Sacramento-San Joaquin Valley watershed; <a href="#"><u>Levee Flood Protection Zone (LFPZ) maps</u></a> represent floodplain areas protected by Central Valley State-Federal Project Levees. Additional resources can be found on DWR’s <a href="#"><u>Flood Preparedness</u></a> webpage.  | -        | -        | -        | -        | X        |
| DWR’s <a href="#"><u>Dry Well Reporting System</u></a> (released in 2021) is a voluntary reporting system available in English and Spanish to identify dry wells or well outages. It includes assistance resources. The <a href="#"><u>Dry Well Susceptibility Tool</u></a> (released by DWR in coordination with the State Water Board in 2022) displays susceptibility per square mile and is being used to help support the investment of State funding and deployment of drought resources. DWR’s <a href="#"><u>California’s Groundwater Live</u></a> and SGMA Data Viewer websites, leverage the <a href="#"><u>California Natural Resources Agency Open Data platform</u></a> to improve the access and timeliness of statewide groundwater information to all communities, including current conditions and well infrastructure in a user-friendly interactive map. | X        | -        | X        | X        | -        |
| The <a href="#"><u>Office of Environmental Health Hazard Assessment CalEnviroScreen</u></a> mapping tool helps identify communities that are most affected by many sources of pollution, and where people are often especially vulnerable to pollution’s effects.   | -        | X        | -        | -        | -        |
| SGMA-related resources include: DWR’s <a href="#"><u>California Groundwater Projects Tool</u></a> (launched in 2022) allows users to explore nearly 3,000 projects initiated over the last decade to protect groundwater resources. The State Water Board’s <a href="#"><u>SGMA Groundwater Quality Visualization tool</u></a> (developed in 2022) allows users to review water quality constituents specific to all medium- and high-priority groundwater basins.  | X        | X        | X        | X        | X        |
| The State Water Board’s <a href="#"><u>Groundwater Ambient Monitoring and Assessment (GAMA) Program</u></a> provides information and resources for domestic well owners and users, such as online tools, fact sheets and FAQs, publications, and more, empowering well owners with knowledge about their wells.   | -        | X        | -        | -        | -        |

| Program (2018-Present)  | A | Q | C | D | F |
|---|---|---|---|---|---|
| <p>California has developed several notification systems to improve communications related to public health and safety, including:</p> <ul style="list-style-type: none"> <li>• State Water Board developed <a href="#">Drinking Water Public Notifications</a> to notify the public when contaminant levels are exceeded.</li> <li>• Caltrans <a href="#">Changeable Message Signs (CMS)</a> provides everything from AMBER alerts, to water conservation messages, to COVID-19 alerts.</li> <li>• As of 2023, Department of Pesticide Regulation is developing a <a href="#">statewide pesticide application notification system</a> to provide the public with advance notice of pesticide application.</li> </ul> | X | X | X | X | X |
| <p>The California Water Data Consortium and Environmental Defense Fund partnered, utilizing funding from DWR, to make an open-source <a href="#">Groundwater Accounting Platform</a> tool that enables water managers, landowners, and water users across California to track water availability and use in near real-time.</p>   | X | - | - | X | X |

Table 6-4 Notes: A = water access, Q = water quality, C = climate change, D = drought, F = flood

Table 6-5 Agency Coordination, Education, and Training

| Program (2018-Present)  | A | Q | C | D | F |
|---|---|---|---|---|---|
| <p><a href="#">K-12 Educators Climate Literacy Training</a> has been used by DWR to reach more than 200,000 students since 2014.</p>  | X | X | X | X | X |
| <p><a href="#">Drinking Water Partnerships and Consolidation</a>: State Water Board supports water partnerships, such as local resource sharing, or consolidation of systems or management of public water systems.</p>   | X | X | - | X | - |
| <p>The <a href="#">Groundwater Management and Drinking Water Well Principles and Strategies</a> provide a framework to guide immediate and long-term drought related groundwater management actions by DWR and the State Water Board to improve the water supply reliability for many Californians and communities who use groundwater. Principles include integrating equity, building trusted relationships, and more. As of 2023, DWR launched the Be Well Prepared campaign and published a <a href="#">Drinking Water Well Guidance Document and Toolkit</a> focused on empowering domestic drinking water well users by providing the information and resources they need to maintain a safe and reliable household water supply.</p> | X | X | X | X | X |

Table 6-5 Notes: A = water access, Q = water quality, C = climate change, D = drought, F = flood

### Local Efforts to Advance Water Equity

In 2022, DWR initiated an exploratory effort to better understand how local water and flood management agencies have advanced water equity within their organizations and service areas. Partnering with representatives across the water sector, DWR developed a survey to gather important best practices, understand resource gaps, and highlight equity actions that were underway.

#### Top Equity Actions Reported by Local Agencies

- Equity as part of agency or district mission statement and strategic plan.
- Formal equity policy or plan.
- Hire staff with expertise in equity.
- Have outreach representative(s) engage with frontline communities.
- Partner with local and community-based organizations to enhance outreach to frontline and Tribal communities.
- Provide equity-oriented staff training.

Additional detailed information was collected related to planning, programs, projects, demographics, language translation and interpretation services, and public meetings. Specifically, for language access services provided, 84 percent of survey participants reported that they have staff that serve the public in language(s) other than English; 39 percent reported having emergency alerts in language(s) other than English. Survey participants contributed valuable applications currently in use, that warrant further exploration by DWR, so that successful equity actions can be encouraged and so resources can be allocated at the State level.

The survey results proved challenging for DWR to infer a baseline of equity-related business practices across water and flood management agencies, particularly because of a wide range of challenges, expertise, and resources for these agencies statewide. Some organizations reported internal challenges such as lack of training, capacity, and funding as key barriers to implementing equity-related policies or programs. There was also acknowledgement among some respondents of legacy challenges, such as community distrust of government and the passage of Proposition 218 (prohibiting public water agencies to assist low-income customers with their water bills), that limit their ability to support vulnerable populations.

There is still important work that needs to be done to further determine what metrics are most effective for measuring meaningful outreach and engagement, representation, and technical and financial assistance. Establishing a baseline will be critical to informing gaps in understanding and how the State can support collective needs of water and flood agencies, which future Water Plan updates intend to continue through the recommendations below and future actions.

### Strategies and Recommendations for Moving Forward

The following recommendations provide actions for specific partners that will further advance equity in water management.

#### California Water Plan

1. Similar to the Federal Environmental Justice Scorecard, California State agencies should report progress on advancing environmental justice and equity to improve transparency and accountability with the public. DWR will collect and report results in future Water Plan updates to inform resource and policy needs.
2. An environmental justice and equity advisory group, comprised of community-based representatives for environmental justice, Tribal, and other frontline communities, will be permanently established to inform Water Plan implementation, ensure accountability and transparency of State and local agency implementation, and inform future Water Plan updates.
3. For each Water Plan update, DWR will survey water agencies and districts on their progress on advancing environmental justice goals and achieving equity within their service areas. This survey would include topics such as outreach and engagement efforts, services provided, workforce data, and affordability considerations. Results will be documented in the 2028 Water Plan update and will be used to inform resource and policy needs.

#### State of California (Executive, Legislature, and State Agencies)

4. Host a public environmental justice summit for each iteration of the Water Plan to ensure ongoing feedback, continuing education, and improved transparency.
5. Seek alignment in State program terminology to expand eligibility for resources to include all vulnerable communities. Examples of terminology that are inconsistent include disadvantaged community, under-resourced community, priority populations, and socially vulnerable.
6. Connect and streamline State equity data tools to improve community understanding of social and climate vulnerabilities.
7. Support resources that are dedicated to community outreach and engagement, interagency coordination, and technical assistance.
8. Reduce barriers to State financial assistance by:
  - A. Exploring State authorities to use advance pay or waive local cost-shares.
  - B. Providing application assistance and pursuing opportunities to streamline and simplify application processes over time.
9. Continue to implement the [\*Drinking Water Well Principles and Strategies framework\*](#) to ensure potential impacts of drought are anticipated and proactively addressed for groundwater-reliant communities.

## Understanding and Addressing Equity in the Management of California's Water Resources

10. The State Legislature should define efficient and equitable land use practices and support programs that incentivize actions. Actions for consideration may be multi-benefit repurposing land use for aquifer replenishment and **floodplain** recharge along riverine corridors, that consider workforce impacts.

### Government Agencies and All Water Sector Partners (Local, State, Federal and Tribal Governments, Non-governmental Organizations, Community-based Organizations, Water Agencies/Districts, Academia)

11. Empower communities by investing in next generation of community water leaders and operators. Examples include sponsorship in water leadership programs, community science programs, workforce development programs, apprenticeship programs, development of PK-12 student curriculum, and other forms of policy and technical skill development.
12. State and local entities should continue to engage community members through community science and crowdsourcing to co-create water management solutions. Examples include water quality testing and data collection, analysis and monitoring, and sharing results with community members.
13. Expand avenues for diverse voices to be a part of all stages of the decision-making process. Examples include:
  - A. Create advisory committees (e.g., youth, environmental justice, Tribal).
  - B. Explore stipends and reimbursements for community participation that help cover transportation and childcare costs.
  - C. Designate community representative to equal voting status as other governing representatives, where feasible.
  - D. Provide various meeting times (including outside of government operating hours) and locations (in-person and virtual options).
  - E. Ensure meeting materials and translation services are in provided in languages that are reflective of the community served.
14. Support resources for frontline communities, including funds for:
  - A. Water quality testing for domestic well owners.
  - B. Water use efficiency measures within households, such as appliance and turf replacements.
  - C. Low-income rate assistance programs.
15. Accelerate system consolidations to stabilize consistently failing or at-risk water systems when State and local assistance prove insufficient. Continue to explore and promote opportunities for regional-scale consolidations, where appropriate.







# 7

## Strengths and Resources of California Tribes

### Statement about this Chapter

Tribal perspectives, recommendations, and stories have been included in past updates of the California Water Plan (Water Plan). This is the first time that a Water Plan chapter has focused entirely on Tribal water management practices and challenges. This Tribal chapter is intended to strengthen local and regional water managers' knowledge of Tribal concerns, strengths, and resources, and to create avenues for collaboration and strong partnerships with Tribes within **watersheds**, county jurisdictions, and throughout each of California's **hydrologic regions**. This chapter is not intended to capture the State's perspective on Tribal issues; it was written predominantly by members of the California Water Plan Tribal Advisory Committee. The chapter is based on the experience and priorities of **California Tribes** from a Tribal perspective and in a Tribal voice.

It is a great honor that Tribal representatives throughout California's diverse regions have shared their insights and practices with the readers of the Water Plan. To gather Tribal viewpoints, the Water Plan team worked with members of *California Water Plan Update 2023's* (Update 2023's) Tribal Advisory Committee on the preparation of this chapter. Tribal members and their representatives contributed their time and expertise to describe water management practices and challenges they face within their watersheds, groundwater basins, and ancestral homelands. They provided their perspectives and presented opportunities on how to overcome those challenges.

It is the State's hope that a chapter in Update 2023 on Tribal challenges, strengths, and resources, raises awareness among regional and local water and resource managers of Tribal concerns and perspectives, leading to greater inclusion of Tribes in **watershed networks** and watershed **resilience** planning. (See Chapter 5, "Focus on Supporting Watershed Resilience," for a discussion of watershed networks.) Ultimately, the hope is that State policies and efforts embracing greater inclusion result in **Tribal Ecological Knowledge**

## Strengths and Resources of California Tribes

(TEK) and Tribal Knowledge being accepted as a type of best available science, a viable and essential tool, and used throughout the state to achieve greater resilience for all.

## Tribal Perspectives for California Water Management

State policies should support Tribal self-determination and self-governance by improving the Tribes' ability to access their sacred sites, protect their cultural resources, and support their water rights. Because much of the traditional and ancestral land of Tribes is no longer under their jurisdiction or control, Tribes feel encouraged by recent State policies that support land co-management and stewardship with local and regional partners. These partnerships are key to achieving the goals of watershed management, addressing climate change, fulfilling equity principles with action, and utilizing best available science to achieve **watershed resilience**.

## Introduction

This chapter aims to amplify all Tribes' voices and increase the quantity and quality of their participation in the preparation of this and future Water Plan updates. It ensures the description and inclusion, protection, and advancement of Tribal water and culturally related needs, co-management, and **sustainability**.

California Native Americans reside throughout the state and maintain their deep connections to water and water-related resources. This chapter respects, values, and acknowledges the diversity of California Tribal communities. At the same time, the chapter intentionally incorporates the experience of all Indigenous people of California and addresses them in an equitable manner. It serves as a foundation for Tribes to collaboratively promote their water concerns, needs, and opportunities for the future as one people, in partnership with the State of California.

The Tribal Advisory Committee's continued participation further utilizes the Water Plan process to institute permanent relationships between Tribes and agencies at all levels of government.

This chapter includes a Tribal perspective for California water management and an overview of Tribal history, Tribal sovereignty, and Tribal water rights. It also includes an overview of Tribal efforts to improve watershed health, climate change adaptation, equity, and funding. It highlights water management challenges faced by Tribal communities and provides strategies and recommendations to begin to address those challenges.

The contents of this chapter include multiple references and explanations of TEK that have broad application beyond Tribal lands. These include indigenous cultural burning, meadow restoration, co-management of resources, replanting with traditional plants, and other practices. Perhaps the greatest lesson is to respect and learn from the Tribes' relationship to the land, rivers, lakes, aquifers, plants, and wildlife. Within that relationship resides a complex and essential set of cultural relationships and a deep respect for maintaining the health and vitality of the environment of those relationships.

### Tribal History

To understand Tribal views on water resource management, it is important to understand that prior to European settlement, the lands of California were populated by Native Americans for more than 19,000 years and included a diversity of 500 Tribes that spoke approximately 300 dialects of more than 100 languages. The legacy of political actions, such as colonization, relocation, and termination toward California Tribes has perpetuated a practice of leaving them out of the discussion in developing State legislation. The exclusion of Tribes in State policies and plans has limited their ability to control and access water in accord with their asserted Indigenous and aboriginal rights. As a result, it has prevented Tribes from continuing their cultural, spiritual, and sustainability practices.

The following is an example of how the human activities from the past two centuries have affected natural systems and Native American culture. Prior to European contact, Tribes from coastal and Central Valley areas historically fished for salmon and steelhead found almost year-round in coastal streams and the Sacramento/San Joaquin rivers system. North Coast Tribes harvested salmon and steelhead principally in late summer and fall months from the Eel, Klamath, Smith, and Trinity rivers and hundreds of smaller streams. Salmon and steelhead have been significant Tribal resources throughout all of California, and Tribes have depended heavily upon these fish species for subsistence, ceremonial, and trade purposes. Today, these once abundant fisheries that were integrally tied to Tribal cultures and beliefs are on the verge of catastrophic collapse. This has imposed additional hardship and challenges for Tribes that depend on them. (Lufkin 1991).

Despite historical trauma, Tribes have survived and continued to be resilient in an ever-changing political and environmental landscape. There are more than 574 sovereign Tribal nations (variously called Tribes, nations, bands, pueblos, rancherias, communities, and Native Villages) in the United States. California is home to 109 federally recognized Tribes, including several Tribes with lands that cross the state boundaries of Oregon, Nevada, and Arizona, as well as the border with Mexico. Figure 7-1 identifies the description and inclusion, protection, and advancement of Tribal water and culturally related needs, rights, and sustainability.

Since time immemorial, Tribes possess the inherent right and authority over their people and territory. This sovereign right predates the establishment of the federal government and the U.S. Constitution. Tribes are not stakeholders, or members of the public, or an ethnic group but, instead, are sovereign governments that require State agencies to engage in government-to-government consultation.

Governor Edmund G. Brown's Executive Order (EO) B-10-11 (2011) recognizes and reaffirms the inherent right of California Tribes to exercise "authority over their members and territory," where Tribal members are "both citizens of California and their respective sovereign nations" with "shared interest in creating increased opportunities for all California citizens." The recognition presented in the executive order resulted in a commitment to identify "areas of mutual concern" through developing partnerships via effective government-to-government consultation with California Tribes.

## Strengths and Resources of California Tribes

Governor Gavin Newsom's EO N-15-19 (2019) acknowledges and apologizes for "historical wrongs" committed by the State of California toward California Native Americans. This executive order reaffirmed the principles in EO B-10-11 and established the Truth and Healing Council "to accurately represent the diversity of experience of California Native Americans within the State of California." These orders effectively require State agencies to engage in government-to-government consultation.

Similarly, Governor Newsom's *Statement of Administration Policy on Native American Ancestral Lands* recognizes past harms done to California Native American communities and states, "...it is the policy of this administration to encourage every State agency, department, board and commission (collectively, "entities") subject to my executive control to seek opportunities to support California Tribes' co-management of and access to natural lands that are within a California Tribe's ancestral land and under the ownership or control of the State of California, and to work cooperatively with California Tribes that are interested in acquiring natural lands in excess of State needs" (Office of the Governor 2020).

As the State continues to establish the Tribal Nature-Based Solutions Program, EO N-82-20 (2020) its *Pathways to 30x30* strategy, and *Natural and Working Lands Climate Smart Strategy*, meaningful Tribal partnerships will be key to implementation of the State's nature-based solutions policies and programs.

As California continues to move forward to promote understanding of the Tribal perspective and learn from the historical treatment and experience of Tribes, it will pave the way toward decisions that will have a positive impact on Tribal sovereignty, culture, and economic and social stability.

### Tribal Sovereignty

Tribal sovereignty refers to the right of American Indians and Alaska Natives to govern themselves. The U.S. Constitution recognizes Indian Tribes as distinct governments; they have, with a few exceptions, the same powers as federal and State governments to regulate their internal affairs (National Congress of State Legislatures 2023). Past and present California governors have acknowledged and affirmed the sovereignty of California Tribes through EO B-10-11 and EO N-15-19.

Ron Goode, Chairman of the North Fork Mono Tribe, shares his thoughts on Tribal sovereignty.

Sovereignty must first be looked at before Tribal Sovereignty. Sovereignty is the inherent right to exercise one's general will freely. There lies the rub, who has that kind of freedom. Surely not Federally Recognized Tribes nor Unacknowledged Tribes. There is freedom of speech until someone doesn't like what you're saying. As Native Americans we are not allowed to make War, appear to be preparing for War, or participating in any similar endeavor. Tribal decisions are always awaiting approval by some agency or governmental body rather than by the county, the state, or the Tribes themselves.

Sovereignty per water rights is ambiguous, what was our "water" and now isn't, how did our water get taken away from us? Basically, it hasn't, we just have to reclaim it off the shelf, off the shelf from those that stole it, traded it, resold it, and never paid for it. Ground water belongs to no one, but everyone is looking to lay claim to it. Words of adjudication, Winter's Doctrine, water rights to land-bases, water usage rights, have legitimate legal bases, for the most part all land bases including homesteads, Indian allotments, tribal reserves, and agricultural lands have ground water attachments.

And yet, some state agency, county or federal agency is trying to charge for water that belongs with the landscape no matter who owns it. Tribal entities have control of the water while it flows to and from their lands but not once it leaves their lands. The upper watershed is unclaimed but once it heads downstream into the coffers and becomes available to downstream users over 110 percent of the water is claimed as a right to use before the water gets to its destination, the ocean.

After that, the sovereign Tribal waters coming from aboriginal Tribal homelands then turns into drought, climate change, fire, environmental and aquatic disasters, ocean rising, ocean temp rising, and global warming. The impacts then land on Tribal communities, rural communities, and agricultural communities. (Ron Goode 2022)

# Strengths and Resources of California Tribes

## Figure 7-1a California Tribal Lands, Northern Section

**Tribal Reservation Boundaries [1]**  
(124 records total – labeled)

**Tribal Trust Land Boundaries (tracts) [1]**  
(5,305 records total – not labeled)

**Select Water Bodies**  
(including lakes > 10 sq. mi.)

**Rivers & Streams**

**Historic location of Indian land once held in Trust for a Terminated Tribe and/or the location of a landless federally recognized Tribe. [2]**  
(22 records total – labeled)

**Tribal Land Notes:**

Boundaries shown are approximate and have been scaled up to improve visualization at current map scale.

