ADDRESSING INSTITUTIONAL VULNERABILITIES IN CALIFORNIA'S DROUGHT WATER ALLOCATION
Part 1: Water Rights Administration and Oversight During Major Statewide Droughts, 1976–2016

A Report for:

California's Fourth Climate Change Assessment

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CALIFORNIA natural resources AGENCY

Edmund G. Brown, Jr., *Governor*

August 2018
CCCA4-CNRA-2018-009

ACKNOWLEDGEMENTS

A technical advisory group reflecting a range of perspectives and technical expertise provided invaluable input and feedback during the project. We are grateful for their efforts and willingness to share their insights and expertise with us. Technical advisory group members provided context for understanding water management decisions and concerns, helped us prioritize our research to increase its impact, and provided feedback on report drafts. They were not asked to endorse the report's conclusions or recommendations. The following individuals were technical advisory group members:

Michael Anderson – *Department of Water Resources*
Art Baggett – *AG Baggett and PJ Weber, Inc.*
Colin Bailey – *The Environmental Justice Coalition for Water*
Gary Bobker – *The Bay Institute*
Scott Cantrell – *California Department of Fish and Wildlife*
Les Grober – *State Water Resources Control Board*
Jennifer Harder – *University of the Pacific, McGeorge School of Law*
John Leahigh – *Department of Water Resources*
Jay Lund – *University of California, Davis*
Jennifer Spaletta – *Spaletta Law PC*

Beyond the technical advisory group, we solicited feedback from individuals and organizations representing a wide range of perspectives and expertise. The following individuals reviewed and provided feedback on a draft of this report: Elizabeth Betancourt *(Western Shasta Resource Conservation District)*; Amanda Fencl *(Policy Institute for Energy, Environment and the Economy, University of California, Davis)*; Greg Gartrell *(Independent Consultant)*; Brian Gray *(Public Policy Institute of California)*; Rick Rogers *(NOAA Fisheries West Coast Region)*; Jeanne Zolezzi *(Herum\Crabtree\Suntag)*; and Brian Coats, Nicole Kuenzi, Laura Lavallee, Andrew Sawyer, and Victor Vasquez *(State Water Resources Control Board)*. Reviewers were not asked to endorse the report's conclusions or recommendations. We thank them for their efforts. We considered their many constructive comments and suggestions when revising the report.

We would also like to thank four anonymous peer reviewers for their useful feedback, which helped to improve this report.

Hayley Oveson, Rapichan Phurisamban, Lisa Lim, and Amie Simmons provided valuable research assistance during our initial explorations of this topic.

Additional support for this work was provided by the UC Water Security and Sustainability Research Initiative (UCOP Grant No. 13941).

Responsibility for the report's final content rests entirely with the authors. Any errors are our own.

PREFACE

California's Climate Change Assessments provide a scientific foundation for understanding climate-related vulnerability at the local scale and informing resilience actions. These Assessments contribute to the advancement of science-based policies, plans, and programs to promote effective climate leadership in California. In 2006, California released its First Climate Change Assessment, which shed light on the impacts of climate change on specific sectors in California and was instrumental in supporting the passage of the landmark legislation Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006), California's Global Warming Solutions Act. The Second Assessment concluded that adaptation is a crucial complement to reducing greenhouse gas emissions (2009), given that some changes to the climate are ongoing and inevitable, motivating and informing California's first Climate Adaptation Strategy released the same year. In 2012, California's Third Climate Change Assessment made substantial progress in projecting local impacts of climate change, investigating consequences to human and natural systems, and exploring barriers to adaptation.

Under the leadership of Governor Edmund G. Brown, Jr., a trio of state agencies jointly managed and supported California's Fourth Climate Change Assessment: California's Natural Resources Agency (CNRA), the Governor's Office of Planning and Research (OPR), and the California Energy Commission (Energy Commission). The Climate Action Team Research Working Group, through which more than 20 state agencies coordinate climate-related research, served as the steering committee, providing input for a multisector call for proposals, participating in selection of research teams, and offering technical guidance throughout the process.

California's Fourth Climate Change Assessment (Fourth Assessment) advances actionable science that serves the growing needs of state and local-level decision-makers from a variety of sectors. It includes research to develop rigorous, comprehensive climate change scenarios at a scale suitable for illuminating regional vulnerabilities and localized adaptation strategies in California; datasets and tools that improve integration of observed and projected knowledge about climate change into decision-making; and recommendations and information to directly inform vulnerability assessments and adaptation strategies for California's energy sector, water resources and management, oceans and coasts, forests, wildfires, agriculture, biodiversity and habitat, and public health.

The Fourth Assessment includes 44 technical reports to advance the scientific foundation for understanding climate-related risks and resilience options, nine regional reports plus an oceans and coast report to outline climate risks and adaptation options, reports on tribal and indigenous issues as well as climate justice, and a comprehensive statewide summary report. All research contributing to the Fourth Assessment was peer-reviewed to ensure scientific rigor and relevance to practitioners and stakeholders.

For the full suite of Fourth Assessment research products, please visit www.climateassessment.ca.gov. This report advances the understanding of the need for more proactive efforts to improve water rights administration and oversight during droughts by examining the strategies the State Water Resources Control Board used to carry out its water rights responsibilities during past droughts.

ABSTRACT

California droughts are likely to become more frequent, longer, and more intense in the future, posing increasing challenges for water management, and raising the stakes for effective drought response. This project aims to help state water governance and decision-making structures adapt to this changing climatic reality.

The State Water Resources Control Board (Board) has significant responsibilities for California water rights administration and oversight, and the decisions it makes affect how scarce water resources are allocated among different human and environmental uses during droughts. We analyzed the strategies the Board used for water rights administration and oversight during the last four major statewide droughts, in water years 1976–1977, 1987–1992, 2007–2009, and 2012–2016. The Board employed an array of different drought response strategies that varied in depth and breadth from drought to drought. We discuss thirteen types of strategies organized into four broad categories: (1) addressing urgent water right requests, (2) providing oversight of existing diversions, (3) providing oversight of water use by end users, and (4) cross-cutting strategies that support or complement strategies in the first three groups. The Board engaged in the greatest breadth and depth of strategies during the recent drought.

Despite some significant and creative in-drought efforts by the Board and others, which led to positive developments during and immediately following each drought, relatively little proactive preparation for drought-specific water rights administration and oversight appears to have occurred between droughts. Instead, our research suggests the Board developed its drought responses on a largely ad hoc basis in the midst of each drought emergency, with varying degrees of success. We conclude that more proactive planning and preparation would improve the Board's future drought responses, making them more transparent, predictable, timely, and effective. A companion report in this volume builds on this analysis with specific recommendations.

Keywords: State Water Resources Control Board, Water Board, drought, drought preparation, drought response, drought response strategies, water rights, water rights administration, water rights oversight, curtailment, conservation, temporary urgency change petition, TUCP, temporary water right, reasonable use, emergency regulations

Please use the following citation for this paper:

Green Nylen, Nell, Michael Kiparsky, Dave Owen, Holly Doremus, Michael Hanemann. (University of California, Berkeley). 2018. ***Addressing Institutional Vulnerabilities in California's Drought Water Allocation, Part 1: Water Rights Administration and Oversight During Major Statewide Droughts, 1976–2016***. California's Fourth Climate Change Assessment, California Natural Resources Agency. Publication number: CCCA4-CNRA-2018-009.

HIGHLIGHTS

Past droughts have stress tested California's water management institutions, revealing vulnerabilities that could impair effective adaptation to climate change. The State Water Resources Control Board (Board) is a key water decision maker whose actions during droughts affect how scarce water resources are allocated among different human and environmental uses. Our review of the Board's past drought responses suggests that:

- **The Board responded differently to each of the last four major statewide droughts, sometimes taking on a very active role, and sometimes taking a more hands-off approach.** In particular, the Board put more effort into water rights oversight during the 1976–1977 and 2012–2016 droughts than it did during the two intervening droughts (from 1987–1992 and from 2007–2009).

- **A lack of sufficient pre-drought planning and preparation was an important factor in the Board's variable drought responses.** Instead of identifying, ahead of time, what actions might be appropriate for different drought contingencies, and developing associated processes, procedures, and information to help it select and appropriately implement them, the Board often needed to improvise important aspects of its drought response strategies in the midst of drought crises.

- **Over-reliance on in-drought improvisation hindered effective drought response.** The Board spent valuable time during each drought marshalling its resources to make basic decisions about which response strategies to use, what to prioritize, and how to engage with stakeholders. Contemporaneous direction from political leadership, especially the governor, heavily influenced these decisions. Water users did not know what to expect from the Board in advance, and therefore found it challenging to make their own drought preparations. This collective uncertainty increased the state's vulnerability to both ongoing water management challenges and extreme precipitation events like droughts.

- **More proactive planning and preparation would improve the Board's future drought responses.** To prepare for the more frequent and intense droughts we expect in the future, and set the stage for more timely and effective in-drought decision making under pressure, the Board can shift from reactive adaptation in the midst of droughts to more anticipatory adaptation based on drought contingency planning. We explore how the Board might approach this task in a companion report in this volume.

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LIST OF ABBREVIATIONS

AB	Assembly Bill
ac-ft	acre-feet
ACL	Administrative Civil Liability
Bay-Delta Plan	Bay-Delta Water Quality Control Plan
Board	State Water Resources Control Board
CALFED	cooperative Delta planning effort involving state and federal agencies
CDFW	California Department of Fish and Wildlife
CDO	cease and desist order
CEQA	California Environmental Quality Act
CESA	Endangered Species Act
CFGC	California Fish and Game Commission
cfs	cubic feet per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin River Delta
DWR	California Department of Water Resources
EIR	Environmental Impact Report
ESA	Endangered Species Act
NDOI	Net Delta Outflow Index
NEPA	National Environmental Policy Act
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries Service
OAL	Office of Administrative Law
OCAP	Long-Term Operational Criteria and Plan
PDSI	Palmer Drought Severity Index
Regional Board	Regional Water Quality Control Board
SB	Senate Bill
SWP	State Water Project
TUCP	temporary urgency change petition
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
WDRs	Waste Discharge Requirements
wy	water year

1: Introduction and Overview

Climate change has already begun to affect California's hydrology and water resources, and droughts are likely to become more frequent, longer, and more intense in the future (see Section 2.2.4). This project is designed to help state water governance and decision-making structures adapt to this changing climatic reality. We focus on how one of California's primary water management institutions, the State Water Resources Control Board (Board), has responded in the past, and could better respond in the future, to droughts and their attendant challenges, including water shortage, uncertainty, and conflict.

California's water rights system is meant to ensure that water is beneficially and reasonably used in the public interest and in accordance with other aspects of the law. During times of shortage, water right priority rules help determine who may use water, when, and how much. In theory, these rules enhance predictability, help prevent and resolve conflicts, and allow water users to evaluate their risk of not receiving water based on the relative priorities of their rights. However, the reality is much messier. The water flowing in a stream past a water user's point of diversion at a particular time may not necessarily be legally available to that water user. Understanding water availability under a particular water right can be challenging for many reasons. Among them:

- California water law is complex, and the relative priorities of relevant water rights may not always be clear. Surface water and groundwater are treated as largely (but not entirely) separate resources governed by separate water rights systems, each of which is a hybrid of land-based and use-based rights with different priority rules. Furthermore, use-based surface water rights acquired before and after the California Legislature created an administrative permitting system have been treated as having different characteristics and limitations.
- In some areas, more senior users divert water downstream of more junior users.
- Some water users may hold (or may claim to hold) multiple types or priorities of right.
- Extensive networks of storage and conveyance infrastructure have altered natural water stores and flows, with potentially important legal and practical consequences.
- Adequate information about water supply (e.g., stream gage data) and demand (e.g., diversion and use data) may not be available on the temporal or spatial scales needed for effective decision making.
- Water rights do not exist in isolation but are exercised in the context of other instream and consumptive uses and a broad range of legal requirements—some embedded in aspects of the water rights system and some imposed externally—that, among other things, protect other water users, water quality, public health, and fish and wildlife.

For these and other reasons, it can be difficult to understand water supply in a particular stream system; how much water individual water users are legally entitled to use; how much water they are actually using; how particular diversions affect flows needed to protect water quality, ecosystems, and particular species; or even the nature of individual water rights. This challenging reality makes it difficult to manage water rights on a real-time basis.

The Board has significant water rights administration and oversight responsibilities, and the decisions it makes affect the allocation of scarce water resources among different human and environmental uses during times of shortage. The nature and extent of the Board's water rights authority is unsettled (and contested), but the Board clearly has direct regulatory authority over a segment of surface water rights, as well as some degree of oversight authority and responsibility for ensuring that water rights, more generally, are exercised appropriately in the broader context of water rights law, water quality law, and other state and federal environmental laws.

Our two-part project aims to help the Board equip itself for more timely and effective water rights administration and oversight during droughts that will increase California's resilience to both climate change and climate variability by (1) analyzing how the Board used its water rights authorities during past droughts and (2) recommending steps the Board might take to improve its future drought response. This report represents the first part of the project. Its purposes are to examine the Board's role in institutional adaptation to the increased frequency and severity of hydrologic extremes expected under continued climate change and to review the strategies the Board has used when responding to each of the last four major statewide droughts.

1.1 Methods

We reviewed publicly available sources of information including reports, peer reviewed articles, law review articles, news articles, and websites, as well as documents produced by the Board including resolutions, decisions, orders, water quality control plans, hearing transcripts, reports, notices, fact sheets, and web-based materials. We also reviewed the legal and regulatory context for California water rights and the Board's water rights related authorities and responsibilities. A technical advisory group reflecting a range of perspectives and technical expertise provided invaluable input and feedback during the project. Finally, we engaged with Board staff, Department of Water Resources staff, and other public and private stakeholders through a number of workshops organized for related projects.[1]

1.2 Who Should Read This Report?

This report provides information and analysis that may be useful to a range of people interested in California water resource management during droughts, including the following:

- ***Board Members and Staff*** — We hope that Board members and staff find the report useful as a supplement to their own retrospective analyses to inform priority setting and planning efforts.
- ***Water Users and Advocates for Environmental Uses of Water*** — Water users (including those who hold or claim surface water or groundwater rights) and advocates for environmental uses of water can gain a better understanding of the Board's water rights responsibilities and strategies during times of water shortage, and how its decisions directly or indirectly affect their interests. The report can help inform their comments and suggestions for improving the tools, processes, and information available to the Board during future droughts.
- ***State and Federal Agencies*** — State and federal agencies with responsibilities that intersect with California water management can use this report as a starting point for

reflecting on how their interactions and coordination with Board could be improved in preparation for, during, and after droughts.

- ***Legislators and Legislative Staff*** — Legislators and legislative staff can use the report to inform their thinking about what legislative changes would enable more timely and effective drought response by the Board.

1.3 Report Organization

Section 1 briefly introduces the project, explains who may find this report useful, and summarizes the report's organization.

Sections 2 and 3 provide context for understanding water rights administration and oversight in California during droughts:

- **Section 2** provides an overview of California's water supply challenges and droughts in California, highlighting the last four major statewide droughts and the increased likelihood of more frequent, longer, and more severe droughts in the future. Appendix A looks at these issues in greater depth.

- **Section 3** summarizes California water rights and discusses the critical role the Board plays in California water management, both in general and during times of drought. Appendix B provides more detail.

Section 4 summarizes the types of strategies the Board has used in responding to past droughts. We have organized them into four groups: (1) strategies addressing urgent water right requests; (2) strategies providing oversight of existing diversions; (3) strategies providing oversight of water use by end users; and (4) cross-cutting strategies that support or complement strategies in the first three groups. Appendix C describes the particular strategies the Board used during each of the last four major statewide droughts in greater depth.

Section 5 discusses our key findings:

1. The Board emphasized different response strategies during different droughts.
2. The Board's role in state drought response was sometimes limited.
3. The Board engaged most extensively during the recent drought.
4. Many factors contributed to differences in the Board's past drought responses.
5. Little proactive planning or preparation took place between droughts.
6. Over-reliance on in-drought improvisation hindered effective drought response.

Section 6 describes the primary conclusion drawn from our findings—that more proactive planning and preparation would improve the Board's future drought responses—and points to **Part 2** (the companion report in this volume), which provides specific recommendations for how the Board could approach this important but challenging task.

2: California Water and Droughts

This Section provides a brief overview of (1) California's ongoing water supply challenges and (2) droughts in California, highlighting the last four major statewide droughts and the expectation that droughts will become more frequent, longer, and more intense in the future. This context is helpful for understanding the administration and oversight of California's water rights system during droughts. Appendix A offers more detail on most topics.

2.1 California's Ongoing Water Supply Challenges

California faces ongoing water management challenges that flow from a highly variable precipitation regime and a substantial spatial and temporal mismatch between surface water supply and water demand. While extensive water storage and conveyance infrastructure and the natural reservoirs of snowpack and groundwater have helped redistribute water in time and space, they have important limits.

2.1.1 Temporal and Spatial Variability of Precipitation

California's wet season is generally short, running from October through April, and total annual precipitation comes from fewer storms over fewer days[2] and translates into more year-to-year variability[3] than for any other U.S. state. To reflect this seasonality, water management is based around an October through September water year (identified by the calendar year in which the water year ends; for example, the 2017 water year ran from October 1, 2016, through September 30, 2017).[4] California's northwestern corner and the northern Sierras experience the majority of the state's precipitation, while the southern San Joaquin Valley and most of the southeastern portion of the state are especially dry.[5]

2.1.2 Mismatched Patterns of Surface Water Supply and Demand

Most of the human demand for water for drinking, agriculture, and industry is focused in the drier parts of the state,[6] and demand is highest during the drier parts of the year.[7]

California water managers have addressed the mismatch between surface water supply and demand by shifting water in time and space. They have harnessed the ability of snowpack[8] and groundwater[9] to act as natural reservoirs and built substantial additional surface storage linked to extensive conveyance infrastructure that allows water to be moved around the state. These networks of state, federal, and local infrastructure[10] capture water in wetter times and places for later use and for transport to drier areas. The two largest storage and conveyance systems are the federal Central Valley Project (CVP), operated by the U.S. Bureau of Reclamation (USBR), and the State Water Project (SWP), operated by the California Department of Water Resources (DWR).

Water storage and conveyance infrastructure has important limitations. This infrastructure is often asked to serve multiple, sometimes conflicting purposes, including water supply, power, flood control, and maintaining adequate water quality and quantity in connected waterways to support environmental uses.[11] Storage and conveyance infrastructure and related water use have also heavily modified natural flows in many areas, often with negative consequences for native ecosystems and species, including species listed as threatened or endangered under the state or federal Endangered Species Acts (ESAs).[12] Additionally, there are important limits to the ability of California's water storage and distribution infrastructure to respond to climatic

variability. While reservoirs are well suited to dealing with seasonal variation in water supply, they are less useful as extended drought reserves.[13] And the increased temperatures, reduced snowpack, and earlier runoff expected with continued climate change will make it harder to manage reservoirs to accomplish their multiple important but competing purposes.[14]

2.2 Droughts in California

Multi-year droughts are relatively common occurrences in California. In this subsection, we define drought, note that drought exacerbates water conflicts, summarize the characteristics of the last four major statewide droughts, and note that severe droughts are expected to occur more frequently in the future, increasing conflicts over water and raising the stakes for effective water management during times of water shortage.

2.2.1 What Is Drought?

Drought can be defined as an extended "period of drier-than-normal conditions that results in water-related problems."[15] It is important to note that, in California, what would be considered "normal" (average) and "drier-than-normal" (drier than average) have varied significantly over time due to multi-decadal trends in climate variability.[16] Dry conditions cause or exacerbate mismatches between the amount, quality, location, and timing of natural water supply and the amount, quality, location, and timing of human water demands and environmental water needs.[17] Droughts can be classified based on meteorological (precipitation), agricultural (soil moisture, evapotranspiration), hydrologic (streamflow, snowpack, groundwater conditions), or other indicators, used singly or in combination.[18]

2.2.2 Drought and Water Conflicts

Drought intensifies conflicts between different water users, between water users and advocates for environmental water uses, and between these groups or individuals and regulatory agencies. Different stakeholders may not see eye-to-eye when it comes to understanding water conditions or interpreting legal requirements and related responsibilities. For a variety of reasons, water right holders may not know when they must curtail their use (i.e., reduce or forego diversions) to avoid harming others under California's water right priority system. These include outdated or inaccurate diversion data, inadequate understanding of resource conditions, incompletely characterized water rights, and unsettled legal questions (see Sections 1 and 3, Appendix B, and **Part 2**). These issues also present challenges for water rights oversight by the Board, including for effectively implementing curtailments to enforce the priority system. Inadequate environmental and social protections, or inadequate implementation and enforcement of these protections, can leave particular ecosystems and communities especially vulnerable to drought. Likewise, regulatory flexibility meant to ease the impacts of drought for some water users may be exercised in a way that intensifies the impacts experienced by others.

Some of the coping strategies that help certain types of water users adapt to water shortage could potentially increase the vulnerability of others in the short-term and have long-term consequences for resource availability more broadly.[19] For example, measures like increasing reliance on groundwater, relaxing water quality and environmental instream flow requirements, water transfers, fallowing land, and changing crops or cropping patterns may help reduce the immediate social and economic impacts of drought on California's agricultural sector.[20] However, in the near term, increased groundwater pumping could also reduce basin

groundwater levels and quality, with negative impacts for those who depend on household or community drinking water wells, especially in rural disadvantaged communities, and for groundwater dependent ecosystems.[21] Without adequate recharge to replenish groundwater stores, heavy reliance on groundwater could increase the future vulnerability of this resource and reduce its reliability as a future drought reserve.[22] Likewise, while relaxing instream flow or water quality requirements during a drought might enable more water to be consumptively used or stored for later use, it could potentially reduce stream flows or raise water temperatures at inopportune times, causing short- and long-term harm to specific ESA-listed species[23] and to commercial and tribal fisheries and the communities that are economically and culturally dependent on them.[24] Reduced stream flows can also increase saltwater intrusion into coastal and Delta waterways, impairing drinking water quality for communities that rely on these sources.[25] On the other hand, strategically relaxing water quality standards during one period of time can save water so that it can be released at a later time to improve flows and flow temperatures and avoid worse salinity intrusion.

Due to these types of tensions, decisions that affect drought water management can be difficult to make and politically controversial.

2.2.3 Characteristics of the Last Four Major Statewide Droughts

State water management agencies commonly identify four major statewide droughts since 1970, in water years 1976–1977, 1987–1992, 2007–2009, and 2012–2016.[26] Although significant droughts occurred earlier in the twentieth century—and the period from about 1910 to 1935 was especially dry[27]—the post-1970 period is most relevant for understanding the current role the Board plays in state drought response. The 1976–1977 drought was the first significant drought following the combination of water rights and water quality responsibilities in the modern Board (see Section 3). It was also the first time the Board attempted to provide substantial oversight of water rights, in a drought or non-drought context (see Appendix C.1.1.3). Additionally, many state and federal environmental laws that impact water management were passed in the late 1960s or early 1970s.[28]

This report examines the Board's responses during each of the last four major statewide droughts. These droughts share similarities but have also differed in important ways, including in duration, precipitation, temperature, hydrologic conditions, legal and political context, and social, economic, and environmental impacts. We explore some of these differences below, and many others in Appendix A.2.3 and Appendix C.

Duration: The last four major statewide droughts each lasted between two (1976–1977) and six (1987–1992) water years. All else being equal, a longer drought will have more severe impacts. However, the shortest of the four droughts was in some ways the most severe (Table 1).