1 – Source: U.S. Bureau of Indian Affairs (Feb. 2018)

2 – Source: DWR acquired legacy data (author unknown)

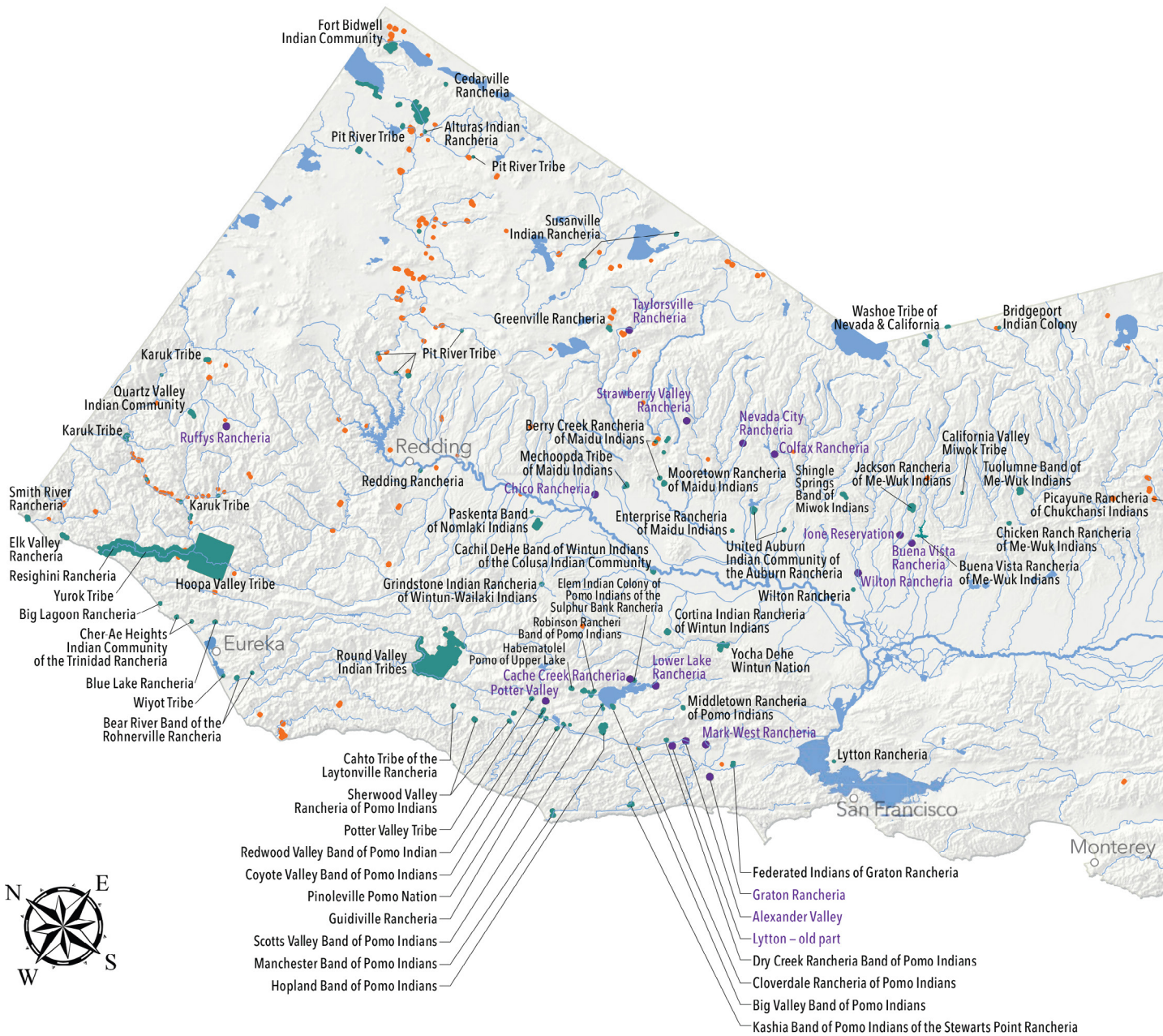
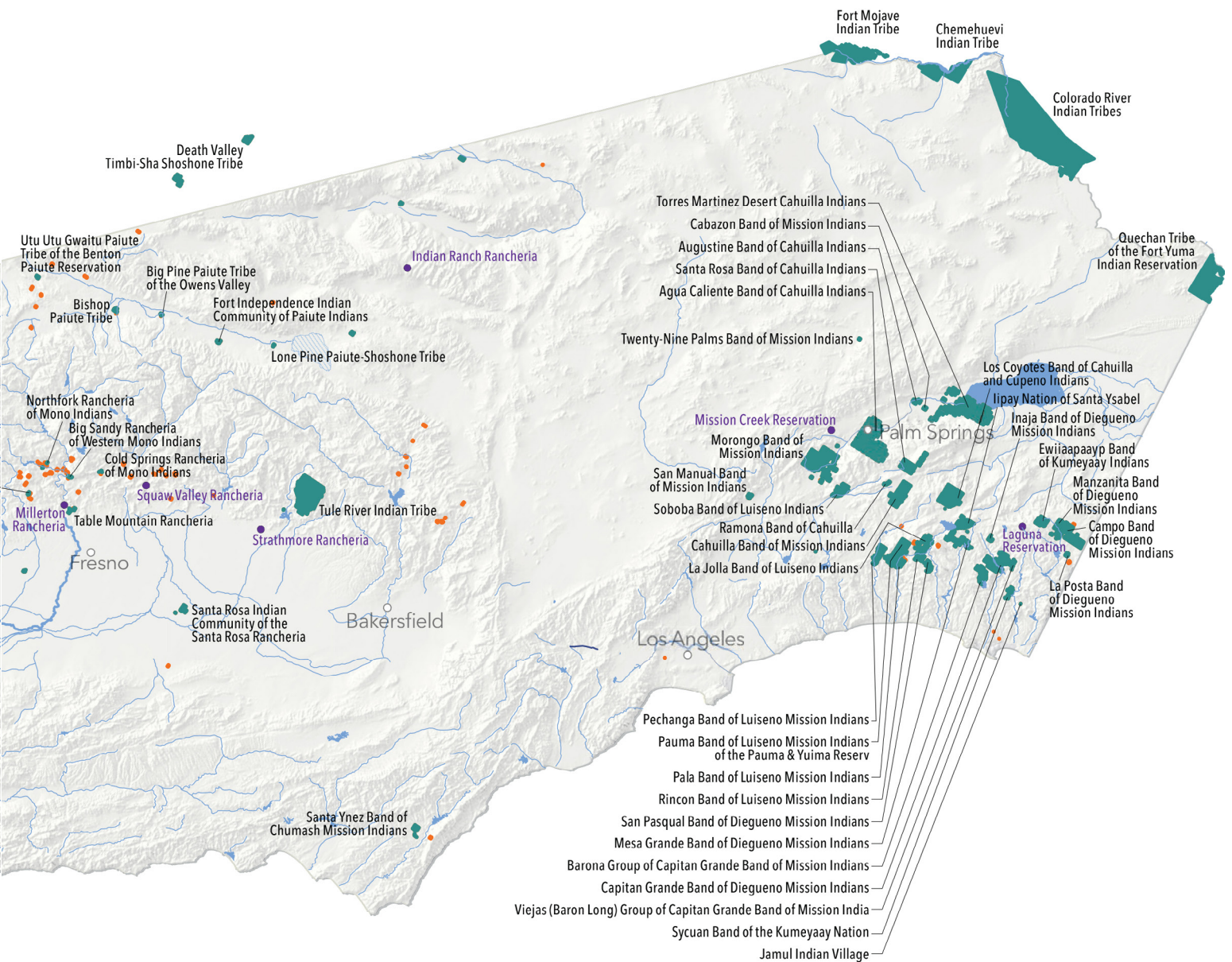


Figure 7-1b California Tribal Lands, Southern Section



## Strengths and Resources of California Tribes

Bo Mazzetti, Chairman of Rincon Band of Luiseño Indians, provides this statement about Tribal sovereignty.

Tribal sovereignty starts with the United States Constitution in what is referred to as the Commerce Clause. In the United States Constitution, it states that only Congress shall regulate commerce with the Indian. When reservations were being created, the Indians were under the Department of War, which eventually became in 1824 the Bureau of Indian affairs.

American Indians were designated by the United States Government as a political group not a minority group, because they had functioning governmental structures as did the United States Government. When the United States created reservations, they recognized the right and fact that each Indian tribe was in fact a sovereign independent government within the United States.

United States government acknowledging each individual tribe as a sovereign, had the rights to establish their own tribal laws and follow their own tribal customs and traditions. Since Congress and the President of the United States negotiate and work directly with Federally Recognized Tribes, which are considered equal to States, the State of California has very limited authority to impose state laws on federally recognized tribes in the state of California. Criminal laws are an area that the state does have jurisdiction, however when it comes to civil regulatory authority the state and local governments do not have authority to impose regulatory laws and ordinances on Federally Recognized Tribes.

Sovereignty, in my opinion, means that it is each Tribe's responsibility to develop laws that will protect their people and also protect their land for future generations. When the state of California is negotiating with a federally recognized tribe, the state should approach the Tribe with the understanding and openness the way the state would negotiate with another state such as Arizona, Nevada, and Oregon, since Federally Recognized Tribes have equal status as a state and higher status in some cases. This is sovereignty.

(Bo Mazzetti 2022)

California's water planning processes have historically not included Tribes. This has limited the ability of Tribes to control and access water, which has constrained their cultural, spiritual, and sustainability practices. For that reason, Tribes must be offered the opportunity to genuinely participate in statewide and regional water planning, to voice their concerns and have them heard and respected, and to shape water policy. Chairman Mazzetti emphasizes the role of the federal government to recognize each federally recognized Tribe as a sovereign and the State approaching negotiations with a Tribe as it would another state government.



## Tribal Water Rights

Tribes assert that they have never ceded their inherent rights to water, and within the Tribal community there is a holistic view of water. Water plays an important role in Tribal lifeways, including subsistence and cultural practices. Water keeps traditions alive and holds knowledge from the past to be passed down to future generations. Water is life.

Art Bunce, attorney for the San Luis Rey Indian Water Authority, shares his explanation of Tribal water rights.

Understanding water rights in California is complicated to start with. Factoring in Indian water rights does not make it any easier. This small article intends to present the overall picture from the 40,000-foot level in a way that ordinary people can understand.

Because of history stemming from the Gold Rush, the essential feature of surface water rights in California is priority. The basic principle is first in time, first in right. Whoever first diverts surface water from a stream or other water body achieves a right to make and keep that diversion, whether used on the same land as the diversion or not, to the amount diverted as of the date of the diversion. Therefore, the oldest water rights have a priority over newer rights, creating a hierarchy of seniority. This means that whoever has the earliest right from a water source is the senior holder and has their water right met in full first. The party with the second most senior right has their right met in full next, and so forth. Tellingly, if the source does not have enough water to satisfy everyone's claims of right in the order of seniority in full, then a senior holder's rights are met in full before the next junior holder gets a drop, and so forth.

Think of a line of claimants in line at a large water tank with a spigot, each claimant with a bucket. The claimants are lined up in order of priority, with the most senior first, and so forth. Each claimant's bucket is the size of his historic diversion, some larger, some smaller. In a wet year, the tank is full. Everyone gets their bucket filled from the spigot in full in the priority order in which they lined up, and everyone goes home happy. But in a dry year, the water in the tank is not enough to meet everyone's claims. The most senior claimants get their buckets filled in full first, as far as the water in the tank goes, and they go home happy. But at some point, the tank is empty. At that point no one who is still in line gets any. That is the meaning of priority.

## Strengths and Resources of California Tribes

There are other factors at play, too. Some people have additional rights for various reasons, such as having land that fronts onto a river, called riparian rights. There are also adjustments for environmental and related reasons. But all these other rights do not change the basic priority system under state law. They just make adjustments in the order in which all the bucket holders line up, and sometimes some change the size of some buckets. But everyone still lines up and is served with water from the source in priority order. Even with these adjustments, in dry years there is a cut-off somewhere along the line of bucket holders. Those ahead of the cut-off are served in full. Those behind it are not served. Virtually all water sources in California are oversubscribed. In most years, there is simply not enough water in the tank to meet everyone's claims. In very oversimplified form, that is the California water rights system of priority.

Look closer at the line of claimants with buckets at the spigot to the tank. Off to the side, but not in line, is another landowner with a bucket. They have never been in line, have never received any water from the source. They have been standing there for years, sometimes a century or more, with an empty bucket, but their bucket is different. It is elastic. It expands when needed. At some point they step forward and take their place in line, according to their priority. In many cases, they have the most senior rights of any claimant from the source. This means that they step into the line often at the very front of the line. Doing this may move back the point in the line where junior holders who had previously been served are no longer served. That is the effect of incorporating federally reserved water rights (FRWR) into the state system of priority.

For the non-Indian claimants, their priority and place in line is determined by the date when each first made their diversion of water from the source. But some lands are not owned by private parties. Some lands are part of a federal reservation, such as a military reservation, a national park or forest, a wildlife refuge, or a federal Indian reservation. For those lands, the priority date is the date of the creation of the reservation. As a matter of federal law (with the name the Winters doctrine), when Congress or the President creates a federal reservation of any kind, the United States automatically reserves sufficient water (both surface water and groundwater) to meet the primary purpose of the reservation, both as of the date of the creation of the reservation and in the future. These are Federal Reserved Water Rights or FRWR. In California, many federal Indian reservations were established as early as the 1870s. That means that, in many watersheds, if there is a federal Indian reservation, that reservation has FRWR with a priority date earlier than all or nearly all others because all or nearly all diversions under state law will have later dates.

Aside from often having very early priority dates, such FRWR have four important characteristics.

First, such FRWR are not lost by non-use. Even if a century or more has passed since a reservation was created, if the Tribe has not used its FRWR, that Tribe may assert its FRWR at any time.

Second, the amount of a Tribe's FRWR is however much is needed to meet the present or future needs of the Tribe for a permanent homeland. This is usually calculated as the practicably irrigable acreage of the reservation, including with modern technology.

Third, a Tribe's FRWR extends not only to surface water, but also to groundwater under its reservation.

Fourth, it is not necessary for a Tribe to have gone to court and to have fully litigated the existence and amount of its FRWR. Most such litigation is extremely expensive, complicated, and often takes decades. Instead, even if unquantified, such rights exist as a matter of federal law and must be dealt with seriously.

The Sustainable Groundwater Management Act of 2014 (SGMA) first began to regulate the use of groundwater in California with the goal of ending overdrafts and requiring balance or sustainability. In very rough terms, that means that groundwater basins be managed in such a way that no more groundwater is extracted from a basin than nature provides. With the above four principles regarding FRWR in mind, SGMA invites Tribes to participate in the SGMA process, and guarantees that their FRWR will "be respected in full" by both the local groundwater sustainability agencies (GSAs) and the State Water Resources Control Board if that agency must step in to manage a basin. Although Tribal participation in GSAs is voluntary with each Tribe, many Tribes chose to participate because they recognize that Earth is a small planet with resources that must be sustainably managed for the long-term benefit of all who live here.

Each GSA must produce a groundwater sustainability plan (GSP), which is a plan for exactly how a GSA intends to bring its basin into sustainability. Few basins include federal reservations of any kind. Those few include basins with federal Indian reservations, military reservations, national forests, etc. Each has FRWR. For example, the GSA that administers the Indian Wells Valley Basin near Ridgecrest has submitted a GSP that makes a real effort to account for and integrate the FRWR of the Naval Air Weapons Station China Lake into the GSP. In that case, the estimated safe sustainable yield of the basin is 7,650 acre-feet per year. While the

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unquantified FRWR of the Naval Weapons Station is probably 100 percent of the groundwater in the basin, the Navy has agreed to limit its extraction to 2,041 acre-feet per year, thereby allowing the GSA to plan accordingly to reduce net other extraction sufficiently over the 20 years of the GSP to bring the basin into sustainability. (See GSP, pp. 3-4, 3-5, 3-19, 3-23, 5-8 to 5-10, and Appendix 5-A)

Each Tribe will make its own decisions. The responsible treatment of FRWR by the U.S. Navy in the Indian Wells Valley Basin GSP can serve as a model for Tribes that wish to exert less than their full FRWR immediately, perhaps in exchange for other local benefits, such as infrastructure, in conjunction with their neighbors. Even though the FRWR in that case are still unquantified, they are successfully integrated into the GSP with the assistance of the federal holder of the FRWR and the good will of the local non-federal community. Open communication and respect go a long way but are not always present.

Lastly, FRWR are not the only water rights that a Tribe may have, although they will often be by far the largest and have the earliest priority. Many Tribes have acquired land by Congressional action or purchase, adding that land to the trust land base of reservation. That additional land will also have FRWR with a priority date of the acquisition of particular parcels. Similarly, a Tribe may independently have the same kinds of water rights that other landowners have, such as riparian rights, easements, etc. They can be handled the same as any other state law-originated water rights, although held by a Tribe.  
(Art Bunce 2022)

In describing what a FRWR is, Art Bunce points out that a Tribe's FRWR has four characteristics:

- It is not lost by non-use.
- The diversion amount is however much is needed to meet the present or future needs of the Tribe.
- It extends to both surface water and groundwater.
- It exists as a matter of federal law even if unquantified.

A Tribe's FRWR generally has a priority date that is earlier than nearly all other water rights in a watershed or aquifer because nearly all diversions under State law generally have later priority dates. Thus, it is strongly encouraged that the State and regions conduct early and continued Tribal engagement and consultation around any water-rights-related planning that may affect Tribes, such as the preparation and updating of groundwater sustainability plans by groundwater sustainability agencies.

In addition, engagement within a region includes actions to determine who the beneficial users are in the region, and the Tribal beneficial and cultural uses in the region. It also includes an understanding of what is Tribal land within a region, what is sovereign (trust) land, what is fee land, and what is public domain allotment land (California Department of Water Resources 2018).

### Tribal Efforts to Improve Watershed Health

TEK, Tribal Science, or Traditional Knowledge/Indigenous Knowledge, is cumulative knowledge passed down through generations that have allowed Tribes to develop symbiotic relationships with their environment. There is renewed vigor and commitment beginning at the federal level to elevate Indigenous Knowledge in federal policy decisions, just as there is in California State government (The White House 2021). Federal policy defines Indigenous Knowledge as a body of observations, oral and written knowledge, practices, and beliefs that promotes environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems.



Cultural burn workshop in Mariposa County led by the North Fork Mono Tribe.

Tribes in California utilize TEK to inform and engage in meadow restoration and cultural burning as they nurture and tend to their environment and promote watershed health. Meadow restoration is important because a properly functioning meadow will store water, filter out sediment and pollutants, provide important habitat, and sequester carbon ([American Rivers website](#)).

Cultural burning, which has been passed down through generations, benefits land and people by improving soil quality and spurring growth of certain plant species, while creating a healthy and resilient landscape ([National Park Service website](#)).

The State supports partnering with Tribes utilizing TEK to co-manage and steward ancestral lands. The Tribes who first inhabited this land practiced land management through knowledge passed down from generation to generation. Western science is finally

## Strengths and Resources of California Tribes

embracing the science of Tribal knowledge, and State policies facilitate State agencies' incorporation of Indigenous practices into co-management practices and acknowledgment of cultural practitioners as subject matter experts. Every watershed and groundwater basin have fragile resources, and these resources are at risk owing to climate change, drought, flooding, and wildland fire. These at-risk resources are in sacred areas essential for ceremony and other contemporary uses still practiced today.