Precipitation: Based on estimates of statewide average precipitation since the 1896 water year, the 1976–77 drought experienced the least precipitation in any 2-water-year period, the 2012–2016 drought experienced the least precipitation in any 3- or 4-water-year period, and the 1987–1992 drought experienced the least precipitation in any 5- or 6-water-year period (Table 1). In addition, 1977 experienced the 2nd-least statewide precipitation of any water year since 1896, 2014 experienced the 3rd-least, and 1987 experienced the 4th-least. During the course of a single drought, statewide precipitation sometimes varied significantly (Figure 1).

Temperature: On average, each drought was progressively warmer than the last, culminating in the 2012–2016 drought, which coincided with record-breaking average temperatures (Figure 1). During the course of a single drought, temperature sometimes varied significantly (Figure 1).

Population: California's population has nearly doubled since the 1976–1977 drought (Table 1). Although water use efficiency has also increased over that time, this means that almost twice as many people are now depending on the state's limited and highly variable water resources, making effective stewardship more important than ever before.

Statewide Drought Emergency Proclamations: During the two most recent major statewide droughts, the serving governor issued a statewide proclamation of drought emergency, something never done prior to 2009 (Table 1). These emergency proclamations, and related executive orders, directed the Board and other state agencies to carry out certain drought response tasks. Both the proclamations were made during the third year of drought, but the 2009 proclamation came toward the end of the 2007–2009 drought, while the 2014 proclamation came toward the middle of the 2012–2016 drought and, likely due in part to this fact, had more far-reaching consequences for state and local drought response.

Table 1: Comparison of Some Features of the Last Four Major Statewide Droughts[29]
Colored circles denote periods of 1 to 6 water years that overlap with each drought and rank in the bottom 10 (driest) for precipitation or the top 10 (warmest) for temperature of all such periods since 1896.

Feature	1976–1977	1987–1992	2007–2009	2012–2016
Population (in millions)	22	29	37	39
Almond acreage (millions of acres)	0.34	?	0.77	0.93
ESA-listed fish (federal)	7	16	30	31
Duration (# of water years)	●●	●●●●●●	●●●	●●●●●
Precipitation (# of periods of X water years ranked in the bottom 10)	1 wy 2 wy 3 wy	1 wy 2 wy 3 wy 4 wy 5 wy 6 wy	1 wy 2 wy 3 wy	1 wy 2 wy 3 wy 4 wy 5 wy
Temperature (# of periods of X water years ranked in the top 10)	None	1 wy	1 wy 2 wy 3 wy 4 wy 5 wy 6 wy	1 wy 2 wy 3 wy 4 wy 5 wy 6 wy
	In 47 counties No statewide proclamation	In 23 counties No statewide proclamation	In 9 counties 1st statewide proclamation (Feb. 27, 2009)	In 29+ counties 2nd statewide proclamation (Jan. 17, 2014)

Emergency declarations	

Rank for period: 1st 2nd 3rd 4th 5th 6th through 10th

Local Drought Emergency Declarations: During each of the four droughts, some of California's 58 counties declared local drought emergencies, ranging from 9 counties during the 2007–2009 drought to 47 counties during the 1976–1977 drought (Table 1).

Environmental Protections: Earlier droughts occurred when there were fewer environmental protections, and therefore fewer environmental restrictions on water diversions. For example, during the 1976–1977 drought, there were few California fish listed as federally threatened or endangered (Table 1). By the end of the 1987–1992 drought, the number of federally listed fish had more than doubled, and many more were listed before or during the 2007–2009 drought.

Hardened Agricultural Demand: The amount of acreage planted in permanent crops has increased dramatically in recent decades in concert with a shift away from lower-value field crops.[30] For example, estimates of California's almond acreage more than doubled from about 483,700 acres in 1995 to 930,000 acres in 2012, and almond acreage continued to increase during the 2012–2016 drought, with an estimated 1,240,000 acres in almonds in 2016, including 300,000 acres of young trees that are not yet bearing fruit.[31] Similarly, estimated wine grape acreage increased from 354,417 to 546,000 acres between 1995 and 2012.[32] The economics of agricultural commodity prices and water availability are linked. Economically valuable permanent crops offer greater financial returns per unit of water applied than annual crops, but they also provide less flexibility in the face of hydrologic uncertainty.[33] Permanent crops require considerable up-front investments of resources and result in a hardening of water demand. They need water every year to stay alive, and fallowing them would means losing potentially substantial returns on investments.

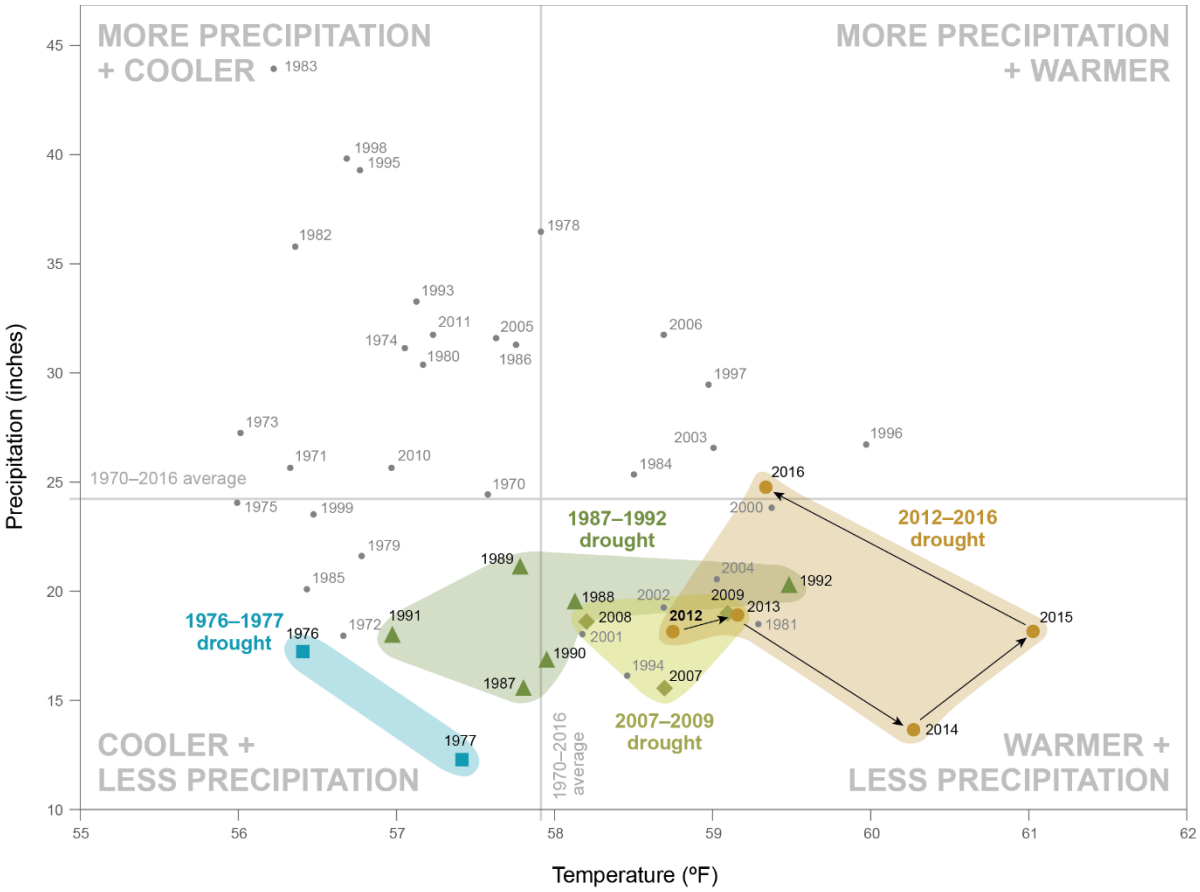


Figure 1: Estimated Statewide Average Temperature and Precipitation for Each Water Year from 1970 to 2016[34]
Arrows show the progression of the 2012–2016 drought.

2.2.4 Droughts May Become More Frequent, Longer, and More Intense

Climate change is expected to warm California's climate, raise sea level, and lead to even more variable weather.[35] Increased warmth will reduce the amount of precipitation that falls as snow and melt the snow that does fall earlier in the water year, significantly reducing the storage potential of snowpack.[36] Higher temperatures will also increase losses to evaporation and transpiration so that more water will need to be applied to accomplish the same task.[37] Sea level rise will inundate low-lying areas and increase seawater intrusion into coastal aquifer systems and surface water, including estuaries.[38] Inland movement of the freshwater/saltwater interface in the Sacramento-San Joaquin River Delta would affect drinking water, fish and wildlife, and agriculture, as well as increase pressure on the aging system of Delta levees; the degree of increased seawater intrusion will also depend in part on how people respond (e.g., with seawalls and higher levees versus allowing areas to flood).[39] Droughts and floods are likely to become more frequent, and more intense.[40]

Anthropogenic warming may have already increased the likelihood of the "co-occurring" hot and dry conditions that have caused recent droughts in California (Figure 1 and Figure A-5).[41] Climate research suggests California may face a future "in which essentially every seasonal,

annual, and multiannual precipitation deficit co-occurs with historically warm conditions[,] . . . increas[ing] the risk of severe impacts on human and natural systems."[42]

As recent experience with droughts—and floods[43]—has highlighted, California's water infrastructure and institutions are not adequately prepared to meet the many challenges that can be expected with continued climate change. Past water management practices during droughts have not always been effective. Rapidly changing conditions have meant that attention, resources, and political will have generally shifted before important lessons learned were fully processed and acted upon. To reduce California's drought vulnerability and increase its drought resilience, water managers at every level will need to improve the information, analysis, and procedures they use to support decision making during times of water stress.

3: The Board's Critical Role in California Water Management

Although other state and federal agencies have roles in California water management (Appendix B.4), the five-member State Water Resources Control Board and its support staff (collectively referred to as the Board in this report) play an especially important, multifaceted one.

The California Legislature has tasked the Board with "exercis[ing] the adjudicatory and regulatory functions of the state in the field of water resources" "in order to provide for the orderly and efficient administration of the water resources of the state."[44] In 1967, the Legislature decided to combine the existing State Water Rights and State Water Quality Boards to form today's State Water Resources Control Board, deliberately marrying water rights and water quality responsibilities in the same agency.[45] Additionally, in 2014, the Board took over responsibility for regulating public drinking water systems from the California Department of Public Health.[46] The Legislature has consolidated these responsibilities within a single entity to allow for their "coordinated consideration."[47]

3.1 Water Rights Responsibilities

The Board has authority and responsibility for administration and oversight of critical aspects of the water rights system. Although the California Supreme Court has described "a legislative intent to vest in the board expansive powers to safeguard the scarce water resources of the state,"[48] the nature and extent of this authority is contested and limited in several important ways. While some aspects of the Board's powers are clear and well-accepted, others are less so.

Despite the often highly interconnected nature of surface water and groundwater, California law has largely treated surface water and groundwater as distinct resources with their own separate, but similar, water rights systems (Figure 2).[49] These systems establish rules for resolving conflicts between water users and for allocating water resources during times of shortage. Appendix B.1 provides a more detailed discussion of water rights and priority rules. All water rights are bound together by the unifying requirements, grounded in common law and expressed in the California constitution, that water resources be reasonably and beneficially used in the public interest "to the fullest extent of which they are capable," and not wasted

(Figure 2).[50] Other sources of law, such as the public trust doctrine and state and federal environmental statutes and regulations, may also influence the exercise of water rights. Appendix B.2 describes these internal and external constraints.

Because the Board has focused most of its attention on surface water rights, this report does so as well. However, we note that this is changing in light of the Board's newly explicit role in sustainable groundwater management as well as widespread recognition of the need to jointly manage interconnected surface water/groundwater systems[51] to adapt to climate change.

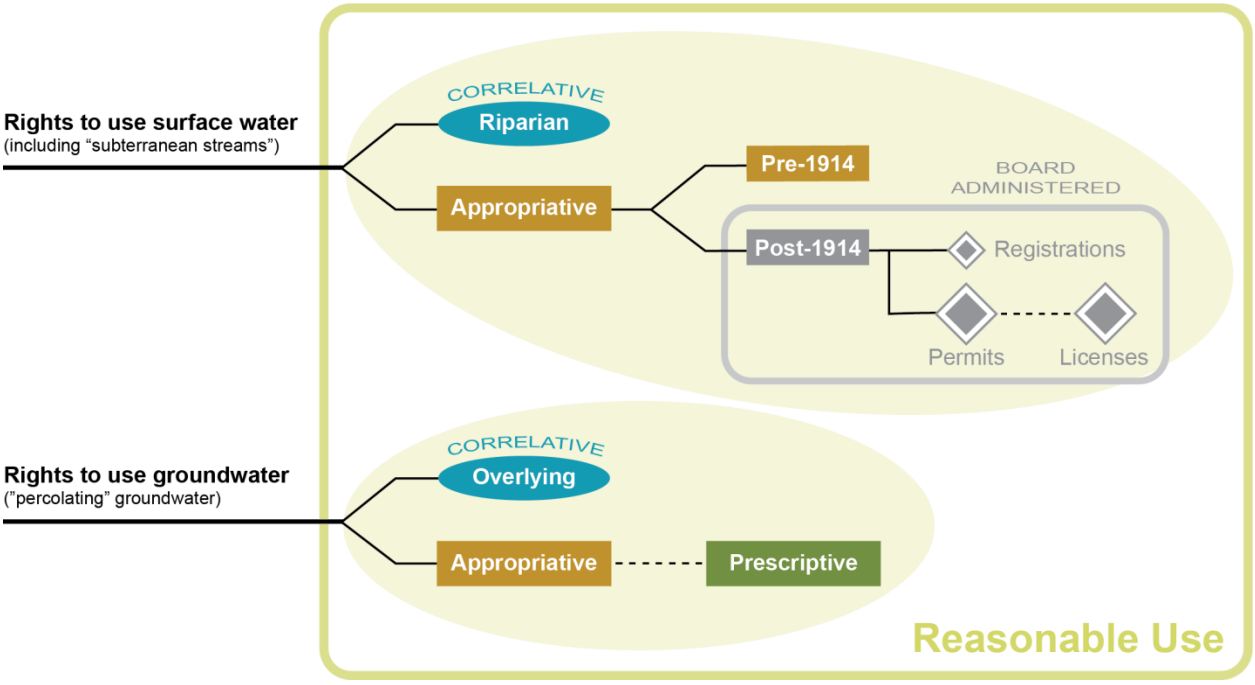


Figure 2: Overview of California's Current Surface Water and Groundwater Rights Systems
See Appendix B.1 and B.2 for more information about California water rights.

3.1.1 Administration of Post-1914 Rights

The Board has clear regulatory authority over appropriative surface water rights acquired on or after December 19, 1914, when the Legislature created the Board's predecessor agency and first established requirements for water right permitting.[52] A permit or license from the Board is now a prerequisite to begin diverting water from a stream or lake for use on nonadjacent property (Appendix B.3.1), and permittees and licensees must petition the Board to make temporary or permanent changes to their water rights (Section 4.1.2, Appendix B.3.1), including transferring them to another party (Section 4.1.3).

3.1.2 Oversight of Water Rights and Use

The Board also has some degree of oversight authority over all water rights and use. California courts of appeal have concluded that the Board has oversight authority over the exercise of all surface water and groundwater rights in order to implement California's constitutional requirement that all water be reasonably and beneficially used in the public interest.[53] This includes the authority to adopt regulations (see Appendix B.3.2) tailored to prevent the

unreasonable use of water.[54] Arguably, the Legislature has provided the Board with explicit enforcement tools to address unauthorized diversions, including out-of-priority diversions by those claiming pre-1914 or riparian rights. These tools potentially include cease and desist orders and administrative civil liability complaints and orders.[55] However, the nature and extent of the Board's oversight and enforcement authorities are contested, especially as applied to specific oversight actions, such as curtailing water diversions under pre-1914 or riparian rights during a drought (see, e.g., Appendix C.4.6 and **Part 2**).[56]

3.1.3 Water Rights Administration and Enforcement During Droughts

Although water rights administration and oversight are important at other times, they are especially critical during droughts. Effective drought-time administration and oversight would ensure that water is allocated to priority uses in accordance with state and federal law, providing adequate protection for human and environmental health and minimizing unnecessary uncertainty by helping water users understand current constraints on water availability as well as future water-availability forecasts.

3.2 Water Quality Responsibilities

The federal Clean Water Act and state Porter-Cologne Water Quality Control Act guide the Board's water quality work.[57] The Board is the ultimate water quality authority for California, responsible for regulating activities that potentially affect the quality of surface water and groundwater. It establishes water quality standards, including instream flow requirements, to "ensure the reasonable protection" of specific beneficial uses in particular water bodies, develops statewide or inter-regional water quality control plans[58] (like the Bay-Delta Plan, see Section 3.3, Appendix B.3.3), and oversees the nine Regional Water Quality Control Boards (Regional Boards), which do most of the frontline work implementing state and federal water quality requirements.[59] Together, the State and Regional Boards regulate discharges of wastewater, stormwater, and agricultural runoff; dredge and fill activities; activities requiring federal licenses or permits that could result in a discharge into a waterway; and other activities that could degrade surface water or groundwater quality, such as land disposal of solid wastes.[60]

When making and implementing water quality related decisions, the Board must also comply with state and federal environmental laws, enforce the constitutional requirement for reasonable and beneficial use in the public interest, protect public trust interests when feasible, and take California's Human Right to Water into consideration (Section 5.4.2, Appendix B.2).

3.2.1 Water Quality Protection During Droughts

Like its water rights role, the Board's water quality role is especially critical during droughts. Droughts can negatively affect water quality, exacerbating the impacts of reduced water supplies on people and ecosystems. Water contaminants become more concentrated with less fresh inflow to dilute them. In coastal areas, reduced freshwater flows allow seawater to intrude further inland, shrinking the zone where conditions are suitable for some species and degrading the quality of water available for drinking and agriculture. Limited water availability and hotter temperatures make it more challenging to store and provide water of sufficient quantity and quality to support later uses, like cold water for salmon, water for salinity protection, and water for municipal and agricultural use.

The Board can weigh different courses of action and plan and implement effective water quality and flow contingencies for droughts, though it has not often done so.

3.3 The Intersection of Water Quality and Water Rights

One of the key ways the Board implements water quality standards and related requirements is through water rights administration and oversight. It can operationalize water quality requirements—for example, for flow volume, temperature, or salinity—by including appropriate terms and conditions in water right permits, licenses, and other approvals (Section 4.1), and by adopting broadly applicable regulations regarding water diversion and use (Section 4.4.1).

However, this critical intersection is currently underutilized. To date, the Board has not yet set water quality and flow requirements to protect fish and wildlife and other beneficial uses for many biologically important surface waters.[61] The requirements that do exist often lack adequate contingencies for the range of hydrologic conditions reasonably expected in a watershed, especially for severe or prolonged drought conditions, leading to requests for ad hoc temporary changes in permit or license conditions during droughts (Section 4.1.2; **Part 2**). Moreover, water quality and flow requirements have been applied to relatively few, generally more junior, diverters (Appendix B.3.3).

A good example of the nexus between water quality and water rights is the Board's Bay-Delta Water Quality Control Plan (Bay-Delta Plan). Through the Bay-Delta Plan, the Board "establishes water quality control measures needed to provide reasonable protection of beneficial uses of water in the Bay-Delta Watershed."[62] These include flow and other water quality standards designed to support municipal, industrial, agricultural, and fish and wildlife uses. Versions were adopted in 1978, 1991, 1995, and 2006.[63] The Bay-Delta Plan's history of adoption and amendment has an interesting relationship with droughts that is explored in Appendix B.3.3. The Appendix and **Part 2** also describe the Board's in-progress efforts to update existing instream flow requirements to protect fish and wildlife uses for the Sacramento and San Joaquin Rivers and to establish instream flow requirements for their major tributaries.

4: The Board's Drought Response Strategies

An array of government and private actors have played significant roles in drought response at the local, regional, or state level. Individual water users have made choices that affected their individual and collective water use, such as whether and how to conserve water or whether, when, and what crops to plant (or fallow). During recent droughts, urban water suppliers have implemented self-designed water shortage contingency plans that include tiered systems of increasingly stringent water use prohibitions and restrictions, such as mandatory limits on landscape irrigation.[64] Although droughts are generally chronic, not acute, crises, California's Standardized Emergency Management System (created following the 1987–1992 drought) has come into play during recent droughts. It provides an organizational structure for coordinating management of emergencies that involve more than one jurisdiction or response agency, incorporating (1) the field-level emergency response Incident Command System, (2) a multiagency coordination system for affected agencies, (3) mutual aid systems that allow

affected jurisdictions to obtain emergency resources from jurisdictions that are not affected, and (4) the "operational area concept" for coordinating information, requests for resources, and emergency response within a county.[65] In their roles as federal and state water project managers, the USBR and DWR have facilitated the voluntary redistribution of water through "Drought Water Banks" and transfer approvals (Appendix C.1.1 and C.2.1), and they and other water project managers have made system operations decisions that affected flow and water quality in waterways around the state. In its role as a regulator of and funding source for public drinking water systems, the Board (and the Department of Public Health before it) has helped communities experiencing drought-related water shortages access emergency water supplies.[66] These are just a few of the ways that different actors have responded to past droughts.

For this report, we reviewed how the Board responded to the last four major statewide droughts, focusing on its critical role in water rights administration and oversight. In its water rights capacity, the Board's actions (or inaction) during times of drought may have important repercussions for nearly every person, entity, and ecosystem in the state.

We found that the Board approached water rights administration and oversight during past droughts using different types and combinations of drought response strategies. In this section, we describe thirteen types of strategies organized into four broad categories: (1) addressing urgent water right requests, (2) providing oversight of existing diversions, (3) providing oversight of water use by end users, and (4) cross-cutting strategies that support or complement strategies in the first three groups. Each category includes a variety of potential tools for implementing the requirement for reasonable beneficial use in the public interest that is inherent in rights to use water (Section 3.1 and Appendix B.2.1). We recognize that there can be significant overlap between these categories, with some types of strategies fitting into more than one. Nonetheless, we hope this organization provides a useful structure for examining the Board's drought response strategies.

More detailed information about the strategies the Board used during particular droughts can be found in Appendix C.

4.1 Addressing Urgent Water Right Requests

During each drought, the Board has faced requests, often urgent, for new water rights and for temporary water right changes, including changes that involve short-term transfers of water rights. It has dealt with these requests in different ways.

4.1.1 New Water Rights

4.1.1.1 Temporary Water Right Permits

In addition to the standard process for acquiring permanent water rights (described in Appendix B.3.1), there is an expedited process available for establishing a temporary water right permit. When an applicant demonstrates an urgent need (whether due to drought or another reason), the Board can issue a temporary water right permit for up to 180 days if, after consulting with a representative of the California Department of Fish and Wildlife (CDFW), it finds that exercise of the permit would not injure other water users or unreasonably impact fish, wildlife, or other instream beneficial uses and would be in the public interest.[67] Review under the California Environmental Quality Act (CEQA) is generally required (see Appendix B.2.3). The Board can issue a temporary permit before public notice is given, but the permit

automatically terminates if the permittee fails to comply with notice requirements.[68] The Board can modify or revoke the permit at any time, and it must supervise water diversion and use under the permit to ensure that other water users and instream uses are protected and that the permittee complies with permit conditions.[69] Although temporary permits are potentially renewable, to acquire a long-term water right, the permittee must separately apply for a standard water right permit.[70]

Requests for new temporary water rights frequently come from existing water right holders, including individual landowners, irrigation districts, and drinking water systems. The need for a temporary water right may arise, for example, because the applicant expects their usual water source (e.g., well water or a particular stream) to be insufficient or unavailable due to the drought, and they believe an alternative source is potentially available or that diverting water during a different season and storing it for later use would mitigate drought impacts to themselves or others.