California Tribes understand the sacred duty to protect cultural resources that allow Tribes to exercise their traditional uses of the land. Currently, the State Water Resources Control Board (State Water Board), through its regulatory authority, is adopting the beneficial use definition to include Tribal beneficial uses. Tribal beneficial uses include traditional and cultural uses that support spiritual, ceremonial, or traditional lifeways that involve navigation, fishing, gathering, or consumption of aquatic resources. The State Water Board will also include Tribal subsistence fishing, which involves the non-commercial catching or gathering of natural aquatic resources for consumption, by Tribal individuals, households, and communities to meet their needs for sustenance.

Some of the traditional uses have been reliance on wild and native plants, the plant materials needed for basket weaving, ceremonial and everyday adornment, and medicinal needs.

Chairman Goode has provided trainings on TEK and cultural burning and its benefits for meadow restoration to maintain the balance needed to sustain traditional practices and uses. Here he shares his experiences of that practice.

There are 10,000 plus meadows in the Sierra Nevada with 70 percent needing maintenance or repair, 25 percent are non-existent, and only 5 percent are somewhat healthy. Meadows have downsized over the past two centuries by 10x, what was once 3,000 acres are now 300, what was 300 is now 30 and what was 30 is now 3.

You used to be able to drive in the high mountains for 20 miles, never leaving a meadow, meadow after meadow, today you have to drive 20 miles to maybe find another meadow. The meadows are the hub of the forest, they are the sponge of the watershed. When rain and snow fall the concept of the forest is the canopy needs to be open - open enough for the root system to hold the water and gradually release the water to the waiting meadow. The meadow then absorbs the water and gently releases it downstream all summer long. Today the meadows are drying up by mid-summer. Drought, yes. Poor management, yes.

When the Indian was living on the land pre-1850 the canopy was 40 percent or less in thickness, some elders say 30 percent and the base between trees was 35-40 feet. Today, the forest is at 80-90 percent canopy, trees (planted trees) are like toothpicks in a jar. When the "drought" of 2012-2015 hit and then the bark beetle infested the trees

they hit were packed together, all same size, 25 to 50 years of age. Trees that were in the meadow that were restored were not as affected by either the drought or bark beetle. Therefore, when the snow and rain fall in the forest some 20 percent trans-evaporation is lost before it hits the ground. Since the floor of the forest is messy and logs lay everywhere, when the snow does fall, it melts first from under the snowpack because of the air pockets on the forest floor.

In general, downstream users do not reinvest in the upper watershed. Funding by agencies is hard to get as most are designed for the agency's purpose and not the forest health. The agencies who say they fund forest health do not fund meadows or wetlands.

Once a meadow is restored, the encroachment of conifers is removed, invasive plants and vegetation is removed, the water table is raised, the springs become functionable, seep springs pop up throughout the meadow. Sunlight is now let in, cultural resources are abundant, flowers and meadow plants are abundant, which means insects return, thousands and thousands of ladybugs return, spiders, ants, bees, dragon flies, butterflies, then come the birds, little ones then the big ones, then comes the reptiles, and the animals small to large.

The Lion brings in its kill to share with the community of other animals. Everyone feasts after the lion is done. Once it's just carcass and bones, the little moles, gophers, possums, etc. all come to gnaw on the bones, their little teeth marks are all on the remains. The seedling oaks are abundant, the mother doe brings her little fawns to the meadow now that it is open and the babies nibble on the succulent seedlings of the oak. They will do that for up to 3-5 years. After 5 years they quit nibbling until the seedling becomes a sapling tree of ten to fifteen years. When the Indian was on the land they would burn or prune some of these young growths back and leave others. The mother doe takes two to two and half years before she can have her first born then 8 months gestation. This is over three years, time for a new seedling to grow and be ready for the new fawns. After a few generations a tradition is born. A tradition that the community of animals contribute to the sustainability of the meadow and forest health. (Ron Goode 2022)

As Chairman Goode describes, much can be learned from past Tribal knowledge and practices to improve watershed health. Agencies should listen and learn from Tribes on how to be better stewards and respect the sensitivities surrounding the sharing and application of Tribal knowledge. With the release of a *Statement of Administration Policy on Native American Ancestral Lands*, State agencies are encouraged to explore opportunities

## Strengths and Resources of California Tribes

for Tribes to manage or co-manage natural land, water, and biological resources to improve watershed health and provide multiple benefits, such as storing water in meadows, providing important habitat, and creating a healthy and resilient landscape.

### Rights of Nature

The Tribal Water Summit 2023 explored the emerging legal and theoretical practice of how Tribal Nations are utilizing concepts and principles from the [Rights of Nature](#) movement.

Environmental and legal theorists are embracing and adopting the Rights of Nature movement as a way of protecting the inherent rights of ecosystems and species similar to the fundamental concept of human rights and the [Human Right to Water](#). It is an international concept affirming that nature should have the same rights as humans. This follows the fundamental belief of Native people and their connection to nature, their belief that plants, animals, and water are their relations. Many nations have adopted nature's rights laws, including Canada, Bolivia, and Peru. In the United States, there is a growing movement for adoption at the local level through cities, counties, and Tribal Nations.

In 2017, New Zealand granted through legislation legal personhood status to the Whanganui River. Personhood status grants the natural resource its own legal identity with the rights, duties, and liabilities of a legal person. In 2018, the White Earth Band of Ojibwe of Minnesota adopted the Rights of Manoomin to protect wild rice and the freshwater sources it needs to survive. The Ojibwe interpreted legal personhood as a framework for dealing with problems like pollution, drought, and climate change that threatened the Manoomin (wild rice). The Manoomin is the first plant species to have the same rights as humans – with an inherent right to pure and freshwater habitat and the right to a healthy environment.

In 2019, the Yurok Tribe granted personhood to the first known river to be granted such rights in North America – the Klamath River. The Klamath River will have the same rights as humans under Yurok Tribal Law. The Yurok Tribe felt the need to protect the Klamath River from climate change, State policies, and federal policies that have affected the flow of water and harmed their main food source – the salmon.

Most recently, in early 2023, the Rincon Band of Luiseño Indians granted personhood status to the San Luis Rey River to protect it from the impacts of the climate crisis.

### Decommissioning of Dams

For many decades, Klamath basin Tribes have voiced their concerns over the impacts the dams have had on Tribal cultures and how key State and federal partners need to include TEK during the ecological process of decommissioning. The following section spotlights the ongoing Klamath Dam removal project, a result of persistent and strategic Tribal activism over several decades.



### ***Klamath River Renewal through Dam Removal – A Tribal Success Story***

Since time immemorial, the Klamath River has been the lifeblood of Native American people, sustaining the Yurok, Hupa, Karuk, Shasta Indian Nation, Klamath Tribes, and others. Also since time immemorial, these communities have carefully stewarded the forests, the meadows, the river and its tributaries, and all the beings within the Klamath River watershed. Beginning in the mid-1800s, drawn to the plentiful waters, gold and other minerals, fertile soils and robust forests, settlers colonized Native land through the Homestead Act, establishing farms and ranches across the land, displacing and waging war on Indigenous people.

Between 1918 and 1960, four hydroelectric dams were constructed along the mainstem of the Klamath River for the sole purpose of generating electricity. These dams segmented the river, blocking salmon from their spawning grounds in tributaries in the Upper Klamath Basin. Prior to development of the dams, the Klamath River was one of the most productive salmon fisheries in the lower Pacific Northwest. Chinook and coho salmon, steelhead trout, and other species sustained Tribal communities throughout the basin.

Over time, the four dams have resulted in a dramatic decline of the fisheries by preventing fish passage to spawning grounds, impeding the flow of fresh water, increasing water temperatures, and causing toxic algal blooms. In 2002, deteriorating river conditions caused a massive fish kill, simultaneously traumatizing and activating the Tribes, and reinvigorating a multi-decade movement demanding removal of the dams.

In 2004, Tribal representatives flew to Scotland to protest at the parent company of PacifiCorp, the owner of the hydroelectric dams. In 2005, Berkshire Hathaway purchased PacifiCorp and shortly thereafter, it appeared that dam removal could be a possibility. In 2020, when a plan to remove the dams hit a snag, Tribal representatives confronted utility company representatives on the river. Eventually, the Tribal voices were heard, and the argument was won that it was more costly to keep and retrofit the dams than to tear them down.

In November 2022, after decades of protest and debate, the federal government approved a roadmap for dam removal. The dam removal project is funded by PacifiCorp customer surcharges and California Proposition 1 water bond funds. It is led by the Klamath River Renewal Corporation, which was formed through the Klamath Hydroelectric Settlement Agreement. Signatories include the States of California and Oregon, local governments, Tribal Nations, PacifiCorp, irrigators, and several conservation and fishing groups. Pre-construction activities are underway, and the smallest of the four dams, Copco #2, has been removed. Drawdown of the remaining three dams will begin in January 2024, and these three dams will be removed by the fall of 2024.

When the reservoirs were created, lands that were home to Tribal villages and burial grounds were taken forcefully by eminent domain and inundated. It is anticipated that, as drawdown occurs, these villages and sacred places may be exposed after being underwater for a century. Tribal cultural resource monitors will be present as reservoir lands are exposed in order to identify and properly handle any exposed Tribal resources.

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Tribal members will continue to play a defining role in the design and implementation of post-dam-removal activities, including ecological restoration at reservoir footprints and upstream tributaries, and growing and collecting native seeds for restoring the landscape.



Copco Dam 2 removal was completed in July 2023.

In the years following dam removal, all eyes will be on the Klamath watershed to see how the river realigns itself and how the fisheries and ecosystem rebound.

### Importance of Water Data Collection

Tribal, federal, State, and local governments are leveraging geographic information systems (GIS) and other data processing methods to inform various studies, including community health and welfare, environment, transportation, and cultural history. As part of environmental studies, water data are collected and stored in various file formats, including those that can be analyzed and visualized in GIS software and web applications, such as maps and dashboards, to monitor, support, and improve California's water supply. This data collection and sharing, in accordance with the Open and Transparent Water Data Act (Assembly Bill 1755), can help Tribes build an equitable water future by providing water data that can support Tribal lands, members, and communities. Through State and federal data transparency, Tribes can utilize government agency-moderated water data and secondarily integrate Tribal data to inform watershed analyses, increase funding opportunities, inform landscape and ecological decision-making, and monitor water as it relates to Tribes, Tribal lands, citizens, and communities, as well as neighboring communities.

### Tribal Knowledge is Data

Tribal knowledge embodies Tribal data. While government agencies are collecting data, many California Tribes are also conducting their own data collection in various forms, including GIS mapping; environmental and water quality monitoring; Tribal cultural

resources; and educational and health information as it relates to Tribal lands, resources, and people. In lieu of quantitative data-driven information collection, storage, and management, Tribal knowledge has traditionally been kept by designated individuals of a given Tribe and shared with a select few through such cultural practices as ceremony, oral history, and storytelling. This knowledge retention is considered by Tribes as a form of data storage and sharing, which includes information about the land, sky, environment, humans, and non-humans (Carrol et al. 2020). For example, Tribal knowledge is applied to the mapping of original homelands, culturally important trails, villages, trade routes, gathering areas, sacred sites, watersheds, flora, and fauna, compiling data that are stored in a Tribe's internal database, subject to Tribal **data sovereignty**.

### Data Sovereignty and Data Governance

Tribal sovereignty is linked to data sovereignty through self-determination, which affirms the ability to control data collection and governs data use. Tribal data includes data collected by Tribes, but also data associated with Tribes, Tribal lands, or Tribal members collected by others (Carrol et al. 2020). Tribes have expressed concerns about federal and State agency data collection and management. For example, information gathered by non-Tribal government entities about Tribes or Tribal members could be collected in a manner or process incongruent with Tribal priorities or interests. Data sovereignty is a Tribe's right to "govern the collection, ownership, and application of data" regarding the Tribe, Tribal members or information kept by the Tribe (Rainie 2017). Moreover, data governance is a Tribe's right to control Tribal data use and reuse by third parties, including data collected from previous research (Tsosie 2019). Tribal data are subject to Tribal sovereignty, reaffirmed by principles of data sovereignty and data governance, to protect Tribes from harm and create a more equitable future.

### Data Stewardship

Data stewards have legal and ethical responsibilities to determine best practices for data collection, management, storage, and sharing. Guidance for data sharing and stewardship is defined by data principles, based on Findability, Accessibility, Interoperability, and Reusability (FAIR), to increase applicable benefits and support "transparency, reproducibility, and reusability" (Wilkinson et al. 2016). As Indigenous peoples worldwide advocate for integration of Indigenous Knowledge into data collection practice, approach, and policy, principles for Indigenous Data Governance based on "Collective Benefit, Authority to Control, Responsibility, and Ethics" (CARE) were developed by the International Indigenous Data Sovereignty Interest Group of the Research Data Alliance. CARE principles support an approach to data that is mindful of people and purpose related to Indigenous peoples, including California Tribes, Tribal lands, and Tribal members (Carrol et al. 2020). A combination of FAIR and CARE principles supports best data-management practices that facilitate information sharing, while increasing equity and collective benefits.

Through Tribal consultation, government agencies, in coordination with Tribes, can establish an approach and process for Tribal data collection, management, and sharing.

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Tribal partnerships developed through consultation are vital for government agency operations' understanding of the importance and interconnectedness of water and other elements of the environment as experienced by Tribal nations, lands, members, and communities. By establishing practices that reflect FAIR and CARE principles, Tribal data can be integrated and protected to prevent misuse or misappropriation, which can cause harm, inequality, and injustices to Tribes and Tribal people. Some examples of practices include establishing a confidentiality agreement or non-disclosure agreement, adding confidentiality statements to documents as appropriate, ensuring metadata standards and practices for GIS data include use limitations, and integrating Tribal data protocols. The Karuk Tribe has publicly shared the [\*Protocol on Karuk Tribe's Intellectual Property Rights\*](#) (2014) to exercise sovereignty over Tribally affiliated information. Additionally, to support Tribal data stewardship and ownership, Tribes may directly submit information to open data platforms to ensure sole data sourcing and management at the Tribe's discretion. Government agencies can also establish a data review process to ensure data standards are managed and upheld.

## Climate Change Impacts on Tribes

Tribes, with close connections to the air, land and water, continue to observe and be affected by climate change, with trends of warmer temperatures, more rain, less snow, and changes in runoff. Concerns about fluctuations in rainfall quantity affect all Tribal people, especially those living in the desert regions with depleted or stressed water sources resulting from ongoing severe drought conditions. In addition, extreme weather – in the form of droughts and floods – prevents water ceremonies from occurring because of low water levels during droughts and prevents access to areas of cultural significance because of inundation, respectively.

Changes in ecosystems resulting from warmer temperatures are already affecting Tribal peoples who rely on food that is hunted or foraged as a primary means of subsistence. Pine nuts and acorns, which are foraged by many Tribal people, are already seeing a decline caused by climate change. Traditional plants used for basketry or medicinal purposes have a shorter window for harvesting or no longer bloom in the arid conditions. Warmer water temperatures threaten salmon runs fished for subsistence, which is a cultural practice linked to physical and mental health among Tribal members. Increased temperatures are causing harmful algal blooms, which are becoming more common and widespread, making it unsafe to be in the water or consume plants and fish from those waters.

The impact of a changing climate on Tribes introduces special concerns that are often not discussed or considered on the broad scale when policy-makers and the scientific community plan for climate change adaptation. Tribal communities have a close and intimate relationship to the cycles of nature, having studied and adapted over millennia to the specific regions Tribes call home. TEK kept Tribal communities in California thriving through past extreme conditions. Today, Tribes are utilizing and blending TEK, western science, and management techniques to mitigate and adapt to climate impacts (National Park Service 2021). The blending of knowledge is important and can assist California in its journey to combat the effects of climate change.

In Humboldt County, the [Blue Lake Rancheria](#) took action to combat climate change and were one of 16 communities selected as Climate Action Champions by President Obama’s administration (Office of Indian Energy Policy and Programs 2015). The Tribe has invested considerable time and money in energy conservation and renewable energy projects. These projects reduce energy consumption and carbon emissions, making Blue Lake Rancheria a model for other communities seeking climate change resilience.

As California continues to be a leader in building climate resiliency, Tribal communities must be included in State and regional policies, programs, and partnerships that build climate resilience. Early and continued meaningful engagement is key. State agencies must continue their outreach to Tribes to learn and share their perspectives and experiences on climate change. The State must be responsive to Tribal-specific impacts that affect Tribal livelihoods, culture, and traditions. The California Office of Environmental Health Hazard Assessment’s 2022 report, [Indicators of Climate Change in California](#) (Fourth Edition), recognizes the value of Tribal knowledge in its climate assessment and, in so doing, informed climate resiliency strategies. [California’s Fifth Climate Change Assessment](#) will create a Tribal research program to integrate Tribal expertise, TEK, and Tribal input throughout the assessment process.

More on climate change is provided in Chapter 5, “Focus on Supporting Watershed Resilience,” which establishes a policy and planning framework needed to adapt to a changing climate.

### Equity and Tribes

Advancing climate resilience depends on strong partnerships and knowledge sharing among agencies, academics, and communities regardless of economic or social status. As climate change affects everyone, access to water also affects everyone. Equity, a theme of Update 2023, acknowledges long-standing and evident inequities in water management and ongoing efforts by the State and others to reduce those inequities. The Governor’s Office of Planning and Research defines equity as just and fair inclusion into a society in which all can participate, prosper, and reach their full potential (Office of Planning and Research 2023).

What is equity to Tribes? The following are thoughts and opinions shared by Tribal Advisory Committee members at the Tribal Water Summit 2023.

Equity is a broad interpretative term that is difficult to define but easy to show examples of what it is not.

In the water management sector, equity is equal distribution of water to all communities.

In the Tribal community, equity is access to clean, drinking water and more.

Equity is education, an understanding of a Tribe’s struggles with colonialism and why they continue to fight for independence.

Equity is the ability for Tribes to freely exercise their sovereignty.

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There is beneficial equity where a benefit is provided available to all, not to an entitled few.

Equity is being treated with respect and have a seat at the table, especially when it comes to water management planning.  
(Tribal Advisory Committee 2022)

Charlie Toledo, Executive Director for the Suscol Intertribal Council, shares her thoughts on equity.

Social justice means the people who are the most vulnerable and have the fewest resources to respond, are the ones who should be prioritized first for help. The data of where the problems and solutions exist are available, and it is time to implement those solutions. Investments into programs that alleviate pollution, clean water and conserve water is what's needed to address water scarcity. Water conservation on a mass scale where all communities conserve and businesses stop using water as a waste product and start recycling and reusing water will bring a renewed appreciation on the value of water.  
(Charlie Toledo 2022)

Stephanie Seuss, Community and Resources Director with the Chicken Ranch Rancheria of Me-Wuk Indians in Tuolumne County, highlights the ongoing struggle faced by Chicken Ranch Rancheria to secure a sustainable source of water for their community.

Equity and social justice are inextricably linked together, and the history of trauma and mistreatment of Tribes has built barriers they continue to overcome. The water rights system developed by colonizers has handicapped Tribes to search for water in the very region they have lived and managed pre-colonialism.

The Chicken Ranch Rancheria of Me-Wuk Indians of California (Tribe) was established in 1908. In 1961, under the California Indian Reorganization Act, they lost their federal recognition. Then in 1984, the Tribe regained their status as federally recognized subsequent to Tilly Hardwick vs. United States and were able to put three acres of land that had a well back into Trust status to provide for their future. This is their story in pursuing a sustainable, reliable, and independent water supply amidst California's complicated regulatory and drought stricken 21st century.

In 2013, due to the unreliability of the Tribe's fractured rock wells in the Sierra foothills, the Tribe negotiated a short-term water purchase agreement and extended a mile long water line to the local public water utility district to acquire a new water supply. However, early the following year, the district contacted the Tribe to let them know that they could be out of water within a couple of months due to the drought. The Tribal Council did not find this

to be a suitable long-term solution and determined that it would be best for the Tribe to control their own water supply future and embarked on finding a path to that end.