During the last four major statewide droughts, the Board received and considered applications for temporary appropriative surface water rights (described in more detail in Appendix C):

- ***1976–1977 Drought —*** Addressed at least 5 petitions for temporary permits.
- ***1987–1992 Drought —*** Addressed at least 19 petitions for temporary permits.
- ***2007–2009 Drought —*** Addressed at least 2 petitions for temporary permits.
- ***2012–2016 Drought —*** Addressed at least 17 petitions for temporary permits, including 4 under a newly established program to facilitate temporary permits for groundwater recharge.

4.1.1.2 Emergency Tank Storage Registration Program

During the 2012–2016 drought, the Board established a program in conjunction with the CDFW to expedite the process for riparian water users on small coastal streams in parts of Northern California to get approval to install a storage tank for small domestic use to capture water during high flows during and after rain events (Appendix C.4.2).

4.1.2 Temporary Water Right Changes

A water right change alters where, when, or how water is diverted or used. A change involving a transfer also generally alters *who* diverts and uses the water. Transfer requests are covered in more detail in the next section.

Post-1914 appropriative right holders can seek permanent (see Appendix B.3.1) or temporary changes to their existing permits or licenses by petitioning the Board. Those with pre-1914 appropriative rights or riparian rights do not need the Board's permission for changes that are consistent with their existing water rights, but they can petition to dedicate some portion of their water right to instream flow.[71] Changes in the source, rate, or season of diversion require a new water right (and therefore a new water right permit), as do enlargements of water rights that would injure other legal users of water.

During droughts, the Board receives requests from surface water users who would like to temporarily modify some aspect of their permit or license. A water user may believe that the drought has made complying with an existing requirement infeasible or that making the change

will help mitigate the effects of the drought in some way. For example, drought conditions may make it difficult for the state and federal projects to meet multiple, potentially competing demands, like (1) maintaining "Delta outflows [for] estuarine species and migrating salmonids in the Bay-Delta; (2) "conserv[ing] water in upstream storage for multiple, [potentially competing,] critical purposes later in the year, including temperature control on the Sacramento and San Joaquin Rivers to protect endangered winter-run Chinook salmon, agricultural use, wildlife refuges, municipal and industrial use, and salinity control in the Delta"; and (3) "export[ing] water for a variety of uses south of the Delta, including agricultural use, municipal and industrial use, and wildlife refuges."[72] The Board has described its role in such cases as trying to "achieve a reasonable balance of competing demands for the limited water supplies available."[73]

In contrast to the lengthy standard change petition process, described in Appendix B.3.1, the Board can act on a temporary urgency change petition (TUCP) much more quickly. It can approve a TUCP upon finding that (1) the proposed change will not cause injury to other legal users of the water; (2) there is "an urgent need to make the proposed change"; (3) the "change may be made without unreasonable effect upon fish, wildlife, or other instream beneficial uses"; and (4) the "change is in the public interest."[74] Just as for a temporary water right permit, the Board can issue a temporary change order before public notice is given, but the permit automatically terminates if the permittee fails to comply with notice requirements.[75] Similarly, the Board can modify or revoke the temporary change order at any time, and it must supervise water diversion and use under the order to ensure that other water users and instream uses are protected and that the permittee complies with permit conditions.[76] Temporary change orders can last for up to 180 days, with the potential for renewal.[77] Any change, including a TUCP, that requires the discretionary approval of a state or local agency must comply with CEQA, unless an exemption or suspension applies (see Appendix B.2.3).

During all four droughts, the Board has received and considered requests for temporary water right changes that did not involve transfers (described in more detail in Appendix C):

- ***1976–1977 Drought —*** Addressed at least 4 requests for temporary changes.
- ***1987–1992 Drought —*** Addressed at least 11 requests for temporary changes.
- ***2007–2009 Drought —*** Addressed at least 15 requests for temporary changes.
- ***2012–2016 Drought —*** Addressed at least 45 requests for temporary changes, including at least 11 regarding water quality and flow requirements for the state and federal water projects.

4.1.3 Short-Term Water Transfers

Since the 1980s, state law has encouraged and facilitated voluntary transfers of water rights among water users.[78] For example, the California Water Code makes clear that those who reduce their use and transfer the unused water maintain their rights.[79] Transfers increased during the 1987–1992 drought, jumping from about 100,000 acre-feet per year before the drought to about 500,000 acre-feet per year from 1989 through 1993, and trended upward to a plateau of about 1.3 million acre-feet per year beginning in 1999.[80] This does not include large volumes of water that, beginning in 2003, were committed for sale or lease but not actually transferred. Although the overall (short-term + long-term + permanent) trading volume trend has been relatively flat since

1999, it peaked at about 1.7 million acre-feet in 2010 and decreased slightly through the 2012–2016 drought.[81] Over the same time period, the volume of short-term trades decreased from a high of more than 1 million acre-feet in 2001 to less than 500,000 acre-feet from 2011 to 2014.[82]

The circumstances under which those with appropriative surface water rights may sell, lease, or exchange all or part of their right differs depending on the type of right (pre-1914 or post-1914) and the type of transfer (short- or long-term) (see Appendix B.3.1). The Board's approval is required when a transfer would result in a change in the point of diversion, place of use, or purpose of use of a post-1914 appropriative water right.[83] Permittees and licensees wishing to transfer water must petition the Board, providing it with data and other information needed to support the transfer. In general, this information is used to estimate the conditions that would have occurred in the absence of the transfer and the amount of water that is available for transfer, as well as to confirm that the transfer met applicable requirements.

For a short-term transfer (lasting 1 year or less), the amount that can be transferred is explicitly limited to "the amount of water that would have been consumptively used or stored by the permittee or licensee in the absence of the proposed temporary change, would not injure any legal user of the water, and would not unreasonably affect fish, wildlife, or other instream beneficial uses. "[84] The Board must only modify terms or conditions of the petitioner's permit or license "as necessary to carry out the temporary change" and cannot deny or condition a temporary transfer "to avoid or mitigate impacts that are not caused by the temporary change."[85] The Water Code specifically exempts short-term water transfers from CEQA.[86] The petition must identify the permit or license that forms the basis for the transfer and include "[a] written description of the changes in water storage, timing, and point of diversion, place and purpose of use, timing and point of return flow, and water quality of instream flows that are likely to occur as a result of the proposed temporary change."[87] Unless the Board grants an extension, the Board must issue a decision on the petition within 35 days of commencing the investigation or publishing notice of the transfer, whichever is later.[88] However, during the past two droughts, the Board has attempted to further expedite its consideration of water transfer proposals at the governor's request.[89] Notably, short-term transfer petitions can be combined with TUCPs for especially urgent transfers lasting 180 days or less (see Section 4.1.2, above).[90]

During all four droughts, the Board has received and considered requests for temporary water transfers (described in more detail in Appendix C):

- ***1976–1977 Drought*** — Addressed at least 2 transfer proposals.
- ***1987–1992 Drought*** — Addressed at least 10 transfer proposals, including 8 involving transfers from Yuba County Water Agency.
- ***2007–2009 Drought*** — Addressed at least 35 transfer proposals, including 13 from various parties to DWR's 2009 Drought Water Bank.
- ***2012–2016 Drought*** — Addressed at least 51 transfer proposals.

4.2 Providing Oversight of Existing Diversions

Another set of drought response strategies the Board has used centers on providing oversight of existing surface water diversions. These strategies span analyzing water supply, demand, and availability in particular watersheds, providing curtailment-related information to diverters,

curtailing water diversions when demand exceeds supply, allowing limited health and safety exceptions to curtailments, and approving alternatives in lieu of curtailments. When executed appropriately, they can help water users plan more effectively for potential upcoming shortage, protect priority uses, and avoid unauthorized diversions.

4.2.1 Analyzing Water Supply, Demand, and Availability in Particular Watersheds

To exercise effective oversight over surface water rights during a drought, the Board needs to understand how much water is physically and legally available under different priorities of right as conditions change over the course of the drought and each water year. The Board engaged in extensive drought water availability analysis during the 1976–1977 and 2012–2016 droughts, and likely engaged in some form of analyses during the two intervening droughts:

- ***1976–1977 Drought*** — Extensively analyzed water availability to support notices of potential water shortage and notices of water unavailability in 1977.
- ***1987–1992 Drought*** — Likely analyzed water availability (?).
- ***2007–2009 Drought*** — Likely analyzed water availability (?).
- ***2012–2016 Drought*** — Extensively analyzed water availability to support notices of potential water shortage and notices of water unavailability in 2014, 2015, and 2016, building on the Board's 1977 analysis.

In 1977, the Board decided to begin analyzing drought water availability to help water users in the Sacramento and San Joaquin River watersheds understand how much water was available to them, so they could avoid inadvertently interfering with others' water rights.[91] Its intent was to ensure that water would be used "in accordance with California water rights laws, and to conserve and extend available supplies to mitigate drought impacts."[92] The Board's analyses were necessarily done at a coarse scale due to data limitations. Its general methodology involved (1) comparing estimates of total watershed-wide supply to total watershed-wide demand and (2) assigning any shortfall to the most junior users in the watershed until it arrived at a priority date for which demand no longer appeared to exceed supply. It estimated monthly supply, demand, and availability for different categories of water rights, beginning with riparian rights, as follows[93]:

Monthly water availability for riparian rights

- Supply: Estimated (Natural inflows + Natural groundwater accretions – Return flows)
- Demand: From existing studies or estimated based on riparian acreage
- Availability: Riparian supply – Riparian demand

Monthly water availability for pre-1914 appropriative rights

- Supply: "[R]esidual natural supply after riparian demands are satisfied" + "return flow from use of ground[water] and project (stored or imported) water in the basin"
- Demand: Estimated from an incomplete set of Statements of Water Diversion and Use
- Availability: Pre-1914 supply – Pre-1914 demand

Monthly water availability for post-1914 appropriative rights

- Supply: Residual supply left after pre-1914 availability was taken into account
- Demand: Estimated from permits and licenses

- Availability: Post-1914 supply – Post-1914 demand

The Board's drought water availability analyses during the 2012–2016 drought were in some ways significant improvements over their 1970s counterparts, but they relied on the same general methodology (see Appendix C.4.5).[94] These coarse-scale analyses have significant limitations because, to accurately characterize water availability and minimize over- and under-curtailments, analyses must account for the hydrologic connectivity, or lack thereof, between different components of supply and demand (see Appendix A of **Part 2** for more discussion of this issue).[95]

4.2.2 Providing Curtailment-Related Information and Curtailing Water Diversions

After analyzing water availability, the Board has acted on what it has learned to ensure that water rights are exercised appropriately. First, to help water users with planning decisions, it has provided advance warning when forecasts suggest a potential water shortage is looming. Second, the Board has sometimes notified water users when water is unavailable for them under their water rights. Third, it has sometimes issued independently enforceable curtailment notices or orders.

4.2.2.1 Identifying Curtailment Objectives

The Board has identified a number of potential objectives for curtailment.

Protecting senior water rights — During the 1976–1977 and 2012–2016 droughts, the Board took the then unprecedented step of issuing curtailment notices (notices of water unavailability) for the stated purpose of protecting more senior water rights from illegal diversions by more junior water users.

Protecting fish flows — During the 2012–2016 drought, the Board adopted regulations to curtail diversions on three Sacramento River tributaries in order to maintain minimum instream flows to support ESA-listed fish species.

Protecting releases of Supplemental Project Water (Term 91) — A series of Board decisions requires the state and federal projects to release water stored in project reservoirs as necessary to meet Delta water quality standards, including for flow and salinity.[96] Term 91 was added retrospectively to many permits and licenses that were issued after 1965 in the Delta watershed to prohibit diversions when releases of "Supplemental Project Water" are required.[97] According to the Board, the Term currently "affects approximately 118 water rights holders in July and August of most years."[98] Between 1984, when it was first implemented, and 2015, Term 91 curtailments were invoked at some point in all but 5 years.[99] In 2012, the Delta Watermaster produced a report suggesting that the Board consider expanding the number of water rights for which Term 91 applies, arguing that it is already implicit in all water rights, since there is no right to take water stored under right by another.[100] Because Term 91 curtailments are expressly built into water right permits and happen nearly every year, they are less closely associated with droughts. However, during droughts they may be invoked earlier in the year and for longer. Most of the permits and licenses in the San Joaquin River watershed include a similar term, Term 93, which has been invoked much less frequently.[101]

4.2.2.2 Providing Curtailment-Related Information

During all four droughts, the Board provided some level of curtailment-related information to water users in some watersheds (described in more detail in Appendix C), although its activities were most extensive during the 1976–1977 and 2012–2016 droughts.

Notices of Potential Water Shortage — During all four droughts, the Board has sent at least some water users notices warning them of forecasted dry conditions and the potential for future water unavailability:

- ***1976–1977 Drought —*** Issued 3,842 notices of potential shortage to diverters in the Sacramento and San Joaquin River watersheds in 1977.
- ***1987–1992 Drought —*** Issued notices of potential shortage to thousands of diverters in the Sacramento and San Joaquin River watersheds during at least two years.
- ***2007–2009 Drought —*** Issued notices of potential shortage statewide in 2009.
- ***2012–2016 Drought —*** Issued notices of potential shortage statewide in 2014 and 2015.

Notices of Water Unavailability (Curtailment Notices) — When the Board's availability analyses suggest that water is unavailable for certain groups of water rights, the Board has sometimes issued water unavailability notices to them.

- ***1976–1977 Drought —*** Issued 4,858 notices of water unavailability to diverters in the Sacramento and San Joaquin River watersheds in 1977.
- ***1987–1992 Drought —*** Issued notices of water unavailability to thousands of diverters in the Sacramento and San Joaquin River watersheds during at least two years.
- ***2007–2009 Drought —*** We did not find information about the Board issuing notices of water unavailability during this drought.
- ***2012–2016 Drought —*** Issued notices of water unavailability to large numbers of diverters in the Sacramento (in 2014 and 2015), San Joaquin (in 2014 and 2015), Eel (in 2014), Russian (in 2014), and Scott (in 2014, 2015, and 2016) River watersheds.

4.2.2.3 Issuing Enforceable Curtailment Notices or Orders

The Board has sometimes issued curtailment notices or orders that have legal effect independent of subsequent potential enforcement actions, like Term 91 curtailment notices and curtailment orders under the Emergency Regulations for Curtailment of Diversions Due to Insufficient Flow for Specific Fisheries (see Appendix C.4.6). Beyond curtailments that are built into permits and licenses or invoked under emergency regulations, individual curtailment orders would generally bar unauthorized diversion on a case-by-case basis, requiring an individual investigation, "issuance of a draft cease and desist order (CDO) or proposed administrative civil liability (ACL), or both, and the opportunity for an evidentiary hearing."[102] These procedural requirements do not apply to notices that serve as a warning, without making any legally binding determination about water availability or whether a violation has occurred.

During the three most recent droughts, the Board issued at least some enforceable curtailment notices or orders (described in more detail in Appendix C), although its activities were most extensive during the 2012–2016 drought:

- ***1976–1977 Drought —*** We did not find information about the Board issuing enforceable curtailment notices or orders during this drought.
- ***1987–1992 Drought —*** Issued Term 91 curtailments.
- ***2007–2009 Drought —*** Issued Term 91 curtailments.
- ***2012–2016 Drought —*** Adopted curtailment regulations to protect fish flows in three tributaries to the Sacramento River, and issued curtailment orders under these regulations in 2014, 2015, and 2016. Issued Term 91 curtailments.

4.2.3 Allowing Limited Health and Safety Exceptions to Curtailments

During the 2012–2016 drought, the Board made limited exceptions from curtailments for water users whose diversions were necessary to support minimum human health and safety needs (see Appendix C.4.7). These exceptions were either explicitly defined in an emergency regulation or implied in the Board's exercise of its enforcement discretion. Both were grounded in California's constitutional prohibition on unreasonable use and the Human Right to Water statute. Such exceptions do not appear to have occurred during the previous three droughts.

4.2.4 Considering Curtailment Alternatives

During the 2012–2016 drought, the Board developed or approved a number of alternatives in lieu of curtailments. These included mandatory enhanced conservation requirements established by regulation, voluntary agreements with state and federal wildlife agencies to maintain minimum flows needed to protect specific fisheries, and voluntary agreements to achieve diversion reductions intended to protect senior water rights through alternative, negotiated means (Appendix C.4.8). The Board does not appear to have considered curtailment alternatives during the previous three droughts.

4.3 Providing Oversight of Water Use by End Users

Some of the strategies the Board has employed during droughts have been directed toward providing oversight of how surface water is ultimately used, whether by water rights holders or those they provide water to. At times, the Board has actively encouraged water conservation or prohibited specific wasteful uses of water on a case-by-case basis. During the 2012–2016 drought, the Board went further, using broadly applicable regulations to prohibit certain wasteful uses of water and to establish mandatory water conservation standards for urban water suppliers (Appendix C.4.9–C.4.11). Measures like these, which are geared toward end users of water, can complement and reinforce strategies addressing urgent water right requests and providing oversight of existing diversions.

4.3.1 Encouraging or Mandating Conservation

The Board has sometimes taken specific actions to encourage water conservation and reuse during droughts, like producing conservation guidance or adopting policies that otherwise encourage conservation and reuse. During the recent drought, the Board instituted mandatory water conservation standards for urban water suppliers for the first time (Appendix C.4.9.3). These were targeted at reducing per-capita residential water use a certain percentage from 2013 levels. This strategy was guided by a series of executive orders from Governor Jerry Brown. During at least two of the last four major statewide droughts, the Board played a key role in encouraging or mandating conservation (see Appendix C):

- ***1976–1977 Drought —*** Engaged in several conservation-related activities, including issuing irrigation conservation guidelines and adopting a reclaimed water policy.
- ***1987–1992 Drought —*** We did not find information about the Board encouraging or mandating conservation during this drought.
- ***2007–2009 Drought —*** We did not find information about the Board encouraging or mandating conservation during this drought.
- ***2012–2016 Drought —*** Adopted statewide emergency regulations prohibiting certain wasteful uses of water, imposing mandatory conservation standards for urban water suppliers, and imposing enhanced conservation requirement in lieu of curtailments in the Russian River. Helped prepare a plan for Making Water Conservation a California Way of Life. Adopted general waste discharge requirements to facilitate recycled water use.

4.3.2 Prohibiting Specific Wasteful Uses of Water

The Board has sometimes prohibited specific wasteful uses of water during droughts (for details, see Appendix C). During the first two of the last four major statewide droughts, this took the form of case-by-case waste and unreasonable use determinations. However, during the recent drought, the Board took a different tack, using broadly applicable regulations to identify and prohibit certain wasteful uses of water.

- ***1976–1977 Drought —*** Made at least one individual determination that a proposed water use would constitute a wasteful and unreasonable use of water.
- ***1987–1992 Drought —*** Determined that at least two instances of using potable water for landscape irrigation when reclaimed water was available constituted a waste and unreasonable use of water.
- ***2007–2009 Drought —*** We did not find information about the Board prohibiting specific wasteful uses of water during this drought.
- ***2012–2016 Drought —*** Adopted emergency regulations that prohibited certain wasteful uses of water statewide (Statewide Urban Water Conservation Requirements), imposed enhanced water conservation requirements in lieu of curtailments in the Russian River watershed, and defined diversions that threaten minimum emergency fish flows as waste and unreasonable use.

4.4 Cross-Cutting Strategies

Some of the drought strategies the Board has used to respond to past droughts are cross-cutting strategies that support or complement strategies related to administration of post-1914 surface water rights, oversight of diversions under existing water rights, or oversight of water use by end users. These have included adopting emergency regulations to address urgent needs, taking steps to improve decision-related information, tracking compliance with various requirements, and taking enforcement actions to address violations.

4.4.1 Adopting Emergency Regulations Targeted to Address Urgent Needs

One of the strategies the Board has used in responding to some drought crises is adopting emergency regulations designed to address urgent needs. In essence, the Board can craft rules that implement, interpret, or clarify existing law—which is often general—in the specific context of the emergency (in this case, water shortage). Drought-related emergency regulations can help the Board carry out its water rights administration and oversight responsibilities more effectively while delineating and helping water users understand their own responsibilities. Sometimes the Legislature or the governor has directed the Board to develop drought-related emergency regulations to operationalize a particular statute or policy, but the Board also has broad authority to develop emergency regulations on its own initiative.

Under the standard rulemaking process (described in Appendix B.3.2), the Board must follow certain procedural requirements, including for providing public notice of a proposed regulation and for seeking and addressing public feedback.

However, when certain conditions are satisfied, streamlined emergency rulemaking procedures allow the Board to develop and adopt regulations more quickly (see Appendix B.3.2.2). Regulations developed using emergency procedures are temporary unless the Legislature explicitly directs otherwise.[103] Therefore, if the Board wants to make them permanent, it generally must fulfill standard rulemaking procedural requirements to achieve that conversion.

Two different statutory provisions, one general (California Government Code § 11346.1) and one drought specific (California Water Code § 1058.5, first introduced in 1991 and amended in 1992, 2014, 2015, and 2016), allow the Board to use expedited emergency rulemaking procedures to respond to a drought emergency. Both provisions substantially reduce public participation requirements and limit review by the Office of Administrative Law (OAL). However, the drought-specific Water Code provision further narrows the scope of OAL review, allows emergency regulations crafted under it to stay in effect longer, eases their renewal, and (as of 2014) allows the Board to fine those who violate the regulations.

Table 2 summarizes the major differences between standard rulemaking, emergency rulemaking under the Government Code, and emergency rulemaking under the Water Code. Appendix B.3.2 provides more detail about each type of rulemaking.

The Board adopted drought-related emergency regulations, summarized in Table 3, during two of the last four major statewide droughts, the 1976–1977 drought and the 2012–2016 drought. In many cases the Governor—and in at least one case, the Legislature—played a direct role in instigating these emergency regulations. The Board does not appear to have adopted drought-related emergency regulations during the 1987–1992 or 2007–2009 droughts. For additional information about the Board's use of emergency regulations during each of the last four major statewide droughts, see Appendix C.

Table 2: Differences Between Standard and Emergency Rulemaking by the Board

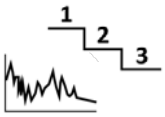
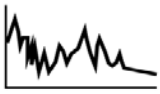
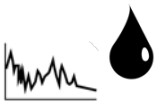
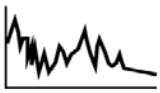
Category	Standard Rulemaking	Emergency Rulemaking Under the Government Code	Emergency Rulemaking Under the Water Code
Emergency Finding	No emergency finding needed	Board must make and support a finding that the regulation is necessary to address an emergency.[104]	Board must find that[105] • it is a critically dry year following 2 or more below normal or drier years or the Governor has proclaimed a drought-related state of emergency, and • the regulation prevents unreasonable use, promotes water conservation or recycling, requires curtailments, or requires reporting related to these.
Public Engagement	The Board must • provide broad public notice of and information about a proposed regulation,[106] • allow at least 45 days for public comment,[107] • hold a public hearing, if requested,[108] • respond to comments received,[109] • allow at least 15 days for public comment on changes.[110]	The Board must • provide notice "to every person who has filed a request for notice of regulatory action" at least 5 working days before submitting a proposed regulation to OAL, unless "delaying action to allow public comment would be inconsistent with the public interest,"[111] and • publish notice documents on its website.[112] OAL must allow at least 5 days for public comment before approving or disapproving a proposed regulation.[113]	
OAL Review	OAL must complete review within 30 working days.[114] Approval requires compliance with[115] • 6 substantive standards • applicable procedural requirements	OAL must complete review within 10 calendar days.[116] Approval requires compliance with[117] • 6 substantive standards • applicable procedural requirements • emergency finding requirement[118]	• No review of emergency findings[119]
Effective Term	No inherent limit	Up to 180 days, with the possibility of up to 2 90-day readoptions if the Board is actively working to make the regulation permanent[120]	Up to 270 days, renewable if the Board determines that emergency conditions persist[121]
Penalty for Violation	No fine or imprisonment unless specifically authorized by statute[122]	No fine or imprisonment unless specifically authorized by statute[123]	Infraction is punishable by a fine of up to $500 per day[124]

- ***1976–1977 Drought*** — Adopted two drought-related emergency regulations.