In 2015, the Tribe engaged the help of specialists that understood and had experience in the operations of the Stanislaus River and reached out to the USBR. The Tribe's lands are adjacent to Federal lands all the way to New Melones reservoir. It was believed that as a Federal Agency to a Sovereign Nation there was an opportunity to purchase water from the USBR. The Tribe proposed the "Emergency Water Supply Project". Meetings with USBR showed that no water could be sold to anyone who was not a part of the CVP (Central Valley Project); and to be a part of the CVP literally took an act of Congress. In addition, after much study and critical review of past operational patterns of the river, it was determined that the pump location could likely be out of water for up to 8 consecutive years. Needless to say, this project fell to the side.

This led to a new project, the "Firm Water Supply Project." The question then became, where to locate a pumping system that would always be submerged, 365 days a year. After much research and discussion, the best location was at the base of the New Melones Dam; located approximately 8 miles from Tribal lands and still across Federal lands. However, at this point in the river, the property is owned and operated by Tri-Dam, a consortium between Oakdale and South San Joaquin Irrigation Districts.

Since 2020, the Tribe has been envisioning, designing, and engineering this project through mitigation. This is being accomplished by having engineers and construction teams walking side by side with cultural practitioners, archaeologists, and biologists. This is to ensure this project works with what was once a part of the Tribe's cultural landscapes. Technically, this project is involved. There is a 500-foot pumping lift out of a river canyon, an 8-mile underground conveyance system, and a complex geologic formation to tunnel through that when complete will deliver water to Tribal lands.

The process has not been easy, and the Tribe has never asked for funding, just access across Federal land to build a water conveyance system for water that the Tribe purchased themselves. From an internal perspective, consultation is important and has come a long way among the agencies; going forward perhaps a coordinated agency approach to project review permitting could be considered when Tribes propose shovel ready or co-management plans.

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At the time of this writing, the Tribe continues to work with the USBR on review of environmental documents, engineering, and constructability assessment. Yet to go, is a long-term license for operations and maintenance across Federal lands.

In the meantime, the drought goes on, the river drops and runs from the shoreline, and the Tribe continues to work towards resiliency, self-reliance, and sustainability. They are working with a sense of urgency. Tri-Dam drops their side of the dam every 3 years for inspections. The next time they are scheduled is January of 2024. It would help from a constructability end to work in the dry to set pumps. To be continued. (Stephanie Seuss 2022)

More on equity can be found in Chapter 6, “Understanding and Addressing Equity in the Management of California’s Water Resources.” The chapter discusses strategies and actions applicable to all watersheds and provides guidance to watersheds facing significant injustices.

## Funding Challenges and Opportunities for Tribes

State grant funding has allowed Tribes to construct projects that provide safe drinking water, restore **floodplains**, and improve fish habitat. Yet, these funding opportunities have historically not been accessible to Tribes. In recent years, the State has made progress to include Tribes in State grant funding opportunities. In June 2023, a review of the [California Grants Portal webpage](#) showed more than 70 different grants available to Tribes in the “Environment and Water” sectors. But even with these grant opportunities, Tribes have identified the following challenges and barriers that limit their ability to access State grants:

- Lack of funding and technical assistance to develop competitive grant applications.
- Limited staff to track the numerous grants from various agencies and the different requirements to apply.
- Funding agreements that have, as a condition, limited waivers of Tribal sovereignty.
- Difficulties with cash flow owing to long timelines for reimbursement and retention withholding.
- Preference in many grants for shovel-ready projects and lack of funding for planning projects, capacity building, and project implementation.
- Short timelines for grant guideline comment periods, applications, and expending funds.
- Conflicts between federal and State requirements for federally recognized Tribes (e.g., prevailing wage and requirements under the California Environmental Quality Act [CEQA] and the National Environmental Policy Act [NEPA]).



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In an effort to address these identified challenges, DWR has developed several models of grant implementation that were achieved through government-to-government consultation. These governance documents can be utilized by State and local agencies for continued guidance. For example, developing language addressing limited waiver of sovereignty, addressing CEQA and NEPA issues on sovereign lands, addressing federal versus State minimum hourly wages, and developing a contracting mechanism for Tribal services that includes project implementation, such as pre-construction involvement.

DWR responded by expanding its Disadvantaged Communities Involvement Grant Program to include Tribes and acknowledge their sovereign government status. The new program, named Disadvantaged Communities and Tribal Involvement Grant Program (DACTI), encourages greater engagement of underrepresented communities and Tribes. The program has conducted needs assessments and funds projects benefiting those communities.

Informed by significant Tribal input and collaboration over the last decade, DWR has modified grant policies to overcome these barriers. Since 2021, DWR has awarded \$39.3 million in grant funds to Tribes for 17 drought responses. More information can be found at [Disadvantaged Community and Tribal Involvement \(DACTI\) Work Group](#) (Roundtable of Regions 2023).

Tribal communities have elevated the equity discussion to encompass social and **environmental justice** issues, as well as advance the discussion of what is a disadvantaged community and how Tribes fit within State and federal definitions. There are many definitions of disadvantaged communities (DACs), beginning with State legislation since the late 1990s and incorporation into State programs in the early 2000s. Tribes have requested direct set asides for Tribal grants, so that Tribes are not competing with local agencies or non-profits for limited funds intended for Tribal communities.

DWR published a guidance document, [Disadvantaged Communities Nomenclature Within the State of California: Findings and Conclusions](#) (2022), to address the inequities of funding for DACs and Tribal communities. By looking historically at the evolution and development of terminology used in funding, a broader view of inequities is possible, with the goal of making systemic change and improving State and regional alignment.

At the 2023 Tribal Water Summit, Tribes requested that State and regional agency leadership align statewide definitions to improve understanding and appropriate use of mapping tools and criteria that define communities. They recommended that the State adopt legislation that would use broader criteria when outlining designated funding to support communities most in need of infrastructure development. In addition, Tribes suggested that all grant programs consider direct Tribal funding and minimum set-asides for **frontline communities** in support of their access to grant funding.

Efforts have been made to streamline the grant process. Access to grants through the [California Grants Portal](#) is the single destination for finding all State grants and loans available for competitive and first-serve programs. Similarly, the federal grants portal,

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[Grants.Gov](#), provides a centralized location for grant seekers to find and apply for federal funding opportunities.

The [California Financing Coordinating Committee](#) combines the resources of several State and federal funding agencies to provide a one-stop shop for available grants, loans, and bond financing for infrastructure projects. The CFCC conducts free funding fairs every year to educate the public and offer potential customers opportunities to meet with financial representatives from each agency and learn more about their currently available funding programs.

A State commitment is important to open, inclusive, and regular communication with Tribal governments and communities to recognize and understand their needs and interests. Creating a channel for Tribal governments to provide input on the best way to access State funding and receive technical assistance will support their efforts to implement water management projects that benefit their watersheds for future generations. (For more information on funding and capacity building, see Chapter 6.)

## Strategies and Recommendations for Moving Forward

Strategies identified at previous Tribal Water Summits and in previous Water Plan updates are listed below as reminders of past accomplishments and what still needs to be done to ensure that Tribal perspectives and concerns are appropriately considered in the development of State regulations, rules, policies, programs, projects, plans, property decisions, and activities that may affect their communities. Strategies and recommendations from the 2023 Tribal Water Summit (TWS) are presented in Chapter 8, “Roadmap to Resilience.”

Respect of Tribal sovereignty through early and continuous communication between State and local leaders with Tribal governments (TWS 2018).

Federal, State, and local agencies need to respect Tribal history and connection to the land by working to ensure Tribal access to ancestral homelands to maintain cultural lifeways (TWS 2018).

Crafting resource governance models that include Tribal voices and perspectives with equal authority in decision-making (TWS 2018).

Learning from Tribal elders and acknowledging Tribal Ecological Knowledge (TEK) as a scientific methodology equal to prevailing methods used by the State and incorporating TEK into management actions through partnership with Tribes and culture keepers (TWS 2018).

Understanding and respecting Tribal water rights (TWS 2018).

## Strengths and Resources of California Tribes

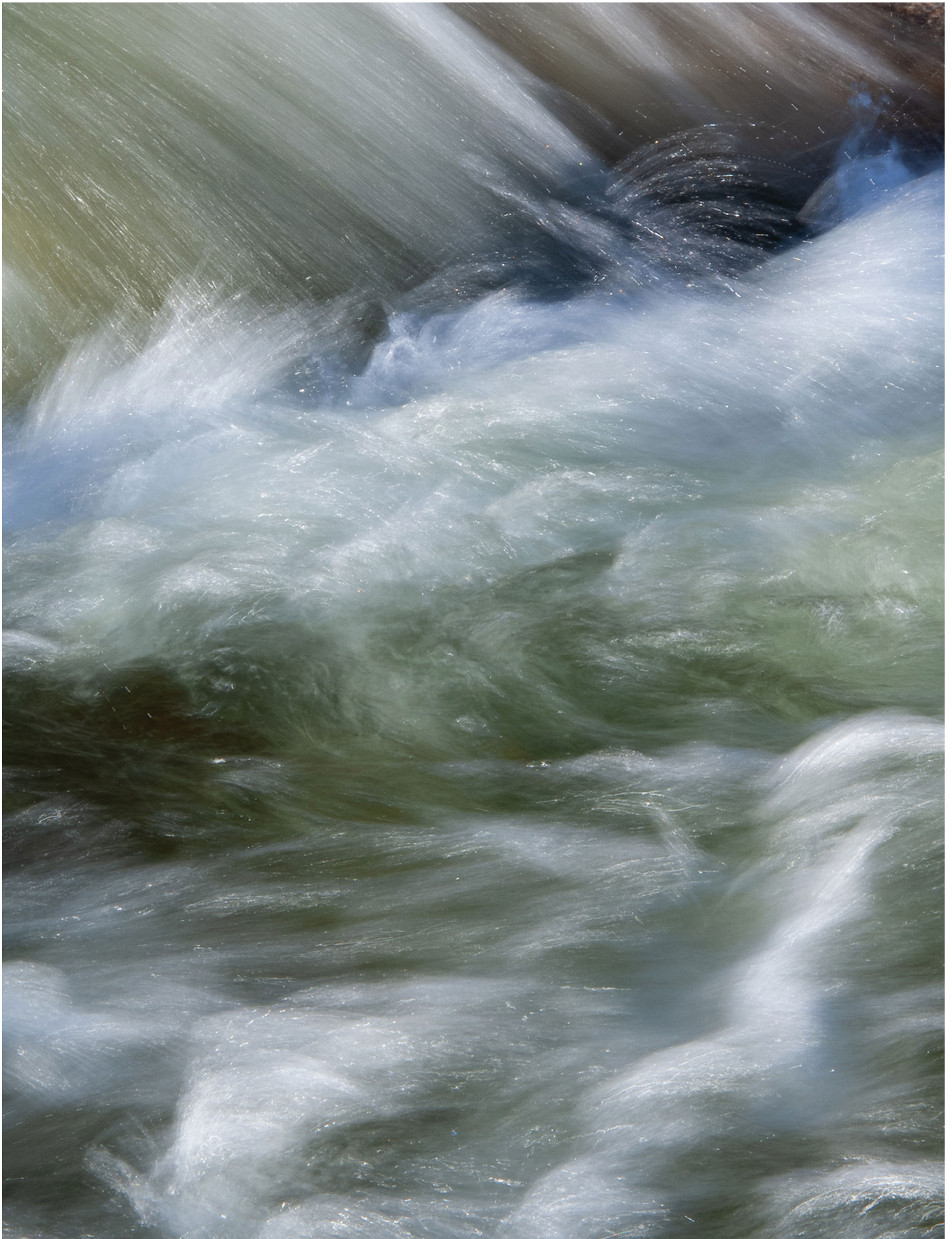
Strengthen relationships with California Native American Tribes, acknowledge and respect their inherent rights to exercise sovereign authority and ensure that they are incorporated into planning and water resource decision-making processes in a manner that is consistent with their sovereign status (California Water Plan Update 2013, Objective 12).

Tribes and State agencies will work together to develop strategies and approaches that better incorporate Tribal Ecological Knowledge into water and water-related resource planning and management activities (TWS 2013).

Tribes and State agencies will work together to develop strategies, educational materials, and recommendations that further the understanding of Tribal uses of water and the broader role of water, and access to water, in Tribal lifeways, including subsistence and cultural practices (TWS 2013).

Tribes and State agencies will work together to develop strategies and options for ensuring greater and early collaboration regarding water resource projects, as well as watershed and land use planning and management activities, especially where decisions affect Tribal trust lands and/or traditional territories/homelands (TWS 2013).

California Tribes live throughout the state, on sovereign and ancestral lands. Their deep connections with water and water resources continues through their traditional and ceremonial use of the land and waterways. California water management planning and strategies to combat climate change and improve watershed resilience must incorporate Tribal values and acknowledge the diversity of Tribes, the lands they reside upon, and the waters they use. State water policies and management strategies must include all Indigenous people of California in an equitable manner to promote their water concerns and needs for the future.



# 8

## Roadmap to Resilience

Objectives, recommendations, and actions for advancing the themes and strategies of *California Water Plan Update 2023* (Update 2023) are outlined in this chapter as a roadmap to **resilience**. The roadmap embodies and builds on the water policies and priorities of the Newsom administration and Legislature, collaboration and alignment among State agencies, and input from California’s diverse communities of place and interest. And it underscores the importance of continuing, enhancing, and accelerating the many ongoing State government programs and initiatives to increase climate resilience and **water equity** for all Californians, as described in Chapter 4, “State’s Role in Creating a Resilient and Equitable Future.”

Update 2023 recommendations and actions will enhance ongoing State activities with stronger State agency alignment; more data-informed decisions; accelerated implementation of multi-sector, multi-benefit actions; and consistent tracking and reporting of State investments.

Implementation of the recommendations and actions is intended to achieve these goals:

- Current and future vulnerabilities from climate change will be better understood and play a greater role in driving water management actions.
- **Watersheds** and the communities and economies they support are more resilient to effects of climate change and other stressors.
- All Californians experience greater equity in the distribution of costs, impacts, and benefits.
- Significant contributions to the Newsom administration’s water and related natural resource priorities, such as [30x30 California](#) and the [California Climate Adaptation Strategy](#).

It will require time, effort, and funding to carry out this plan. The pace of implementation will depend on the feasibility and availability of resources and competing priorities.

## Roadmap to Resilience

### Organization

The roadmap to resilience is organized around these seven objectives:

1. Support watershed resilience planning and implementation.
2. Improve resilience of State, federal, and regional “backbone” built water infrastructure.
3. Improve resilience of backbone natural infrastructure.
4. Advance equitable outcomes in water management.
5. Support and learn from Tribal water and resource management practices.
6. Increase support for regulatory programs and enhance regulatory flexibility to address a changing climate.
7. Provide guidance and support continued resources for implementing actions toward water resilience.

Each objective includes at least one recommendation, and each recommendation includes one or more actions to implement the recommendation. The recommendations were synthesized from preceding chapters and sorted under the seven objectives.

### Objectives and Actions

#### Objective 1: Support Watershed Resilience Planning and Implementation.

California’s watersheds are currently experiencing major climate change challenges that will be magnified in the future. Improving and accelerating climate resilience planning and implementation at the watershed scale will improve water resilience where impacts are most acutely experienced. Recommendations under this objective seek to support and accelerate watershed resilience through priority State actions.

#### **Recommendation 1.1. Improve State Agency Alignment for Watershed Resilience.**

*Action 1.1.1. Align State Agencies to Support Watershed Resilience.*

State agencies should align to support watershed resilience and better respond to climate extremes, such as flood and drought, by sharing challenges and best practices across agencies, identifying opportunities for innovative and prioritized actions, supporting and accelerating multi-benefit projects, and identifying opportunities to leverage and integrate the California Water Plan progress and performance tracking tools. Specifically, State agencies should coordinate their efforts among DWR’s Watershed Resilience Program, the Sustainable Groundwater Management Act (SGMA), regional water quality control plans, the Office of Planning and Research’s (OPR’s) Integrated Climate Adaptation and Resilience Program, California Department of Public Health, California Department of Fish and Wildlife’s Landscape Conservation Planning Program, and the California Department of Conservation’s Division of Land and Resource Protection programs.

*Action 1.1.2. Develop and Support Watershed Resilience Frameworks and Technical Resources.*

DWR will develop and support a watershed resilience planning framework, including guidance, case studies, and technical resources for water resource managers to conduct watershed climate vulnerability assessments and resilience plans. This framework will improve consistency and comprehensiveness of watershed vulnerability assessments and will build upon related frameworks, such as SGMA, DWR's Climate Change Program, OPR's Adaptation Planning Guidance, and the Ocean Protection Council's Sea Level Rise Guidance. The framework also will provide access to common climate projection data sets and analytics, such as those supported by Cal-Adapt, DWR's climate change program, California's Fifth Climate Change Assessment, and the National Oceanic and Atmospheric Administration's sea-level mapping.

### **Recommendation 1.2. Establish a Watershed Resilience Program.**

*Action 1.2.1. Establish Watershed Resilience Program.*

With existing funding, DWR will establish the Watershed Resilience Program, as the next evolution of the Integrated Regional Water Management Program, to accelerate locally led watershed resilience planning and implementation, including financial assistance. This program would expand coordination and emphasize integrated, multi-sector, and outcome-based planning, action, and monitoring in response to climate challenges, as called for in the *Water Resilience Portfolio*. DWR will pilot this program in 2024 and consider statewide implementation in the longer term.

### **Recommendation 1.3. Support Long-Term Sustainability for Critically Challenged Regions.**

*Action 1.3.1. Identify the Regions of the State with High Climate Vulnerabilities and Preparedness Challenges.*

DWR will perform an initial assessment of current and future climate vulnerabilities for all watersheds of the state for a comprehensive set of water resource management sectors. In addition, the level of preparedness of the watersheds will be assessed. Regions that are most vulnerable and least prepared will be identified.

*Action 1.3.2. Prioritize Implementation Actions and State Assistance to Critically Challenged Regions.*

Utilizing the results of Action 1.3.1, in combination with watershed resilience plans, DWR will identify adaptation strategies to assist critically challenged communities, environment, and other resources in these areas. Employing a "whole-of-government" approach, this effort will be coordinated with other State agencies. The State should prioritize implementation of actions and provide State financial and technical assistance for critically challenged regions.

### **Recommendation 1.4. Expand and Improve Monitoring, Reporting, Data, and Decision-Support Tools.**

*Action 1.4.1. Explore Developing Watershed Data and Performance Tracking Hub.*

DWR will explore advancing the current Water Plan Watershed Hub to incorporate statewide and regional watershed resilience (scalable) indicators and explore data and tool

## Roadmap to Resilience

integration opportunities with other similar efforts, such as the California Department of Forestry and Fire Protection's (CAL FIRE's) forest data hub, OPR's vulnerable communities platform, and the California Natural Resources Agency's Resources Agency Project Tracking and Reporting (RAPTR) efforts. This action includes exploring opportunities to continue to enhance data collection such as expansion of California's stream gauge networks and identification of linkages between aquifer systems within watersheds.

*Action 1.4.2. Improve Water Plan Data and Analytical Tools.*

For California Water Plan Update 2028, DWR will work with other State agencies, including the State Water Resources Control Board (State Water Board), to expand the **future scenarios** model studies from the Central Valley toward statewide coverage with standardized climate vulnerability assessments and adaptation strategy evaluations; accelerate the release of annual **water balances**; develop a water accounting system of historical and future **water budgets**; and strengthen the alignment of open data and analytical tools used by DWR, State agencies, and regional water programs.

### **Objective 2: Improve Resiliency of "Backbone" State, Federal, and Regional Built Water Infrastructure.**

Recognizing that most watersheds in California are interconnected and dependent on State, federal, and regional built water infrastructure, statewide water resilience can only be achieved with improvements to the resiliency of these backbone systems. The recommendations under this objective seek to improve existing **built backbone infrastructure** systems, adapt operations for climate change, increase integration of these systems, and improve information sharing.