- ***1987–1992 Drought*** **—** We did not find information about the Board adopting drought-related emergency regulations during this drought.
- ***2007–2009 Drought*** **—** We did not find information about the Board adopting drought-related emergency regulations during this drought.
- ***2012–2016 Drought*** **—** Adopted six sets of drought-related emergency regulations.

Notably, much of what the Board accomplished through emergency regulations developed in the midst of droughts could have been accomplished, or facilitated, using non-emergency processes as part of proactive pre-drought preparations (see **Part 2**).

Table 3: Summary of Drought-Related Emergency Regulations

Effective dates	Subject matter of emergency regulations		Affected code sections (Cal. Code Regs. tit. 23)	Discussed more in
1/31/1977 *(permanent)*		Hearings in Response to Drought Emergency Conditions	736.1 (now 767)	Appendix C.1.11
6/7/1977 to 2/9/1978		Conservation and Protection of Water Within the Sacramento-San Joaquin Delta and Its Tributary Streams	764.20	Appendix B.3.3.1 and C.1.11
6/2/2014 to 12/29/2015		Curtailment of Diversions Due to Insufficient Flow for Specific Fisheries[125]	877, 878, 878.1, 878.2, 879, 879.1, 879.2	Appendix C.4.6
7/16/2014 to 4/14/2015		Statewide Drought-Related Curtailment of Water Diversions to Protect Senior Water Rights[126]	875, 878.1, 878.3, 879	Appendix C.4.6
7/16/2014 to 7/15/2017		Informational Orders[127]	879	Appendix C.4.12
7/28/2014 to 11/25/2017		Statewide Urban Water Conservation[128]	863–866	Appendix C.4.9 and C.4.10
7/6/2015 to 12/28/2016		Enhanced Water Conservation and Additional Water User Information for the Protection of Specific Fisheries in Tributaries to the Russian River[129]	876	Appendix C.4.9 and C.4.10
1/19/2016 *(until revised)*		Measuring and Reporting Water Diversions[130]	907, 908, 910–912, 915–917, 920, 922, 924, 925, 929, 931–938	Appendix C.4.12

4.4.2 Improving Decision-Related Information

Droughts can pull deficiencies in the information and tools on which the Board relies into sharp focus. For example, the effectiveness of conservation actions can be hard to demonstrate without an understanding of both baseline use and changes in use. As another example, to effectively oversee surface water diversions, the Board needs to be able to understand supply, demand, and the relative priority of legal entitlements to use water, as well as how these are related in time and space. Getting adequate information about watershed supply and demand at the spatial and temporal scales the Board needs to inform drought decision making has been a challenge.

Awareness of information needs, combined with the sense of urgency a drought can provide, may open doors that are normally locked, enabling legislative and policy changes that address critical information gaps. Our research suggests that the Board undertook a variety of actions to improve decision-related information during the 1976–1977 drought and, especially, the 2012–2016 drought (described in more detail in Appendix C). Although we did not identify particular efforts associated with improving decision-related information during the 1987–1992 and 2007–2009 droughts, it is likely the Board did undertake some, for example related to the 2009 water legislation package that, among other things, imposed a penalty for failing to file statements of diversion and use for riparian or pre-1914 rights.[131]

- ***1976–1977 Drought —*** Collected new data about water use during the drought and made recommendations for improving decision-related information for the future.
- ***1987–1992 Drought —*** We did not find information about the Board taking actions to improve decision-related information during this drought.
- ***2007–2009 Drought —*** We did not find information about the Board taking actions to improve decision-related information during this drought.
- ***2012–2016 Drought —*** Adopted emergency regulations for informational orders, then used them to improve information about diversions and relative water right priority. Improved information about urban water use by requiring reporting as part of mandatory conservation standards for urban water suppliers. Adopted emergency regulations for enhanced measurement and reporting of diversions under Senate Bill 88 that will greatly improve the timeliness and accuracy of future diversion data.

Below, we discuss several types of information needs related to understanding water availability in particular watersheds. During the recent drought, the Board's Division of Water Rights identified the aspirational goal of "[r]eal-time management of flows and diversions that accurately tracks water availability and the need for curtailment based on the accounting of water rights[and] hydrology, and . . . ensuring that minimum in-stream flow levels are met."[132] This is not yet a reality, but the Board has taken some substantial steps toward improving the timeliness and accuracy of the data it relies on in the midst of drought, either on its own initiative or with help from the governor or Legislature.

4.4.2.1 Information About Water Supply

Effective oversight of water diversions during a drought requires an adequate understanding of whether water is, or is likely to be, available under particular rights in a particular watershed at a particular time. To inform its understanding of the supply side of this analysis, the Board uses

water supply data collected and analyzed by others, including DWR, the U.S. Geological Survey (USGS), and academic researchers. This includes DWR's estimates and projections of "full natural flow" that rest on calculations based on data from a limited number of locations.[133] The Board has generally based its drought water availability analyses on supply estimates for entire watersheds and major tributaries. But estimating supply in smaller subbasins, many of which are ungaged, and determining how different subbasins are hydrologically connected may be critical for understanding water availability under particular water rights. Modeling can potentially help fill this gap. Appendix A of **Part 2** includes a more thorough discussion of this issue.

4.4.2.2 Information About Water Diversion and Use

To inform its understanding of the demand side of drought water availability analyses, the Board looks to self-reported information from water users in a watershed. This information has generally been incomplete, out of date, inaccurate, or all three. Those diverting under post-1914 rights are required to provide annual water use reports documenting their diversions during the previous calendar year. Historically, the Board received little information about diversion and use under riparian and pre-1914 rights. Since 1965, Water Code Sections 5101 and 5104 had required reporting of monthly diversions under these rights every three years. However, few complied until the Legislature imposed a penalty for failure to file as part of its 2009 water legislation package.[134] In 2015, the Legislature enacted enhanced diversion measurement and reporting requirements for surface water diversions (and diversions from subterranean streams) through Senate Bill 88, and the Board issued regulations to implement the new requirements (see Appendix C.4.12.3). During the 2012–2016 drought, the Board also sought more timely information about diversions under many riparian and pre-1914 rights in the Delta watershed through emergency informational orders (see Appendix C.4.12.2).

4.4.2.3 Relative Water Right Priorities

Information about surface water diversion and use is important for drought water availability analyses, but it is not sufficient. The Board also needs to understand other characteristics of water rights, including the relative priorities of different diversions and their specific locations within a watershed relative to other water diversions and water supply information. The Board has a relatively good understanding of the legal basis for and characteristics of the appropriative rights it has permitted, licensed, or registered since 1914. However, because pre-1914 appropriative rights and riparian rights were exempted from that permitting system, the Board generally knows much less about them, except where the rights were involved in an adjudication or were the target of a specific water rights investigation. During the 2012–2016 drought, the Board sought information about the basis for many riparian and pre-1914 rights in the Delta watershed through emergency informational orders. (See **Part 2** for a more detailed discussion of this issue).

4.4.3 Tracking Water Right Compliance and Taking Enforcement Actions

Two critical components of water rights oversight are (1) tracking compliance and (2) taking enforcement actions to address problems. Because they are intimately linked, we discuss them together in this section.

4.4.3.1 Tracking Water Right Compliance

Compliance with various aspects of water rights law may be tracked, and non-compliance may be brought to the Board's attention, through a variety of different means.

Self-reported information — When diverters or others are required to collect and report specific information to the Board, that information can confirm compliance with or reveal potential violations of particular requirements, for example, water quality standards. Additionally, when reporting is required on a regular schedule, failure to report is itself a type of violation, but it may also signal that there could be further problems underlying the failure to report.

Field inspections — Field inspections and incidental field observations by Board staff (or staff from the Regional Boards, DWR, the CDFW, or other government agencies) can bring unlawful diversions and other violations to the Board's attention. While inspections could theoretically be done at random, they are more likely to be targeted toward particular areas of concern or directed at those who fail to comply with self-reporting requirements.[135]

Remote sensing — Aerial photos and satellite data can reveal potential violations such as unauthorized dams and reservoirs or irrigation in areas that should be fallowed.

Complaints — Complaints by members of the public can bring potential water right violations to the Board's attention, whether or not the party filing the complaint has been directly injured. For example, state regulations allow those affected by violations of the terms or conditions of permits or licenses to file complaints with the Board.[136] If Board staff investigate and determine that a violation which potentially warrants enforcement action may have occurred, they can refer the matter to the Board.[137] But complaints can also address other types of allegations, such as unauthorized diversion, injury to senior rights, or misuse of water (including waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion, and impacts to public trust resources).[138] Currently, members of the public can file water right-related complaints through California EPA's online Environmental Complaint System.[139] Complaints often increase significantly during drought years.

Our research suggest that the Board undertook various actions to track compliance during the 1976–1977 drought, the 1987–1992 drought, and the 2012–2016 drought. Although we found no information regarding compliance tracking during the 2007–2009 drought, it is likely the Board did undertake some form of tracking. For information about the Board's actions tracking compliance during each of the last four major statewide droughts, see Appendix C.

- ***1976–1977 Drought —*** Tracked compliance using a variety of techniques.
- ***1987–1992 Drought —*** Tracked compliance via field inspections.
- ***2007–2009 Drought —*** We did not find information about the Board taking actions to track compliance during this drought.
- ***2012–2016 Drought —*** Tracked compliance using a variety of techniques.

4.4.3.2 Taking Enforcement Actions

The Board has had access to—and made use of—a number of different strategies for carrying out enforcement actions against violators. The California Legislature has made clear that it intends the state to "take vigorous action to enforce the terms and conditions of permits licenses, certifications, and registrations to appropriate water, to enforce state board orders and decisions, and to prevent the unlawful diversion of water."[140]

Informal enforcement actions — The Board sometimes takes informal enforcement actions to try to spur corrective action by violators, for example, sending a reminder to a diverter that missed an initial deadline for responding to an informational order.

Formal enforcement actions — The Board can also take formal enforcement actions to address unauthorized diversion or use of water, including (1) since 1980, issuing a cease and desist order (CDO),[141] (2) since 1987, imposing administrative civil liability (ACL),[142] and (3) revoking a water user's permit or license.[143] Before taking a formal enforcement action, the Board must provide the alleged violator with proper notice and hold a hearing, if requested.[144] The Board can also refer a case to the Attorney General for prosecution.[145] Additionally, 2014 drought relief legislation enhanced the enforceability of emergency regulations developed under Water Code Section 1058.5 by making violations subject to fines of up to $500 per day.

Our research suggests that the Board undertook drought-related enforcement actions during the 1976–1977 drought, the 1987–1992 drought, and the 2012–2016 drought. Although we found no information regarding drought-related enforcement actions during the 2007–2009 drought, it is likely the Board did undertake some. For information about the Board's drought-related enforcement actions during each of the last four major statewide droughts, see Appendix C.

- ***1976–1977 Drought*** — Took enforcement actions related to 30 drought-related water rights complaints, referring 6 cases to the Attorney General.
- ***1987–1992 Drought*** — Pursued at least one drought-related ACL action and made a number of waste and unreasonable use determinations in response to complaints.
- ***2007–2009 Drought*** — We did not find information about the Board taking drought-related enforcement actions during this drought.
- *2012–2016 Drought* — Took various drought-related enforcement actions, including sending reminder letters and imposing CDOs and ACLs.

5: Key Findings and Discussion

Our analysis of the Board's past drought responses suggests the following key findings.

5.1 The Board Emphasized Different Response Strategies During Different Droughts

The Board has many potential tools at its disposal and can tap a wide array of strategies to respond to droughts. As Section 4 and Appendix C demonstrate, the Board has used or emphasized different types and combinations of drought response strategies during each drought. Figure 3 summarizes this variation by illustrating the relative extent to which the board used different types of drought response strategies during each of the last four major statewide droughts.