#### **Recommendation 2.1. Reinvest in and Modernize Built Backbone Infrastructure Systems.**

*Action 2.1.1. Modernize and Expand Backbone Conveyance Systems.*

The State should prioritize and support investments to modernize and expand State, federal, and regional conveyance systems that provide benefits to multiple regions. This effort also should include repairing and improving aging or damaged infrastructure to facilitate **groundwater recharge**, wildfire protection, system flexibility, and other outcomes intended to improve resiliency.

DWR and The State Water Project (SWP) contractors will continue investing in existing SWP assets to maximize operational flexibility of the SWP and thus better store and convey water resulting from more frequent extreme events. Specific actions include California Aqueduct Subsidence Program, SWP Asset Management program, and ongoing capital investments in SWP infrastructure.

*Action 2.1.2. Improve Dam Safety and Restore Storage Capacity in Reservoirs.*

Accelerating repairs, rehabilitation, or removal of deficient dams will improve life safety and allow for restoration of storage capacity in many reservoirs. Recognizing that there is a need to aid dam owners with these actions, DWR will implement a new grant program to provide funding to address deficient dams (California Water Code Section 6300). DWR will also implement civil administrative enforcement actions against non-compliant dam owners for the purposes of protecting life and property.



**Recommendation 2.2. Adapt and Expand Existing Systems for Climate Change.***Action 2.2.1. Maximize Operation of Systems for Changing Climate.*

DWR will evaluate the potential of existing water resource management systems to be operated for the anticipated hydrological shifts resulting from climate change and continue to provide benefits. DWR will specifically evaluate the potential for adaptive operations, such as forecast-informed reservoir operations (FIRO), for the SWP to accommodate climate change and increasing variability consistent with Phase 3 of DWR's *Climate Action Plan*. In addition, DWR will continue to support other backbone system managers to investigate adaptive operations of those systems and seek alignment on specific types of actions that could be taken to better adapt water management to respond to climate change.

*Action 2.2.2. Expand SWP Storage and Conveyance Capacity.*

The SWP and potential federal and local partners will explore opportunities to expand SWP storage and conveyance capacity (including Delta conveyance) to help regulate supplies under increasingly extreme hydrology (e.g., **weather whiplash**) and capture more water during wet periods for use in dry periods.

*Action 2.2.3. Reduce Risks to California Parties using Colorado River Water.*

Support efforts of the Colorado River Board of California and water providers in Southern California dependent on Colorado River water to reduce and respond to risks caused by Lower Basin supply and demand imbalances, "structural deficit," and long-term decline in available Colorado River water supply. Increase flexibility, exchanges, and storage to improve the quality and certainty of Colorado River water supply, particularly during post-2026 guidelines development.

**Recommendation 2.3. Increase Integration of State, Federal, and Regional Built Backbone Systems.***Action 2.3.1. Identify Opportunities for System Integration.*

DWR will identify opportunities where integration of existing or planned systems and programs could expand benefits and more effectively adapt to changed conditions. DWR will work with willing partners to identify and support interties, operational agreements, and exchanges of water and wheeling capacity that improve quality, flexibility, and resilience. Evaluation of integration potential will include the Water Storage Investment Program facilities, groundwater banks, regional aqueduct interties, and regional reuse or desalination programs.

*Action 2.3.2. Expand Water Supply Portfolio in Colorado River Dependent Areas.*

Expand water supplies (e.g., additional SWP storage options, urban stormwater capture, regional reuse, stormwater capture and use, or desalination) available to the Colorado-River-dependent areas in California to increase reliability and resilience.

*Action 2.3.3. Evaluate Opportunities for Alternative Management of Backbone Systems.*

Much of the built water infrastructure in California was constructed more than 50 years ago. In many cases, the management of these infrastructure systems has evolved considerably. In some cases, the management of these systems has incrementally

## Roadmap to Resilience

changed such that the current operations and benefits are substantially different than those originally intended. DWR will work with partners to evaluate opportunities for alternative management of backbone systems for improved water supply reliability among environmental, agricultural, and urban sectors.

### **Recommendation 2.4: Improve Data, Analysis, and Information-Sharing to Support Integrated Water Management and Planning.**

#### *Action 2.4.1. Improve SWP Delivery Capability Report.*

DWR will ensure that SWP water users and the public have transparent, risk-informed information about SWP capabilities by making key improvements to the SWP Delivery Capability Report and issuing documentation of SWP drought planning activities. Improvements will include use of climate-adjusted hydrology; evaluation of science-driven and system risk-informed future scenarios; and model updates for recent operational, regulatory, and physical conditions.

#### *Action 2.4.2. Continue Use of State-of-the-Art Monitoring and Forecasting.*

DWR will work with other State agencies to continue the use of state-of-the-art monitoring and forecasting networks and tools to optimize operations, thereby reducing flood risk, increasing water storage, and maximizing statewide electrical grid support. Recognizing the unevenness in availability and quality of forecasting throughout the state, as well as climate influences on hydrological forecasting, DWR will explore additional forecasting tools, such as FIRO, and approaches and make them available statewide. DWR also will implement its draft Roadmap for Climate Resilient Forecasting.

#### *Action 2.4.3. Expand the Use of Open Data for Water Management.*

The Open and Transparent Water Data Act (Assembly Bill 1755 [Dodd 2016]) requires DWR, in consultation with the California Water Quality Monitoring Council, the State Water Board, and the California Department of Fish and Wildlife, to create, operate, and maintain a statewide integrated water data platform. Much of the water data currently housed in the Open Data platform is associated with water rights and groundwater monitoring and management. DWR will coordinate with the other State agencies to expand the use of the data platform by other State and local programs for better informed management and accessibility of water resources in California.

### **Recommendation 2.5. Improve Integration of Water, Energy, and Agricultural Systems.**

#### *Action 2.5.1. Expand Understanding and Application of Integrated Water, Ecosystem, Energy, and Agricultural Systems.*

The State should expand understanding of the linkage between water, energy, and agricultural systems and the relative impacts of changes in one on the others. The State should improve the application of integrated water (quality and quantity), energy, and agricultural system measures to support future management of these systems.

#### *Action 2.5.2. Support and Integrate California Department of Food and Agriculture Climate-Smart Agriculture Programs.*

The State should continue to support and integrate the California Department of Food and Agriculture's Climate-Smart Agricultural programs with other resilience efforts, such as

SGMA. Programs that encourage improved manure management practices, healthy soils, and water efficiency can conserve water and protect water quality.

**Recommendation 2.6. Continue and Increase Water Use Efficiency Efforts to Reduce Water Demands in all Sectors.**

*Action 2.6.1. Continue to Support Urban and Agricultural Water Use Efficiency Efforts.*

As part of a diverse water portfolio, the State should continue to encourage urban and agricultural water use efficiency efforts, as summarized in the respective California Water Plan resource management strategies. Implementing the recommendations provided in the agricultural and urban resource management strategies will reduce agricultural and urban demands in the state.

**Objective 3: Improve Resiliency of Natural “Backbone” Infrastructure.**

The resilience of built infrastructure is intrinsically linked to the resilience of natural infrastructure. Recognizing this interdependence, the recommendations under this objective seek to improve the resilience of natural infrastructure through accelerated ecosystem restoration and identifying critically important ecosystem hubs and groundwater basins.

**Recommendation 3.1. Expand and Accelerate Ecosystem Restoration.**

*Action 3.1.1. Expand and Accelerate Ecosystem Restoration.*

The State should expand and accelerate ecosystem restoration to protect, restore, and enhance the provision of ecosystem services. Protection and restoration of natural communities by employing nature-based solutions should be prioritized and accelerated while recognizing that restoration often occurs within highly altered environments. This will allow more flexible or extensive use of built infrastructure while protecting or expanding ecosystem services.

*Action 3.1.2. Manage Aquifers as Natural Infrastructure Having Multi-Benefit Ecosystem Services to Accelerate Replenishment and Remediation Actions.*

Building upon Senate Bill 122’s definition of aquifers as natural infrastructure, and Senate Bill 659’s call to provide actionable recommendations to develop additional groundwater recharge opportunities that increase the recharge of the state’s groundwater basins, the State should recognize aquifer replenishment and remediation actions as a public benefit eligible for State technical and regulatory assistance. It should also build on SGMA, Flood-MAR, and ensure the State Water Board has the capacity to process water rights and permitting of groundwater recharge efforts during wet years while avoiding injury to other legal users of water, protection of water quality, and protection of the environment.

The State should continue to characterize and understand its groundwater basins and associated aquifers and natural groundwater resources infrastructure; and to identify and establish infrastructure needs so that surface water resource natural and built infrastructure can be integrated to optimally facilitate the transfer of water in a true conjunctive management framework.

## Roadmap to Resilience

The State should work toward compiling a publicly available list of the locations, types, and volumes of all conjunctive management operations in the state and make the information available to water managers for preparing water budgets and water accounting.

### *Action 3.1.3. Improve Wildfire Resilience in California's Watersheds.*

The State should accelerate wildfire resilience efforts in California's high-risk watersheds. Recognizing the interplay between forest health, wildfires, water supply, flood management, and water quality, DWR will coordinate with the California Wildfire and Forest Resilience Task Force to identify critical watersheds where direct action can be developed or supported to improve resilience. To that end, DWR will continue to evaluate actions and appropriately respond to wildfire impacts in the Feather River watershed, as the primary contributing watershed for the SWP.

## **Recommendation 3.2. Improve Resilience of Major Natural Systems.**

### *Action 3.2.1. Restore Ecological Function and Climate Resilience in the Sacramento-San Joaquin Delta.*

Support programs that restore ecological function and promote climate resilience per recommendations in *The Delta Plan*, the State Water Board's Bay-Delta Plan, biological opinions, voluntary agreements, and the *California Climate Adaptation Strategy*, to reduce conflicts between water management and ecosystem health.

### *Action 3.2.2. Incentivize Land Use Changes on Subsidized Lands in the Sacramento-San Joaquin Delta.*

The State should continue to support programs that incentivize land use change on the highly organic and deeply subsidized lands within the Delta per recommendations in *The Delta Plan*, the 2023 Scoping Plan, and the forthcoming Climate Adaptation Strategy. Such land use changes as conversion to rice cultivation or managed wetlands re-saturates the land, thereby reducing subsidence and thus the risk of levee failure that threatens the region and Central Valley Project and SWP facilities. This also reduces greenhouse gas emissions by slowing the breaking down of peat soils. These practices can improve the long-term resilience and economic viability of the region.

### *Action 3.2.3. Continue Implementation of Restoration at the Salton Sea.*

Recognizing that restoration of the Salton Sea is integral to water supply resiliency on the Lower Colorado River and major ecosystem services for California. The State should continue to support resources to complete habitat restoration and playa dust suppression projects identified in the *Salton Sea Management Program Phase I: 10-Year Plan* (2018). The State should continue to partner with the U.S. Army Corps of Engineers and local partners for implementation of the public draft *Salton Sea Long-Range Plan* (2022).

### *Action 3.2.4. Evaluate Opportunities to Reduce Pressures on Owens and Mono Lakes through Support for Southern California Reuse Programs.*

Recognizing that the waters from the Owens and Mono lakes watersheds are the source of supply for a large portion of Southern California, enhancing the water supply in the region with large-scale urban stormwater capture and water reuse could reduce the pressures on

these source watersheds. Consistent with the governor's *Water Supply Strategy*, targeted investments in reuse supplies could significantly increase the resilience of the Southern California region, the state's most populated area.

**Recommendation 3.3. Improve Aquifer Management, Replenishment, and Resilience.**

*Action 3.3.1. Increase Opportunities for Managed Aquifer Recharge.*

DWR will identify opportunities to enhance managed aquifer recharge by local governments and landowners. DWR will analyze major rivers and tributaries to establish known conditions of flood stage to enable flood water capture and diversion for managed aquifer recharge and storage and flood risk reduction. This action supports a statewide feasibility study for managed aquifer recharge to assess optimum locations for replenishing aquifers and identifying potential additional or modified statewide infrastructure needs. The State should establish processes and conditions for programmatic permitting to accelerate groundwater recharge programs at the local and regional scale, including evaluation of safeguards related to water quality and drinking water.

California should continue to investigate ways to capture excess stormwater and flood flows, especially during extreme atmospheric river events, for groundwater recharge to replenish aquifers and augment supplies for later use. The recently enacted California Water Supply Solutions Act of 2023 (SB 659) is a step in this direction and requires DWR to establish actionable recommendations to develop additional groundwater recharge opportunities that increase the recharge of the state's groundwater basins.

Consistent with the Water Supply Strategy and where economically feasible, the State should encourage using recycled municipal water or desalinated brackish groundwater or seawater as sources of supply for recharging local aquifers.

*Action 3.3.2. Advance Strategies that Halt or Minimize Land Subsidence.*

DWR will promote and advance strategies that halt or minimize land subsidence by reducing groundwater extraction and increasing groundwater recharge in regions with known or increasing land subsidence that may affect critical infrastructure including water conveyance, flood control, transportation, and utilities. This action will leverage related and on-going efforts such as SGMA and the California Aqueduct Subsidence Program.

The State should continue to provide statewide subsidence data, such as the statewide Interferometric Synthetic Aperture Radar (InSAR) and groundwater-based monitoring stations, that informs land management.

*Action 3.3.3. Increase Coordination with Land Use Planning.*

The State should support local coordination and alignment of land use planning and groundwater management to improve water supply reliability across residential, agricultural, and environmental needs and reduce groundwater demand. This should include expanding land transition and strategic land repurposing efforts to balance distribution of agriculture, ecosystem, and domestic land uses; and to advance strategies to improve local well permitting practices. Included would be improved alignment of the planned use of groundwater with local basin groundwater sustainability goals and

## Roadmap to Resilience

identification of optimal areas for enhanced recharge and critical connections in aquifer systems to enable local governments to maximize opportunities for managed aquifer recharge.

### *Action 3.3.4. Advance Data-driven Decision-making in Groundwater Management.*

Groundwater data and information are critical for improving the understanding of groundwater basins and their hydrogeologic characteristics. The State should strengthen and support long-term groundwater data collection programs at State, local, and regional levels to expand spatial coverage and increase the frequency of data collection. The State should enhance SGMA reporting systems and align them with the Open and Transparent Water Data Act (AB 1755) to make groundwater data easily accessible, useful, timely, and transparent to support short-term and long-term planning for sustainable groundwater management, support enhancement of existing groundwater-level data collection programs to expand spatial coverage, and increase the frequency of groundwater-level measurements. This would improve understanding of the seasonal variations and enable more timely and better-informed decision-making. The State should support and collaborate with local agencies on the application of new technologies and tools for geologic and hydrogeologic characterization of groundwater basins and water budgets to inform long-term planning for sustainability under average and dry conditions.

### *Action 3.3.5 Maintain Momentum for Sustainable Groundwater Management.*

The State's assistance and assessment programs should empower local agencies to manage groundwater more diligently and comprehensively. The State should continue to enhance existing planning, technical, and financial assistance as part of its statewide groundwater management efforts, so that local agencies, working with their interested parties, can maintain momentum toward their long-term goals of sustainable groundwater management. The State should promote and support groundwater projects that achieve multiple benefits to reduce statewide overdraft, replenish and remediate aquifers, reduce drought risks, and secure ecosystem benefits.

## **Objective 4: Advance Equitable Outcomes in Water Management.**

Recognizing that current inequities exist in California's institutional systems and that resilience for California must include resilience for all, the recommendations under this objective emphasize improving community outreach and engagement, local capacity building efforts, and access to State assistance programs.

### **Recommendation 4.1. Create Opportunities for Meaningful Outreach and Engagement**

#### *Action 4.1.1. Host a Public Environmental Justice Summit.*

Similar to the Tribal Water Summit, the State should host a public **environmental justice** summit for each iteration of the California Water Plan to ensure ongoing feedback, continuing education, and improved transparency.

#### *Action 4.1.2. Establish an Environmental Justice and Equity Advisory Group.*

In support of California Water Plan updates, relevant State agencies will convene and leverage existing environmental justice and equity advisory groups to inform plan

content. Additional representatives from environmental justice, Tribal, and other **frontline communities** will be recruited.

*Action 4.1.3. Expand Avenues for Diverse Voices to be a Part of All Stages of the Decision-making Process.*

The State and local entities should build upon and expand models for community involvement, including meeting facilitation, language access services, and financial compensation for participation.

*Action 4.1.4. Harness Members of the Public through Community Science.*

State and local entities should leverage community member expertise to co-create water management solutions for upholding the human right to water. Examples include water quality testing and data collection, analysis, and monitoring; and sharing results with community members.

**Recommendation 4.2. Build Community Capacity and Resilience.**

*Action 4.2.1. Invest in the Next Generation of Community Water Leaders and Operators.*

The State and local entities should provide sponsorship for water leadership programs, community science programs, workforce development programs, apprenticeship programs, development of PK-12 student curriculum, and other forms of policy and technical skill development.

*Action 4.2.2. Continue to Implement the Drinking Water Well Principles and Strategies Framework.*

The State should continue to implement this framework to ensure that the potential impacts of drought are considered in planning efforts and are proactively addressed for groundwater-reliant communities.

*Action 4.2.3. Support Dedicated Positions for Coordination and Cooperation.*

The State should support and integrate positions dedicated to community engagement, interagency coordination, and technical assistance.

*Action 4.2.4. Incentivize Efficient and Equitable Land Use Practices.*

The State Legislature should define efficient and equitable land use practices and support programs that incentivize actions. Actions for consideration may be multi-benefit repurposing land use for aquifer replenishment and **floodplain** recharge along riverine corridors, that consider workforce impacts.

*Action 4.2.5. Support Targeted Resources to Support Frontline Community Members.*

The State should support targeted resources such water quality testing for domestic well owners, water use efficiency measures within households (e.g., appliance and turf replacements), and low-income rate assistance programs.

*Action 4.2.6. Improve Community Understanding of Social and Climate Vulnerabilities.*

The State should inventory, assess, and streamline State equity data tools to improve public understanding of social and climate vulnerabilities. The State should also prepare

## Roadmap to Resilience

informational materials to enhance public understanding of key water management challenges.

*Action 4.2.7. Survey Water Agencies and Districts on Their Progress in Advancing Environmental Justice and Equity.*

For each Water Plan update, DWR will survey water agencies and districts on their progress to advance environmental justice goals and achieve equity within their service areas. This survey would include topics such as outreach and engagement efforts, services provided, workforce data, and affordability considerations. Results will be documented in California Water Plan Update 2028 and will be used to inform resource and policy needs.

### **Recommendation 4.3. Improve Access to and Outcomes of State Resources.**

*Action 4.3.1. Evaluate Barriers to State Financial Assistance.*

The State Legislature should continue to evaluate grant administrative authorities to include the use of advance pay and waiving local cost-shares. State agencies should support improved application assistance and expedite disbursement of allocated funds.

*Action 4.3.2. Seek Alignment Across State Equity Terminology.*

Bringing alignment to equity terminology can help to expand program eligibility for technical and financial resources to include all vulnerable communities. Examples of terminology that are inconsistent include disadvantaged community, under-resourced community, priority populations, and socially vulnerable.

*Action 4.3.3. Explore Additional Opportunities for Funding Operations and Maintenance.*

The State should engage with local agencies in frontline communities to understand gaps in local operations and maintenance financing capacity and explore solutions to reduce the burden of water affordability while building system resilience.

*Action 4.3.4. Report State Progress on Advancing Environmental Justice and Equity.*

Similar to the federal Environmental Justice Scorecard, State agencies should report progress on advancing environmental justice and equity to improve transparency and accountability with the public. DWR will collect and report results in future Water Plan updates to inform resource and policy needs.

*Action 4.3.5. Accelerate Consolidations for Consistently Failing or At-Risk Systems.*

Accelerate system consolidations to stabilize consistently failing or at-risk water systems when State and local assistance prove insufficient. Continue to explore and promote opportunities for regional-scale consolidations, where appropriate.

### **Objective 5: Support and Learn from Tribal Water and Resource Management Practices.**

**California Tribes** have a long history of sustainable water and resource management practices. But Tribal communities also face a growing number of water management challenges related to water rights, infrastructure development, engagement, and funding. The recommendations under this objective seek to support strategies to address these challenges and support and learn from Tribal water management practices.



**Recommendation 5.1. Strengthen partnerships with California Tribes that acknowledge and respect their sovereign authority and ensure that Tribes are included in planning and water resources decision-making processes, consistent with their sovereign status.**

*Action 5.1.1. Support Tribal Engagement with State Funding Programs.*

DWR will engage with the Department of General Services to explore existing State contracting guidelines, the required language of general terms and conditions, and other required State contracting forms to ensure and support Tribal engagement with State funding programs. One example for consideration is adoption of the Public Entity Agreements (developed by DWR) for contracting between State agencies and California Tribes.

*Action 5.1.2. Support Tribal Engagement in Programs, Projects, and Activities Respectful of Tribal Beneficial Use Designations.*

State agencies should engage with Tribes early in decision-making and program development to support Tribal engagement in programs and projects and support activities respectful of Tribal beneficial use designations. Specific funding to Tribes is essential to ensure Tribal engagement and to acknowledge the subject matter expertise of Tribal partners.

*Action 5.1.3. Consider Impacts on Tribal Cultural Resources.*

State and federal agencies should consider impacts on Tribal cultural resources in their review of water management decisions on water transfers and other resource management strategies.

**Recommendation 5.2. Collaborate with Tribes to incorporate Indigenous Knowledge (or Tribal Ecological Knowledge) into California water policy, planning, and projects.**

*Action 5.2.1. Provide Staff Training to Increase Awareness about California Tribes.*

State and federal agencies should increase staff training on Tribal engagement best practices, Tribal history, cultural sensitivity, and working with Indigenous Knowledge.

*Action 5.2.2. Educate Water Managers Regarding Tribal Perspectives and Resources.*

State agencies, including DWR, should convene a conference and provide training to educate water managers on Tribal water rights, Tribal water transfers, Indigenous Knowledge, and other Tribal water issues.

*Action 5.2.3. Develop Guidance on Data Collection, Management, and Sharing.*

Office of Planning and Research should develop guidance on data collection and management and sharing protocols when collaborating with Tribes on Tribal expertise, data, and Indigenous knowledge to ensure data are not causing harm, misuse, or misappropriation.

## Roadmap to Resilience

*Action 5.2.4. Protect Tribal Data Sovereignty, Intellectual Property, and Confidentiality.*

Utilizing guidance from Action 5.2.3, policies and regulations should be developed to protect **data sovereignty**, intellectual property, and confidentiality associated with Indigenous Knowledge.

*Action 5.2.5. Increase Tribal Involvement in State Agency Water-Related Activities.*

State agencies should explore administrative procedures that would enable financial assistance for Tribal involvement in State agency water-related activities.

*Action 5.2.6. Support Tribal Infrastructure Development.*

State and federal government should support infrastructure development that facilitates Tribal water storage, leasing, and transfers.

### **Recommendation 5.3. Collaborate to further understand Tribal water quality, ecosystems, and access to water, to support Tribal lifeways including subsistence and cultural practices.**

*Action 5.3.1. Support Tribal Lifeways and Cultural Practices.*

State agencies should collaborate with Tribes to prioritize objectives for water quality and quantity that support aquatic health and resilience relevant to Tribal lifeways and cultural practices.

*Action 5.3.2. Continue Co-Management Agreements with Tribes.*

State agencies should continue using co-management agreements with Tribes to protect and enhance ecosystems, as well as support such conservation efforts and nature-based solutions to recognize Tribal connections and access to ancestral land. State agencies should build partnerships that include long-term financial assistance for co-management or returning lands to Tribes for their stewardship.

*Action 5.3.3. Support Tribal Climate Change Research.*

The State should support Tribal climate change research to assess climate vulnerability and evaluate adaptation strategies that utilize Western science and Indigenous Knowledge.

## **Objective 6: Support and Increase Flexibility of Regulatory Systems.**

Update 2023 details how climate change is driving a need for planning and projects capable of addressing future uncertainties. It also discusses the need to fully support regulatory programs and to ensure that they are flexible and adaptive enough to meet the challenges of a changing hydrology. The recommendations under this objective seek to support that and other related outcomes.

### **Recommendation 6.1. Support Regulatory Processes with Robust and Consistent Data for Decision-Making.**

*Action 6.1.1. Improve Data for Regulatory Decision-Making.*

Recognizing that robust data supports improved understanding, more aligned regulation, and the foundation for future changes, the State should support current and future regulatory processes with robust and consistent data for decision-making.

### **Recommendation 6.2. Increase Efficiency and Efficacy of Regulatory Systems to Meet Needs of a Changing Climate.**

*Action 6.2.1. Explore Broader Application of Flexible Regulatory Approaches.*

The California Natural Resources Agency and CalEPA should jointly explore opportunities to apply the Cutting Green Tape Initiative approach to a broader suite of actions, such as those that improve resilience of natural and built infrastructure at watershed scales. Identify and resolve regulatory uncertainties that could impede project construction and operation without compromising the intended outcomes of regulations.

*Action 6.2.2. Engage State Agencies to Identify Statutory and Regulatory Changes.*

DWR, in consultation with State agencies, will identify potential statutory and regulatory changes to facilitate and streamline water-resource project approval and completion and provide recommendations to the Newsom administration's Infrastructure Strike Team (established in Executive Order N-8-23) for consideration.

*Action 6.2.3. Enable DWR to Acquire or Manage Water Rights to Facilitate Sustainability and Resiliency.*

DWR will explore the potential for acquiring or managing water rights for the public benefit in certain areas where jurisdiction is challenging but benefits are broadly public (e.g., flood waters for recharge, drought banks).

### **Recommendation 6.3. Explore Water Right Process and Procedures for Adapting to Changing Climate.**

*Action 6.3.1. Modernize Water Rights Data to Facilitate Adaptive and Real-time Decisions.*

The State should continue to modernize water rights data to allow for adjustments to changing hydrological conditions and climate change. To make a century-old water rights system work in this new era, the State Water Board needs accurate and timely data, modern data infrastructure, and increased capacity to halt water diversions when the flows in streams diminish. These improvements are a necessary predicate to modernize the water rights system in a manner that respects water right priorities and aligns with current public values and needs. The State Water Board is implementing the Updating Water Rights Data for California (UPWARD-California) project. UPWARD-California will modernize the State's water-rights data management system, digitize paper records, and create a 21st-century data system to help California respond to drought and ensure long-term water resilience.

*Action 6.3.2. Facilitate Collaborative Approaches toward Meeting Regulatory Objectives.*

The State should continue to support opportunities to meet regulatory objectives in creative, collaborative ways, including voluntary solutions (with regulatory backstops) such as the Sacramento-San Joaquin Delta Voluntary Agreements, that enhance flows and habitats.

### **Objective 7: Provide Guidance and Support Continued Resources for Implementation of Actions toward Water Resilience.**

Sustainable resources are essential for creating more resilient water-resource management systems, which are foundational to adapting to an increasingly variable hydroclimatic

## Roadmap to Resilience

regime of swings between drought and flood. Developing statewide and watershed resilience requires local, State, and federal investments and unique approaches to sustainable funding. The recommendations under this objective seek to align resources with the needs of California water management.

### **Recommendation 7.1. Provide Funding for Watershed Resilience Programs.**

*Action 7.1.1. Leverage Emerging Funding Opportunities to Advance Water Plan, Water Resilience Portfolio, and Water Supply Strategy Priorities.*

DWR and other State agencies should consider using future general obligation bonds to implement Update 2023's recommendations that require capital investment. This action should include State assistance for actions that produce water resilience [public] benefits at a statewide scale.

*Action 7.1.2. Coordinate and Align Watershed Resilience-Related Programs and Investments.*

DWR will explore opportunities to improve the efficacy of financial assistance programs, technical assistance programs, and State agency approaches to implementing the Update 2023 vision for improving watershed resilience.

*Action 7.1.3. Improve Grant Application Requirements.*

The State should explore how best to simplify grant applications and expand eligibility, such as the expanded use of block grants, to support a broader range of projects.

*Action 7.1.4 Provide State Assistance for Small Community Water Systems.*

The State should provide targeted assistance for the operations, maintenance, water system consolidation, and other strategies for certain small community water systems and build on The Safe and Affordable Drinking Water Fund (SB 200), which allocated funds to help water systems provide an adequate and affordable supply of safe drinking water.

*Action 7.1.5. Support Funding for Water Plan Data and Analysis.*

The State should provide support for core Water Plan functions, such as collecting, updating, and analyzing the land and water use data necessary for completion of the plan and supporting other State water-planning efforts that rely on the data.

*Action 7.1.6. Develop Framework for Quantifying Investment in Source Watersheds.*

The State should develop a framework for quantifying investment needed to make source watersheds more resilient and establish an approach that incentivizes proportional investment by the beneficiaries of source watersheds.

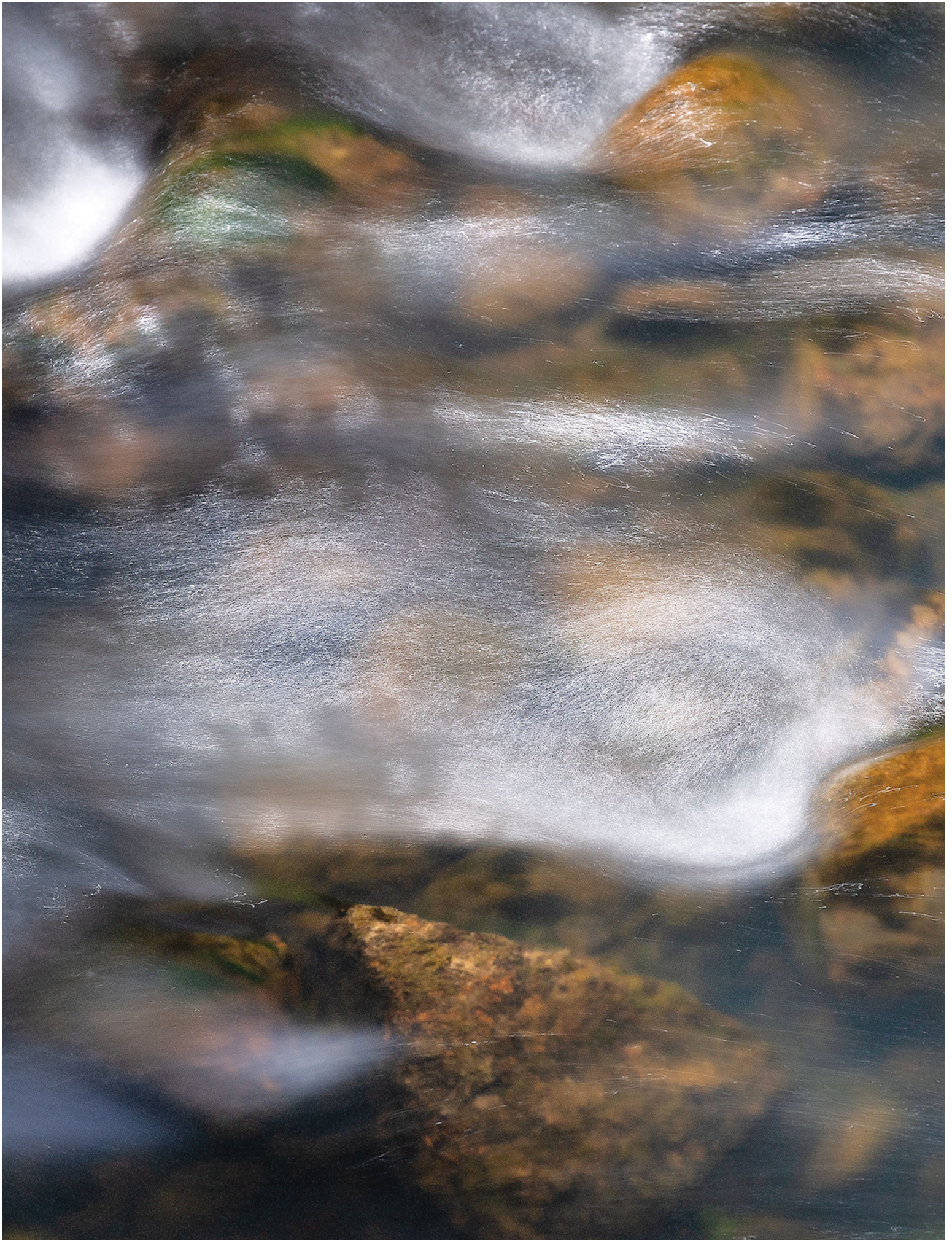
## The Way Forward

Update 2023 is a comprehensive Water Plan intended to increase understanding of the pressing issues, uncertainties, and vulnerabilities in California water management today, and to resolve them by aligning existing and proposed water initiatives. This plan embodies the aspirations, challenges, and priorities of State government, California's diverse communities, and watersheds. It frames the needed policies, authorizations,

and enabling conditions for State, federal, Tribal, regional, and local partners to jointly implement Update 2023 strategies and actions. Specifically, the following enabling conditions are necessary to meet the plan’s objectives:

- The administration explores changes to enabling water policies and legislation, if needed, to implement these actions.
- Local and regional water sectors and jurisdictions begin partnering, planning, and acting as **watershed networks** to jointly assess their climate vulnerabilities, evaluate multi-sector **adaptation** strategies, and implement multi-benefit projects to improve regional and inter-regional resilience.
- Communities of interest and place and elected officials unite around the State’s vision and priorities for California water – act upon climate urgency, watershed resilience, and equity in water management; participate in the implementation of Update 2023 actions; and agree to learn and adapt by tracking progress and outcomes with consistent indicators and metrics.

California has the capacity and resolve to meet its water and climate challenges, create economic opportunity, and improve public and environmental health and safety with the strong alignment of State, federal, Tribal, and local leadership; public-private-partnerships; collaborative, multi-sector actions and co-management; research and technology; and community engagement.



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No references.

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United Nations Department of Economic and Social Affairs. 2007. "United Nations Declaration on the Rights of Indigenous Peoples" New York City (US): Department of Economic and Social Affairs. [Government Report.] Viewed online at: <https://www.un.org/development/desa/indigenouspeoples/declaration-on-the-rights-of-indigenous-peoples.html>. Accessed: Oct. 17, 2023.

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## Chapter 8

No references.







# Useful Web Links

California Water Plan Update 2023

<https://water.ca.gov/Programs/California-Water-Plan/Update-2023>

## Chapter 1

Water Resilience Portfolio

<https://resources.ca.gov/Initiatives/Building-Water-Resilience/portfolio>

Water Supply Strategy

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf>

## Chapter 2

State Water Resources Control Board stream health portal

[https://mywaterquality.ca.gov/eco\\_health/streams/condition/index.html](https://mywaterquality.ca.gov/eco_health/streams/condition/index.html)

## Chapter 3

30 x 30: Accelerating Conservation of California's Nature

<https://www.californianature.ca.gov/pages/30x30>

Assembly Bill 1755: The Open and Transparent Water Data Act

<https://water.ca.gov/ab1755>

California Climate Adaptation Strategy

<https://climateresilience.ca.gov/>

California Climate Change Assessments

<https://opr.ca.gov/climate/icarp/climate-assessment/>

## Useful Web Links

California Department of Forestry and Fire Protection's Fire and Resource Assessment Program

<https://frap.fire.ca.gov/>

California Department of Water Resources

<https://water.ca.gov>

California EcoRestore

<https://water.ca.gov/Programs/All-Programs/EcoRestore>

California's Groundwater Update 2020 (Bulletin 118)

[https://data.cnra.ca.gov/dataset/calgw\\_update2020](https://data.cnra.ca.gov/dataset/calgw_update2020)

California's Healthy Soils Initiative

<https://www.cdfa.ca.gov/healthysoils/>

California's Wildfire and Forest Resilience Action Plan

<https://wildfiretaskforce.org/wp-content/uploads/2022/04/californiawildfireandforestresilienceactionplan.pdf>

California Water Supply Strategy

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf>

California Water Data Consortium

<https://cawaterdata.org/>

Central Valley Flood Protection Plan

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

Delta Conveyance

<https://water.ca.gov/Programs/State-Water-Project/Delta-Conveyance>

Department of Conservation Watershed Coordinator Program

<https://www.conservation.ca.gov/dlrp/grant-programs/watershed>

Division of Safety of Dams

<https://water.ca.gov/programs/all-programs/division-of-safety-of-dams>

Draft Handbook for Water budget Development: With or Without Models

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Water-Budget-Handbook.pdf>

Dry Well Reporting System

<https://mydrywell.water.ca.gov/report/>

DWR's Flood-MAR Program

<https://water.ca.gov/programs/all-programs/flood-mar>

DWR's Moving to Action

<https://water.ca.gov/Programs/All-Programs/Climate-Change-Program/Moving-to-Action>

Executive Order B-55-18 to Achieve Carbon Neutrality

<https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf>

Forecast Informed Reservoir Operations

<http://cw3e.ucsd.edu/FIRO/>

Human Right to Water Policy

[https://www.waterboards.ca.gov/water\\_issues/programs/hr2w/](https://www.waterboards.ca.gov/water_issues/programs/hr2w/)

Integrated Climate Adaptation and Resiliency Program

<https://opr.ca.gov/climate/icarp/>

Integrated Climate Adaptation and Resiliency Program Climate Services

<https://opr.ca.gov/climate/icarp/services.html>

Integrated Climate Adaptation and Resiliency Program Grant Programs

<https://opr.ca.gov/climate/icarp/grants/>

Integrated Climate Adaptation and Resiliency Program Technical Advisory Council

<https://opr.ca.gov/climate/icarp/tac/index.html>

Integrated Regional Water Management

<https://water.ca.gov/programs/integrated-regional-water-management>

Natural and Working Lands Climate Smart Strategy

[https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/FINAL\\_DesignDraft\\_NWL\\_100821\\_508-opt.pdf](https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/FINAL_DesignDraft_NWL_100821_508-opt.pdf)

Racial Equity Action Plan

[https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/DWR-REAP-06142022-FINAL\\_ay11.pdf](https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/DWR-REAP-06142022-FINAL_ay11.pdf)

Safe and Affordable Funding for Equity and Resilience

[https://www.waterboards.ca.gov/water\\_issues/programs/grants\\_loans/sustainable\\_water\\_solutions/safer.html](https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/safer.html)

Salton Sea Management Program

<https://saltonseaca.gov>

San Joaquin River Restoration Program

<https://www.restoresjr.net>

State Agency Sea-Level Rise Action Plan for California

[https://www.opc.ca.gov/webmaster/\\_media\\_library/2022/02/Item-7\\_Exhibit-A\\_SLR-Action-Plan-Final.pdf](https://www.opc.ca.gov/webmaster/_media_library/2022/02/Item-7_Exhibit-A_SLR-Action-Plan-Final.pdf)

## Useful Web Links

State Water Board Racial Equity Resolution

[https://www.waterboards.ca.gov/racial\\_equity/resolution-and-actions.html](https://www.waterboards.ca.gov/racial_equity/resolution-and-actions.html)

State Water Efficiency and Enhancement Program

<https://www.cdfa.ca.gov/oefi/sweep/>

State Water Project

<https://water.ca.gov/programs/state-water-project>

State Water Project energy production

<https://water.ca.gov/What-We-Do/Power>

State Water Project – State Power Augmentation Project

<https://water.ca.gov/What-We-Do/Power>

Strategic Plan to Protect California’s Coast and Ocean 2020-2025

<https://www.opc.ca.gov/webmaster/ftp/pdf/2020-2025-strategic-plan/OPC-2020-2025-Strategic-Plan-FINAL-20200228.pdf>

Transforming Environmental Restoration: Progress on the Cutting Green Tape Initiative

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Green-Tape/update-20220317/CNRA-Report--Transforming-Environmental-Restoration--Progress-on-the-Cutting-Green-Tape-Initiative.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/](https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/)

Water Resilience Portfolio

<https://resources.ca.gov/Initiatives/Building-Water-Resilience/portfolio>

Water Resilience Portfolio – January 2021 Progress Report

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-WRP-Progress-Report.pdf>

Water Supply Strategy

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf>

## Chapter 4

30 x 30: Accelerating Conservation of California’s Nature

<https://www.californianature.ca.gov/pages/30x30>

Adapting to Rising Tides Program

<https://barc.ca.gov/our-work/past-projects/adapting-rising-tides-art-bay-area#:~:text=The%20ART%20Bay%20Area%20project,flooding%20and%20sea%20level%20rise.>

Agreements to Support Healthy Rivers and Landscapes

<https://resources.ca.gov/Initiatives/Voluntary-Agreements-Page#:~:text=The%20agreements%20encompass%20a%20set,scientific%20monitoring%20and%20changing%20conditions.>

Arkstorm

<https://www.usgs.gov/programs/science-application-for-risk-reduction/science/arkstorm-scenario>

Assembly Bill 1384: Requires Safeguarding California Plan to Prioritize Equity

<https://pluralpolicy.com/app/legislative-tracking/bill/details/state-ca-20212022-ab1384/1032774>

Assembly Bill 1668: County Drought Advisory Group

[https://www.waterboards.ca.gov/water\\_issues/programs/conservation\\_portal/california\\_statutes.html](https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/california_statutes.html)

Assembly Bill 1739: Sustainable Groundwater Management Act

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=201320140AB1739](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1739)

Assembly Bill 1755: The Open and Transparent Water Data Act

<https://water.ca.gov/ab1755>

Assembly Bill 2108: Environmental Discharge Outreach

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=202120220AB2108](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB2108)

Assembly Bill 2193: Habitat Restoration and Enhancement Act

[https://leginfo.legislature.ca.gov/faces/codes\\_displayText.\\_=FGC&division=2.&title=&part=&chapter=6.5.&article=](https://leginfo.legislature.ca.gov/faces/codes_displayText._=FGC&division=2.&title=&part=&chapter=6.5.&article=)

Assembly Bill 2877: Tribal Water Infrastructure Bill

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=202120220AB2877](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB2877)

Assembly Bill 32: Climate Change Scoping Plan

<https://ww2.arb.ca.gov/resources/fact-sheets/ab-32-global-warming-solutions-act-2006>

Assembly Bill 401–State Studies Water Affordability

[https://www.waterboards.ca.gov/water\\_issues/programs/conservation\\_portal/assistance/docs/ab401\\_report.pdf](https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/docs/ab401_report.pdf)

Assembly Bill 685: Human Right to Water

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=201120120AB685](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB685)

Assembly Bill 691 Synthesis Report

<https://www.slc.ca.gov/content-types/ab-691-synthesis-report/>

Assembly Bill 923: Intergovernmental Consultation

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=202120220AB923](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB923)

## Useful Web Links

Bay Adapt, Regional Strategy for a Rising Bay Joint Platform

<https://www.bayadapt.org/>

Board Resolution 2022-0002: Emergency Regulation to Prohibit Wasteful Water Use

[https://www.waterboards.ca.gov/board\\_decisions/adopted\\_orders/resolutions/2022/rs2022\\_0002.pdf](https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2022/rs2022_0002.pdf)

CalEnviroScreen

<https://oehha.ca.gov/calenviroscreen/about-calenviroscreen>

California Aqueduct Subsidence Program

<https://water.ca.gov/Programs/Engineering-And-Construction/Subsidence>

California Biodiversity Collaborative

<https://cabiodiversitynetwork.org/>

California Climate Adaptation Strategy

<https://climateresilience.ca.gov/>

California Climate Change Assessments

<https://opr.ca.gov/climate/icarp/climate-assessment/>

California Coastal Commission Environmental Justice Policy

[https://documents.coastal.ca.gov/assets/env-justice/CCC\\_EJ\\_Policy\\_FINAL.pdf](https://documents.coastal.ca.gov/assets/env-justice/CCC_EJ_Policy_FINAL.pdf)

California Coastal Commission's Sea Level Rise: Coastal Adaptation Planning Guidance for Critical Infrastructure

<https://www.coastal.ca.gov/climate/slr/vulnerability-adaptation/infrastructure/>

California Department of Conservation's Regional Forest and Fire Capacity Program

<https://www.conservation.ca.gov/dlrp/grant-programs/Pages/Regional-Forest-and-Fire-Capacity-Program.aspx>

California Department of Forestry and Fire Protection's Fire and Resource Assessment Program

<https://frap.fire.ca.gov/>

California Department of Water Resources

<https://water.ca.gov>

California EcoRestore

<https://water.ca.gov/Programs/All-Programs/EcoRestore>

California Environmental Flows Framework

<https://ceff.ucdavis.edu/>

California Forest Carbon Plan

<https://ww2.arb.ca.gov/resources/documents/forest-carbon-plan#:~:text=The%20Forest%20Carbon%20Plan%20considers,and%20black%20carbon%20emission%20source.>



California Natural Resources Agency: Environmental Justice Policy

<https://www.conservation.ca.gov/Documents/Environmental%20Justice%20Policy%20-%20CNRA.pdf>

California Sea Level Rise Guidance

<https://www.opc.ca.gov/updates-californias-sea-level-rise-guidance/>

California State Lands Commission: Environmental Justice Policy

<https://www.slc.ca.gov/wp-content/uploads/2018/11/EJPolicy.pdf>

California State Wildlife Action Plan

<https://wildlife.ca.gov/SWAP/Final>

California Underserved and Small Producer Program

<https://www.cdfa.ca.gov/cusp/>

California Water Data Consortium

<https://cawaterdata.org/>

California Water Supply Strategy

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf>

California's Wildfire and Forest Resilience Action Plan

<https://wildfiretaskforce.org/wp-content/uploads/2022/04/californiawildfireandforestresilienceactionplan.pdf>

California's Healthy Soils Initiative

<https://www.cdfa.ca.gov/healthysouils/>

Capitol Collaborative on Race and Equity

<https://sgc.ca.gov/programs/healthandequity/racial-equity/>

Carbon Capture and Sequestration Program

[https://ww2.arb.ca.gov/our-work/programs/carbon-capture-sequestration#:~:text=Carbon%20capture%20and%20sequestration%20\(CCS,compressed%2C%20transported%2C%20and%20sequestered.](https://ww2.arb.ca.gov/our-work/programs/carbon-capture-sequestration#:~:text=Carbon%20capture%20and%20sequestration%20(CCS,compressed%2C%20transported%2C%20and%20sequestered.)

Carbon Management Program

<https://deltaconservancy.ca.gov/delta-carbon-program/>

Central Valley Flood Protection Plan

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

Climate Action Plan for Transportation Infrastructure

<https://calsta.ca.gov/-/media/calsta-media/documents/capti-july-2021-a11y.pdf>

Climate Action Plan Phase 3, Vulnerability Assessment

<https://resilientca.org/projects/7db36797-d149-4d3b-8c7a-33a642c51f18/>

## Useful Web Links

Climate Adaptation and Biodiversity Program and Landscape Resilience Program

<https://tahoe.ca.gov/programs/climate-change/>

Climate Adaptation and Resiliency Program

<https://wcb.ca.gov/Programs/Climate-Adaptation>

Climate and Energy Program

<https://www.fire.ca.gov/what-we-do/natural-resource-management/environmental-protection-program/climate-and-energy-program#:~:text=Funded%20primarily%20by%20California%20Climate,Business%20and%20Workforce%20Development%20grants.>

Climate Change Adaptation Program

<https://tahoe.ca.gov/programs/climate-change/>

Climate Change and Desert Resiliency Policy

<https://cvmc.ca.gov/climate-change-policy/>

Climate Change Initiatives

<https://wildlife.ca.gov/Science-Institute/Climate-Change>

Climate Change Initiatives

<https://www.coastal.ca.gov/climate/climatechange.html>

Climate Change Partnerships

<https://www.energy.ca.gov/about/campaigns/international-cooperation/climate-change-partnerships>

Climate Change Program

<https://water.ca.gov/programs/all-programs/climate-change-program>

Climate Change Program

<https://www.coastal.ca.gov/climate/climatechange.html>

Climate Change Program

<https://www.opc.ca.gov/climate-change#:~:text=OPC's%20Climate%20Change%20program%20seeks,at%20all%20levels%20of%20government.>

Conveyance and Groundwater Trading White Papers

[https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2022/05\\_May/May2022\\_Item\\_10\\_Attach\\_1\\_WhitePaper\\_Final.pdf](https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2022/05_May/May2022_Item_10_Attach_1_WhitePaper_Final.pdf)

Delta Adapts

<https://deltacouncil.ca.gov/delta-plan/delta-adapts-faq#:~:text=Delta%20Adapts%20consists%20of%20a,state%2C%20regional%2C%20and%20local%20governments>

Delta Conveyance

<https://water.ca.gov/Programs/State-Water-Project/Delta-Conveyance>

Department of Conservation Watershed Coordinator Program

<https://www.conservation.ca.gov/dlrp/grant-programs/watershed>

Disadvantaged Communities and Tribal Involvement Grant Program

<https://water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs/Proposition-1/DAC-Involvement-Program>

Division of Safety of Dams

<https://water.ca.gov/programs/all-programs/division-of-safety-of-dams>

Draft Emergency Water Conservation Regulation

[https://www.waterboards.ca.gov/water\\_issues/programs/conservation\\_portal/regs/emergency\\_regulation.html](https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/regs/emergency_regulation.html)

Draft Handbook for Water budget Development: With or Without Models

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Water-Budget-Handbook.pdf>

Drinking Water Partnerships and Consolidation

[https://www.waterboards.ca.gov/drinking\\_water/certlic/drinkingwater/waterpartnership.html](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/waterpartnership.html)

Dry Well Reporting System

<https://mydrywell.water.ca.gov/report/>

DWR's Flood-MAR Program

<https://water.ca.gov/programs/all-programs/flood-mar>

DWR's Moving to Action

<https://water.ca.gov/Programs/All-Programs/Climate-Change-Program/Moving-to-Action>

Efforts to Address Sea Level Rise

<https://www.slc.ca.gov/sea-level-rise/>

Equity Plan

<https://www.opc.ca.gov/equity/>

Executive Order B-55-18 to Achieve Carbon Neutrality

<https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf>

Executive Order N-10-21: 15% Reduction in Water Use

<https://www.gov.ca.gov/wp-content/uploads/2021/07/7.8.21-Conservation-EO-N-10-21.pdf>

Executive Order N-16-22: All State Agencies and Departments Integrate Equity in All Strategic Plans

<https://www.gov.ca.gov/2022/09/13/governor-newsom-strengthens-states-commitment-to-a-california-for-all/>

## Useful Web Links

Executive Order N-3-23: Build Water Resilience into Current System Use

<https://www.gov.ca.gov/wp-content/uploads/2023/02/Feb-13-2023-Executive-Order.pdf?emrc=b12708>

Executive Order N-42-20: Protects Homes and Businesses from Water Shutoffs During COVID

<https://www.csga.net/blogs/vanessa-gonzales/2021/06/15/brown-act-and-water-shutoff-emergency-executive-or>

Executive Order N-4-23: Floodwater Capture and Recharge Improvements

<https://www.gov.ca.gov/wp-content/uploads/2023/03/3.10.23-Ground-Water-Recharge.pdf>

Executive Order N-5-23: Easing of Drought Restrictions

<https://www.gov.ca.gov/wp-content/uploads/2023/03/3.24.23-Drought-update-executive-order.pdf>

Executive Order N-7-22: Drought Well Permitting Requirements

<https://www.gov.ca.gov/wp-content/uploads/2022/03/March-2022-Drought-EO.pdf>

Executive Order N-82-20: Creates Biodiversity Collaborative to Advance 30x30

<https://www.gov.ca.gov/wp-content/uploads/2020/10/10.07.2020-EO-N-82-20-.pdf>

Extreme Symposium

<https://water.ca.gov/News/News-Releases/2022/Oct-22/DWR-Hosts-Drought-to-Flood-Symposium>

Forecast Informed Reservoir Operations

<http://cw3e.ucsd.edu/FIRO/>

Fourth and Fifth Climate Assessment

<https://climateassessment.ca.gov/>

Fire and Resource Assessment Program

<https://www.fire.ca.gov/what-we-do/fire-resource-assessment-program>

GAMA Program

[https://www.waterboards.ca.gov/water\\_issues/programs/gama/about.html](https://www.waterboards.ca.gov/water_issues/programs/gama/about.html)

Greenhouse Gas Emissions Reduction Plan

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/All-Programs/Climate-Change-Program/Climate-Action-Plan/Files/CAP-I-GGERP-Update-2020.pdf>

Groundwater Management Principles and Strategies to Monitor, Analyze and Minimize Impacts to Drinking Water Wells

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/DrinkingWater/Files/Final-Principles-and-Strategies-with-the-Implementation-Matrix.pdf>

Healthy Soils Initiative

<https://www.cdfa.ca.gov/healthysoils/>

Healthy Watersheds Partnership

[https://mywaterquality.ca.gov/monitoring\\_council/healthy\\_watersheds/](https://mywaterquality.ca.gov/monitoring_council/healthy_watersheds/)

Human Right to Water Policy

[https://www.waterboards.ca.gov/water\\_issues/programs/hr2w/](https://www.waterboards.ca.gov/water_issues/programs/hr2w/)

Human Right to Water

<https://water.ca.gov/Programs/All-Programs/Human-Right-to-Water#:~:text=California%20was%20the%20first%20state,%2C%20cooking%2C%20and%20sanitary%20purposes.>

Integrated Climate Adaptation and Resiliency Program (ICARP)

<https://opr.ca.gov/climate/icarp/>

Integrated Climate Adaptation and Resiliency Program Climate Services

<https://opr.ca.gov/climate/icarp/services.html>

Integrated Climate Adaptation and Resiliency Program Grant Programs

<https://opr.ca.gov/climate/icarp/grants/>

Integrated Climate Adaptation and Resiliency Program Technical Advisory Council

<https://opr.ca.gov/climate/icarp/tac/index.html>

Integrated Climate Adaptation and Resiliency Program

<https://opr.ca.gov/climate/icarp/>

Integrated Energy Policy Report

<https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report>

Integrated regional water management

<https://water.ca.gov/programs/integrated-regional-water-management>

Justice, Equity, Diversity, and Inclusion Action Plan

<https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=189223&inline>

K-12 Educators Climate Literacy Training

<https://water.ca.gov/News/Blog/2021/October/DWR-Nationally-Recognized-for-Partnership-Educators-Climate-Change>

Klamath River Dam Removal

<https://klamathrenewal.org/the-project/>

Multi-Agency Coordination to Support Water Supply Strategy goals for Reuse and Desalination Projects

[https://www.waterboards.ca.gov/water\\_issues/programs/ocean/desalination/](https://www.waterboards.ca.gov/water_issues/programs/ocean/desalination/)

## Useful Web Links

Making Water Conservation a California Way of Life

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Make-Water-Conservation-A-California-Way-of-Life/Files/PDFs/Final-WCL-Primerpdf?la=en&hash=B442FD7A34349FA91DA5CDEFC47134EA38ABF209>

Multi-Agency Coordination to Support Water Supply Strategy goals for Storage Projects

<https://cwc.ca.gov/Water-Storage>

Multi-Benefit Land Conversion Program

<https://www.conservation.ca.gov/dlrp/grant-programs/Pages/Multibenefit-Land-Repurposing-Program.aspx>

Natural and Working Lands Climate Smart Strategy

[https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/CNRA-Report-2022---Final\\_Accessible.pdf](https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/CNRA-Report-2022---Final_Accessible.pdf)

Office of the Climatologist

<https://water.ca.gov/climate-Meteorology>

Order Conditionally Approving Temporary Urgency in Light of Drought Conditions

<https://www.waterboards.ca.gov/drought/tucp/>

Pollinator Habitat Program

<https://www.cdfa.ca.gov/oefi/php/>

Proclamation: Drought State of Emergency

<https://www.gov.ca.gov/wp-content/uploads/2021/07/7.8.21-Conservation-EO-N-10-21.pdf>

Proclamation: State of Emergency in Nine Counties

<https://www.gov.ca.gov/wp-content/uploads/2021/07/7.8.21-Drought-SOE-Proc.pdf>

Protecting Californians from Extreme Heat

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Climate-Resilience/2022-Final-Extreme-Heat-Action-Plan.pdf>

Racial Equity Action Plan

[https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/DWR-REAP-06142022-FINAL\\_ay11.pdf](https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/DWR-REAP-06142022-FINAL_ay11.pdf)

Racial Equity Action Plan

[https://www.waterboards.ca.gov/racial\\_equity/docs/racial-equity-action-plan-final-en.pdf](https://www.waterboards.ca.gov/racial_equity/docs/racial-equity-action-plan-final-en.pdf)

Racial Equity Hub

<https://sgc.ca.gov/programs/racial-equity/>

Racial Equity Resolution

[https://www.waterboards.ca.gov/racial\\_equity/resolution-and-actions.html](https://www.waterboards.ca.gov/racial_equity/resolution-and-actions.html)

Regional Flood Maps

<https://water.ca.gov/Programs/Flood-Management/Risk-Assessment-and-Mapping>

Regional TEKacity Program

<https://www.conservation.ca.gov/dlrp/grant-programs/Pages/Regional-Forest-and-Fire-Capacity-Program.aspx>

Resolution 2021-15 on Commitment to Diversity

<https://cvfpb.ca.gov/wp-content/uploads/2021/01/November-2021-Board-Meeting-Agenda.pdf>

Roadmap for a Climate Resilient Forecasting Framework

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/All-Programs/Climate-Change-Program/Climate-Change-And-Water/Files/RoadmapforClimateResilientForecastingFramework.pdf>

Safe and Affordable Funding for Equity and Resilience

[https://www.waterboards.ca.gov/water\\_issues/programs/grants\\_loans/sustainable\\_water\\_solutions/safer.html](https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/safer.html)

Safe and Affordable Funding for Equity and Resilience (SAFER) Program

<https://www.waterboards.ca.gov/safer/>

Salton Sea Management Program

<https://saltonsea.ca.gov>

San Joaquin River Restoration Program

<https://www.restoresjr.net>

Sea Level Rise Coastal Adaptation Planning Guidance for Critical Infrastructure

<https://www.coastal.ca.gov/climate/slr/vulnerability-adaptation/infrastructure/>

Senate Bill 552: Drought Planning and Minimum Resiliency Measures

<https://water.ca.gov/Programs/Water-Use-And-Efficiency/SB-552>

Senate Bill 88: State Can Consolidate Water Systems

[https://www.waterboards.ca.gov/drinking\\_water/programs/compliance/](https://www.waterboards.ca.gov/drinking_water/programs/compliance/)

Senate Bill 998: Limits Water Shutoffs to Low Income Customers

<https://www.ci.sanger.ca.us/460/Water-Shut-Off-Policy-SB-998>

State Agency Sea Level Rise Action Plan for California

[https://www.opc.ca.gov/webmaster/media\\_library/2022/02/Item-7\\_Exhibit-A\\_SLR-Action-Plan-Final.pdf](https://www.opc.ca.gov/webmaster/media_library/2022/02/Item-7_Exhibit-A_SLR-Action-Plan-Final.pdf)

State Guidance Resources

<https://opr.ca.gov/>

## Useful Web Links

State Plan of Flood Control

[https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/FSSR-and-SPFC/2022-SPFC\\_508.pdf](https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/FSSR-and-SPFC/2022-SPFC_508.pdf)

State Power Augmentation Project

<https://www.energy.ca.gov/powerplant/simple-cycle/roseville-state-power-augmentation-power-site>

State Water Board Racial Equity Resolution

[https://www.waterboards.ca.gov/racial\\_equity/resolution-and-actions.html](https://www.waterboards.ca.gov/racial_equity/resolution-and-actions.html)

State Water Efficiency and Enhancement Program

<https://www.cdfa.ca.gov/oefi/sweep/>

State Water Project – State Power Augmentation Project

<https://water.ca.gov/What-We-Do/Power>

State Water Project Energy Production

<https://water.ca.gov/What-We-Do/Power>

State Water Project

<https://water.ca.gov/programs/state-water-project>

Strategic Plan to Protect California's Coast and Ocean 2020-2025

<https://www.opc.ca.gov/webmaster/ftp/pdf/2020-2025-strategic-plan/OPC-2020-2025-Strategic-Plan-FINAL-20200228.pdf>

Sustainable Agricultural Lands Conservation

<https://sgc.ca.gov/programs/salc/>

Sustainable Groundwater Management Program

<https://water.ca.gov/programs/groundwater-management/sgma-groundwater-management>

Technical Assistance Guidelines/Tribal Guidelines

<https://sgc.ca.gov/programs/cace/resources/guidelines/>

The Delta Plan

<https://deltacouncil.ca.gov/delta-plan/>

Transformative Climate Communities

<https://sgc.ca.gov/programs/tcc/>

Transforming Environmental Restoration: Progress on the Cutting Green Tape Initiative

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Green-Tape/update-20220317/CNRA-Report--Transforming-Environmental-Restoration--Progress-on-the-Cutting-Green-Tape-Initiative.pdf>

Urban and Community Forestry Grant Program

<https://www.fire.ca.gov/what-we-do/grants/urban-and-community-forestry-grants>



Urban and Small Community Drought Relief Programs

<https://water.ca.gov/Water-Basics/Drought/Drought-Funding/Urban-Drought-Grant>

Urban Flood Protection Grant Program

<https://water.ca.gov/Work-With-Us/Grants-And-Loans/Urban-Flood-Risk-Reduction>

Urban Water Management Plans

<https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans>

Water Plan/Water Budget Team

<https://water.ca.gov/Programs/California-Water-Plan/Water-Plan-Participation>

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/](https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/)

Water Resilience Portfolio

<https://resources.ca.gov/Initiatives/Building-Water-Resilience/portfolio>

Water Resilience Portfolio – January 2021 Progress Report

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-WRP-Progress-Report.pdf>

Watershed Coordinator Program

<https://www.conservation.ca.gov/dlrp/grant-programs/watershed>

Watershed Improvement Program

<https://sierranevada.ca.gov/what-we-do/>

Watershed Resilience Initiative

<https://resources.ca.gov/Initiatives/Building-Water-Resilience/portfolio>

Wildlife Action Plan

<https://wildlife.ca.gov/SWAP>

Working Lands and Riparian Corridors Program

<https://www.conservation.ca.gov/dlrp/grant-programs/Pages/Working-Lands-and-Riparian-Corridors-Program.aspx>

Yolo Bypass Cache Slough Partnership

<https://ybcspartnership.org/>

## Chapter 5

April 2021 Drought Proclamation

<https://www.gov.ca.gov/wp-content/uploads/2021/04/4.21.21-Drought-Proclamation.pdf>

Assembly Bill 132

[https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=202120220AB132](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB132)

## Useful Web Links

Assembly Bill 148

[https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=202120220AB148](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB148)

Budget Act of 2021

[https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=202120220SB129](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220SB129)

CalEnviroScreen 4.0

<https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40>

California's Groundwater Live

<https://sgma.water.ca.gov/CalGWLIVE/>

California Groundwater Projects Tool

[https://experience.arcgis.com/experience/00197adac22f4b06a3f410068d43a641/?utm\\_medium=email&utm\\_source=govdelivery](https://experience.arcgis.com/experience/00197adac22f4b06a3f410068d43a641/?utm_medium=email&utm_source=govdelivery)

California Natural Resources Agency Open Data

<https://data.cnra.ca.gov>

California Partnership for the San Joaquin Valley's dry well outreach materials

<http://www.sjvpartnership.org/priorities/water-supply-quality/water-resources/>

Domestic Wells Dashboard

<https://storymaps.arcgis.com/stories/f2b252d15a0d4e49887ba94ac17cc4bb>

Dry Domestic Well Susceptibility and Reporting Fact Sheet

<https://data.cnra.ca.gov/dataset/calgw-live/resource/9c58b42b-dc7d-438c-8225-3d5dbf9bc20d>

Dry Well Reporting System

<https://mydrywell.water.ca.gov/report/>

Dry Well Susceptibility Tool

<https://storymaps.arcgis.com/stories/f2b252d15a0d4e49887ba94ac17cc4bb>

Executive Order N-7-22

<https://www.gov.ca.gov/wp-content/uploads/2022/03/March-2022-Drought-EO.pdf>

Grant Information Act of 2018

[https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=201720180AB2252](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2252)

Grants Best Tips and Practices for Success

<https://water.ca.gov/Work-With-Us/Grants-And-Loans/Grants-Best-Practices>

Groundwater Conditions Report - Water Year 2020

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Groundwater-Conditions-Report-Fall-2021.pdf>

Groundwater Management Principles & Strategies to Monitor, Analyze & Minimize Impacts to Drinking Water Wells

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/DrinkingWater/Files/Final-Principles-and-Strategies-with-the-Implementation-Matrix.pdf>

Groundwater Management Principles & Strategies to Monitor, Analyze & Minimize Impacts to Drinking Water Wells (Spanish)

[https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/DrinkingWater/Files/Final-Principles-and-Strategies\\_ESP.pdf](https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/DrinkingWater/Files/Final-Principles-and-Strategies_ESP.pdf)

Irrigation Wells Dashboard

<https://storymaps.arcgis.com/stories/f2b252d15a0d4e49887ba94ac17cc4bb>

SGMA Assistance and Engagement

<https://water.ca.gov/Programs/Groundwater-Management/Assistance-and-Engagement>

SGMA Best Management Practices and Guidance

<https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents>

SGMA Financial Assistance

<https://water.ca.gov/Work-With-Us/Grants-And-Loans/Sustainable-Groundwater>

SGMA Groundwater Quality Visualization Tool

[https://www.waterboards.ca.gov/water\\_issues/programs/sgma/water-quality-visualization-tool.html](https://www.waterboards.ca.gov/water_issues/programs/sgma/water-quality-visualization-tool.html)

SGMA Technical Assistance

<https://water.ca.gov/Programs/Groundwater-Management/Data-and-Tools>

Well Completion Report Request Form

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Wells/Files/Well-Completion-Request-form.pdf>

## Chapter 6

2023 Drinking Water Needs Assessment

[https://www.waterboards.ca.gov/drinking\\_water/certlic/drinkingwater/documents/needs/2023needsassessment.pdf](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2023needsassessment.pdf)

April 2021 Drought Proclamation

<https://www.gov.ca.gov/wp-content/uploads/2021/04/4.21.21-Drought-Proclamation.pdf>

Assembly Bill 132

[https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=202120220AB132](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB132)

Assembly Bill 148

[https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=202120220AB148](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB148)

## Useful Web Links

Assembly Bill 923

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=202120220AB923](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB923)

Assembly Bill 1168

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=201720180AB1668](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB1668)

Assembly Bill 1384

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=202120220AB1384](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1384)

Assembly Bill 2108

[https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=202120220AB2108](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB2108)

Best Available Maps (BAM) Displaying 100- and 200-Year Floodplains

<https://gis.bam.water.ca.gov/bam/>

Budget Act of 2021

[https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=202120220SB129](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220SB129)

CalEnviroScreen 4.0

<https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40>

California Climate Investments: Cap Trade Dollars at Work

<https://www.caclimateinvestments.ca.gov/>

California Grants Portal

<https://www.grants.ca.gov/>

California Groundwater Projects Tool

[https://experience.arcgis.com/experience/00197adac22f4b06a3f410068d43a641/?utm\\_medium=email&utm\\_source=govdelivery](https://experience.arcgis.com/experience/00197adac22f4b06a3f410068d43a641/?utm_medium=email&utm_source=govdelivery)

California Natural Resources Agency Open Data

<https://data.cnra.ca.gov>

California Partnership for the San Joaquin Valley's dry well outreach materials

<http://www.sjvpartnership.org/priorities/water-supply-quality/water-resources/>

California Strategic Growth Council, Technical Assistance Guidance for State Agencies

<https://sgc.ca.gov/programs/cace/resources/guidelines/>

California Strategic Growth Council, Transformative Climate Communities

<https://sgc.ca.gov/programs/tcc/>

California's Groundwater Live

<https://sgma.water.ca.gov/CalGWLIVE/>

California's Water Supply Strategy: Adapting to a Hotter, Drier Future

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf>

Central Valley Flood Protection Plan Update 2022

[https://cvfpb.ca.gov/wp-content/uploads/2022/12/Central\\_Valley\\_Flood\\_Protection\\_Plan\\_Update\\_2022\\_ADOPTED.pdf](https://cvfpb.ca.gov/wp-content/uploads/2022/12/Central_Valley_Flood_Protection_Plan_Update_2022_ADOPTED.pdf)

Central Valley Floodplain Evaluation and Delineation Maps

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

Department of Water Resources Education

<https://water.ca.gov/What-We-Do/Education>

Department of Water Resources Grants and Loans

<https://water.ca.gov/Work-With-Us/Grants-And-Loans>

Department of Water Resources Grants Best Practices and Tips for Success

<https://water.ca.gov/Work-With-Us/Grants-And-Loans/Grants-Best-Practices>

Domestic Wells Dashboard

<https://storymaps.arcgis.com/stories/f2b252d15a0d4e49887ba94ac17cc4bb>

Drinking Water Well Principles and Strategies framework

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/DrinkingWater/Files/Final-Principles-and-Strategies-with-the-Implementation-Matrix.pdf>

Drinking Water Well Guidance Document and Toolkit

<https://water.ca.gov/Programs/Groundwater-Management/Drinking-Water-Well>

Dry Domestic Well Susceptibility and Reporting Fact Sheet

<https://data.cnra.ca.gov/dataset/calgw-live/resource/9c58b42b-dc7d-438c-8225-3d5dbf9bc20d>

Dry Well Reporting System

<https://mydrywell.water.ca.gov/report/>

Dry Well Susceptibility Tool

<https://storymaps.arcgis.com/stories/f2b252d15a0d4e49887ba94ac17cc4bb>

Executive Order N-82-20

<https://www.gov.ca.gov/wp-content/uploads/2020/10/10.07.2020-EO-N-82-20-.pdf>

Executive Order N-7-22

<https://www.gov.ca.gov/wp-content/uploads/2022/03/March-2022-Drought-EO.pdf>

Executive Order N-16-22

<https://www.gov.ca.gov/2022/09/13/governor-newsom-strengthens-states-commitment-to-a-california-for-all/>

## Useful Web Links

Flood Preparedness, Department of Water Resources

<https://water.ca.gov/What-We-Do/Flood-Preparedness>

Grant Information Act of 2018

[https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=201720180AB2252](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2252)

Grants Best Tips and Practices for Success

<https://water.ca.gov/Work-With-Us/Grants-And-Loans/Grants-Best-Practices>

Groundwater Ambient Monitoring and Assessment (GAMA) Program

[https://www.waterboards.ca.gov/water\\_issues/programs/gama/](https://www.waterboards.ca.gov/water_issues/programs/gama/)

Groundwater Conditions Report - Water Year 2020

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Groundwater-Conditions-Report-Fall-2021.pdf>

Groundwater Management Principles & Strategies to Monitor, Analyze & Minimize Impacts to Drinking Water Wells

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/DrinkingWater/Files/Final-Principles-and-Strategies-with-the-Implementation-Matrix.pdf>

Groundwater Management Principles & Strategies to Monitor, Analyze & Minimize Impacts to Drinking Water Wells (Spanish)

[https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/DrinkingWater/Files/Final-Principles-and-Strategies\\_ESP.pdf](https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/DrinkingWater/Files/Final-Principles-and-Strategies_ESP.pdf)

Human Right to Water: Statute and State Agency Policies

- Department of Water Resources' Human Right to Water Policy (2019) [https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/California-Department-of-Water-Resources-Human-Right-to-Water-Policy\\_0421.pdf](https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/California-Department-of-Water-Resources-Human-Right-to-Water-Policy_0421.pdf)
- State Water Resource Control Board's Human Right to Water Resolution No. 2016-0010 (2016) [https://www.waterboards.ca.gov/board\\_decisions/adopted\\_orders/resolutions/2016/rs2016\\_0010.pdf](https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf)
- Water Code Section 106.3 (2012) [https://leginfo.legislature.ca.gov/faces/codes\\_displaySection.xhtml?lawCode=WAT&sectionNum=106.3](https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=WAT&sectionNum=106.3)

Irrigation Wells Dashboard

<https://storymaps.arcgis.com/stories/f2b252d15a0d4e49887ba94ac17cc4bb>

Levee Flood Protection Zone (LFPZ) maps, Department of Water Resources

<https://gis.lfpz.water.ca.gov/lfpz/>

Low Income Household Water Assistance Program (provides funds to assist low-income households with water and wastewater bills)

<https://www.acf.hhs.gov/ocs/programs/lihwap>

Online System of Well Completion Reports (OSWCR)

<https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Completion-Reports>

Racial Equity and Environmental Justice Resolutions and Policies

- California Coastal Commission's Environmental Justice Policy (2019) [https://documents.coastal.ca.gov/assets/env-justice/CCC\\_EJ\\_Policy\\_FINAL.pdf](https://documents.coastal.ca.gov/assets/env-justice/CCC_EJ_Policy_FINAL.pdf)
- California Strategic Growth Council, Racial Equity Resource Hub <https://sgc.ca.gov/programs/racial-equity/>
- Central Valley Flood Protection Board Resolution No. 2021-15 (2021) <https://cvfpb.ca.gov/wp-content/uploads/2022/12/Resolution-2022-29-signed.pdf>
- Department of Water Resources' DWR's Racial Equity Action Plan (2022) [https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/DWR-REAP-06142022-FINAL\\_ay11.pdf](https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/DWR-REAP-06142022-FINAL_ay11.pdf)
- State Water Resource Control Board's Water Board's Racial Equity Resolution 2021-0050 (2021) [https://www.waterboards.ca.gov/board\\_decisions/adopted\\_orders/resolutions/2016/rs2016\\_0010.pdf](https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf)

Safe and Affordable Funding for Equity and Resilience (SAFER)

- Drinking Water Site: <https://www.waterboards.ca.gov/safer/>
- Water Partnerships: [https://www.waterboards.ca.gov/drinking\\_water/certlic/drinkingwater/waterpartnership.html](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/waterpartnership.html)

Sustainable Groundwater Management Act (SGMA)

- Assistance and Engagement, Department of Water Resources <https://water.ca.gov/Programs/Groundwater-Management/Assistance-and-Engagement>
- Best Management Practices and Guidance, Department of Water Resources <https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents>
- *California Groundwater Projects Tool*, Department of Water Resources <https://experience.arcgis.com/experience/00197adac22f4b06a3f410068d43a641/>
- Groundwater Quality Visualization Tool, State Water Resources Control Board [https://www.waterboards.ca.gov/water\\_issues/programs/sgma/water-quality-visualization-tool.html](https://www.waterboards.ca.gov/water_issues/programs/sgma/water-quality-visualization-tool.html)

## Useful Web Links

- Technical Assistance, Department of Water Resources <https://water.ca.gov/Programs/Groundwater-Management/Data-and-Tools>

Water Resilience Portfolio 2020

[https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/Final-California-Water-Resilience-Portfolio-2020\\_ADA3\\_v2\\_ay11-opt.pdf](https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/Final-California-Water-Resilience-Portfolio-2020_ADA3_v2_ay11-opt.pdf)

Well Completion Report Request Form

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Wells/Files/Well-Completion-Request-form.pdf>

## Chapter 7

American Rivers – Mountain Meadow Restoration in California

<https://www.americanrivers.org/threats-solutions/restoring-damaged-rivers/mountain-meadows/>

Blue Lake Rancheria

<https://www.bluelakerancheria-nsn.gov>

California Financing Coordinating Committee

<https://www.cfcc.ca.gov>

California's Fifth Climate Change Assessment Fact Sheet

[https://opr.ca.gov/climate/docs/20220629-OPR\\_ICARP-5th\\_Assessment\\_Fact\\_Sheet.pdf](https://opr.ca.gov/climate/docs/20220629-OPR_ICARP-5th_Assessment_Fact_Sheet.pdf)

California Grants Portal

<https://www.grants.ca.gov>

Disadvantaged Communities Nomenclature Within the State of California: Findings and Conclusions

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Tribal/Files/IRWM/URC-Nomenclature-Whitepaper.pdf>

Disadvantaged Community and Tribal Involvement (DACTI) Work Group

<https://www.roundtableofregions.org/dacti-work-group>

Grants.gov (Federal Grants Portal)

<https://www.grants.gov>

Indicators of Climate Change in California, Fourth Edition

<https://oehha.ca.gov/climate-change/epic-2022>

National Park Service – Indigenous Fire Practices Shape our Land

<https://www.nps.gov/subjects/fire/indigenous-fire-practices-shape-our-land.htm#:~:text=Cultural%20burns%20passed%20down%20through,a%20healthy%20and%20resilient%20landscape>



Protocol on Karuk Tribe's Intellectual Property Rights

[https://sipnuuk.karuk.us/system/files/atoms/file/ATALM17\\_KTResearchProtocol.pdf](https://sipnuuk.karuk.us/system/files/atoms/file/ATALM17_KTResearchProtocol.pdf)

## Chapter 8

FY 2022-23 Fund Expenditure Plan: Safe and Affordable Drinking Water Fund

[https://www.waterboards.ca.gov/water\\_issues/programs/grants\\_loans/sustainable\\_water\\_solutions/docs/2022/draft\\_2022-23\\_sadwfep.pdf](https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/2022/draft_2022-23_sadwfep.pdf)



# Supporting Documents

2023 California Tribal Water Summit Proceedings

Addressing Complex Problems Together: A Network Study

California's Groundwater Conditions, Semi-Annual Update: October 2023

California's Groundwater Update 2020

California Water Plan Glossary

California Water Plan Resource Management Strategies 2023 Updates:

- Agricultural Water Use Efficiency
- Conjunctive Water Management
- Desalination (Brackish and Seawater)
- Flood Management
- Municipal Recycled Water
- Precipitation Enhancement
- Recharge Area Identification, Utilization and Protection
- Reservoir Reoperation
- Urban Stormwater Runoff Capture and Management
- Urban Water Use Efficiency
- Watershed Management

## Supporting Documents

Contributors to California Water Plan Update 2023

DWR Climate Change Risk and Preparedness Assessment

From Climate Traces to Climate Insights: Future Scenarios Analysis for the California Central Valley

Merced River Flood-MAR Reconnaissance Study Report, plus appendices:

- Plan of Study
- Analytical Tools Integration
- Baseline Performance and Climate Change Vulnerability
- Adaptation Strategy Performance

Process Guide for Update 2023

Summary of Equity Survey for Water and Flood Management Agencies/Districts in California

Water Portfolios and Balances

Water Supply and Balance to Water Budget: Merced Basin Pilot Study

Watershed Hub Resilience Indicators and Metrics

Watershed Resilience Framework and Toolkit

WEAP Model Application to Decision-Scaling Using Paleo Climate: A Pilot Study of the Merced River Planning Area







California Water Plan Update 2023 envisions a future where all Californians benefit from water resources that are sustainable, resilient to climate change, and managed to achieve shared values and connections to our communities and the environment.

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