5.2 The Board's Role in State Drought Response Was Sometimes Limited

During some droughts, the Board played a more limited role in state drought response. In particular, the Board took a more hands-off approach that emphasized addressing water right requests during the 3-year 2007–2009 drought and, to a lesser extent, during the 6-year 1987–1992 drought (Figure 3). During these droughts, the Board's role was dominantly reactive, with its drought-related agenda determined largely by the nature of the applications, petitions, and other requests it received. Other state agencies, like DWR, and other state programs, like Drought Water Banks run by DWR, played a greater role.[146] After these droughts, the Board did not publish a public retrospective of its drought response activities or recommendations for future drought-related improvements.

5.3 The Board Engaged Most Extensively During the Recent Drought

The Board was most active in state drought response during the 1976–1977 and 2012–2016 droughts, but especially the latter (Figure 3).

Extensive Role in 1976–1977 Drought Response

At the beginning of 1977, the second year of the brief 1976–1977 drought, the Board began to actively engage in significant water rights oversight for the first time in approximately six decades of existence.[147] Most notably, it developed a method for analyzing water availability under different priorities of right in a watershed to help diverters avoid inadvertently interfering with more senior water rights. The Board used this methodology as the basis for issuing thousands of notices of potential water shortage and unavailability. It carried out field investigations and aerial surveys to confirm compliance and identify potential instances of waste and unreasonable use, responded to water rights complaints, and carried out enforcement actions. The Board also provided irrigation conservation guidelines to farmers in drought impacted areas.

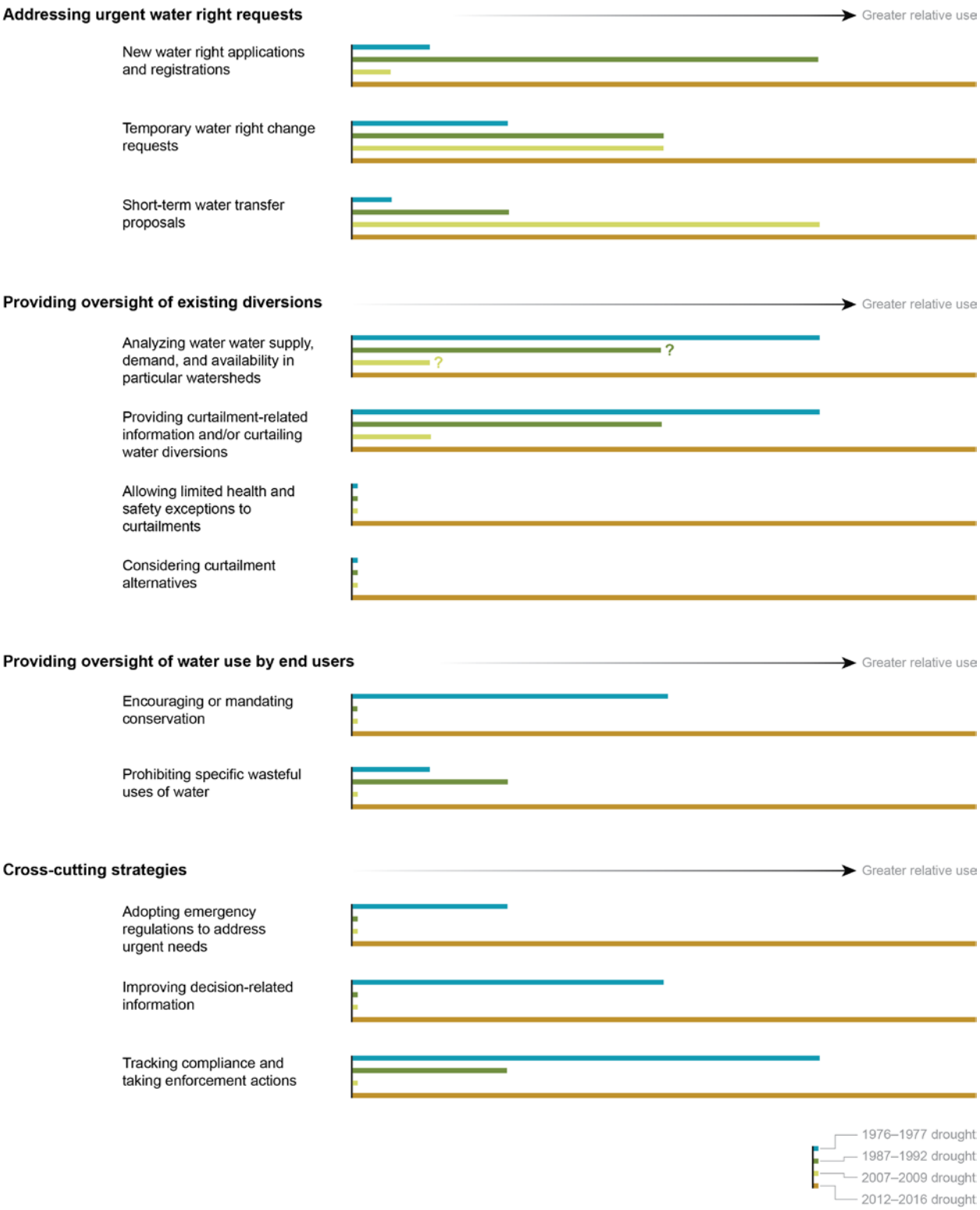


Figure 3: Relative Extent to Which the Board Has Used Different Types of Drought Response Strategies During Each of the Last Four Major Statewide Droughts
Bar length corresponds to the Board's relative use of each type of drought response strategy during each drought, taking into account both breadth and depth of use.

This drought was also the first time the Board tried to integrate its water rights and water quality work, developing an interim water quality control plan to protect Delta water quality and adopting a subsequent regulation relaxing the requirements in the interim plan as the state and federal projects struggled to manage Delta salinity and to keep water in storage for later use in case the drought continued.

Although the drought ended quickly (and with it, the Board's Dry Year Program), the Board published a retrospective analysis that described how it responded to the drought and provided recommendations for future actions the Board and Legislature could take to improve water rights administration and enforcement during future droughts, as well as more generally. The Governor's Commission to Review California Water Rights Law also came up with recommendations. Although some of the recommendations in these documents were implemented, others were never acted upon (as the Board noted in its 2015 Drought Report).

More Extensive Role in 2012–2016 Drought Response

During California's most recent drought, from 2012–2016, the Board employed the widest variety and greatest depth of strategies in its drought response. It used some of these for the first time, and others that had lain largely dormant since the 1976–1977 drought. Some, like requirements for mandatory urban water conservation, were sweeping in their application. Others were more narrowly focused on particular watersheds. Many of these interventions were legally innovative, and the Board invoked important but underutilized principles, like the constitutional requirement for reasonable use and the public trust doctrine, that it had not relied on as extensively during previous droughts. Additionally, the Board's strategies were not static—many evolved through an iterative approach as more information and experience accumulated. The shift to a more active Board was not without controversy, and many of the Board's actions generated opposition and, sometimes, litigation.

5.4 Many Factors Contributed to Differences in the Board's Past Drought Responses

Our analysis suggests that a range of factors contributed to variation in how the Board responded to past droughts. These include differences in the meteorological and hydrological makeup of the droughts themselves, changes in the state's population, and changes in environmental conditions that affected how people and ecosystems experienced their impacts. They also include changes in the legal and political landscape over time, changes in information availability, and changes in factors that are internal to the Board.

5.4.1 Drought Severity and Duration

By several measures, the 1976–1977 and 2012–2016 droughts were the most severe (see Section 2.2.3). As might be expected, the Board was more actively engaged in a wider variety and depth of drought response activities during these droughts, including a greater emphasis on oversight of diversions to ensure that water rights were being exercised appropriately—especially important when water is especially scarce.

Although drought duration played some role, it was less important than other factors. The Board was more active during the 6-year 1987–1992 drought than it was during the 3-year 2007–2009 drought, but it was even more active during the 2-year 1976–1977 drought and the 5-year 2012–2016 drought.

5.4.2 Changing Legal Requirements

Many legal developments have occurred since the 1970s, both within and outside the context of droughts. Appendices A.2.3, B.2.3, and C explore some of these changes. We mention two here:

Environmental Protections — Earlier droughts occurred when there were fewer environmental protections, and therefore fewer environmental restrictions on water diversions (see Appendix A.2.3 and Table A-2 and Appendix B.2.3). For example, during the 1976–1977 drought, there were few California fish listed as federally threatened or endangered (see Table 1). By the end of the 1987–1992 drought, the number of federally listed fish had more than doubled, and many more were listed before or during the 2007–2009 drought.

The Human Right to Water Statute — When the Legislature passed California's human right to water statute in 2012, it introduced a clear requirement for the Board to consider the effect of its decisions on "the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes."[148] One of the ways the Board responded to the requirement was to include an exception to the fisheries related curtailment regulations it issued for diversions needed to meet minimum health and safety needs.

5.4.3 Direction and Support from Political Leadership

How much and what type of effort the Board put into drought response was also influenced by the degree of support—and the type and nature of direction—it received from the state's political leaders, namely, the governor and the Legislature. For example, during both the 1976–1977 drought and the 2012–2016 drought, the same person (Jerry Brown) was governor, and, in both time periods, he emphasized the importance of water rights issues, directing the Board to take on certain drought response tasks. Acknowledging that some water management challenges stem from uncertainty and other limitations of the laws governing water rights, Governor Brown also established a commission to review and recommend changes in California water law.[149] During the 2012–2016 drought, specific directives from the governor spurred (or at least preceded) most of the Board's major drought response efforts. Similarly, the Legislature's actions before and during the 1987–1992 drought encouraged transfers and exchanges as a way to deal with limited water supplies, raising DWR's profile in drought response.

5.4.4 Changes in Information Availability

Another important variable was information availability. The information the Board can draw from to inform its drought decision making has changed over time. This includes information about water demand and use, which is a critical for analyzing the potential for future water shortage and the availability of water under particular water rights during a shortage. In 1977, the Board approximated demand under riparian and pre-1914 appropriative rights based on estimates of riparian acreage and a very incomplete set of statements of diversion and use. Advances in diversion information that enabled more accurate drought water availability analyses were not available until the recent drought. Legislative changes at the end of the 2007–2009 drought and in the midst of the 2012–2016 drought greatly increased the accessibility and timeliness of the information available to the Board about pre-1914 appropriative and riparian diversions. In 2010, the Board moved from having little information about these diversions to receiving statements of diversion and use for them every three years. In 2014 and 2015, it issued informational orders to gather more recent and timely information for some of these diversions.

Going forward, the Board will have access to annually reported diversion information for all diverters, as well as the ability to require monthly, or (for larger diverters) more frequent reporting in particular watersheds when water shortage is projected. These, and other improvements in the quantity, quality, and timeliness of information available to the Board, will enable more detailed and timely analyses to support more targeted and effective decisions.

5.4.5 Internal Factors

In addition to the broader physical and institutional context of each drought, changes in factors internal to the Board also affected how it responded during each drought. These include funding, the nature of staff expertise, staffing levels, systems for maintaining institutional memory, and how the Board prioritizes and organizes the work associated with its many water rights and water quality responsibilities. It is important to recognize that these factors, though described here as "internal," are not fully under the Board's control. The governor and Legislature directly and indirectly shape the agency's capabilities, as well as its priorities, during and between droughts.

5.5 Little Proactive Planning or Preparation Took Place Between Droughts

Our research did not reveal evidence of significant drought-specific planning and preparation by the Board between past droughts. Limited planning and preparation between droughts increased the need for in-drought improvisation and may have been an important factor in driving some of the variation in the Board's drought responses.

In the wake of the 1976–1977 drought, the Board's 1978 retrospective report noted that it had entered the drought without a plan of approach, concluding that it would be useful to "plan and standardize methodology and procedures to better administer water rights during [both] the normal year and future droughts."[150] A reasonable inference is that the Board did not consider the drought water availability analysis methodology and curtailment-related procedures it developed during the 1976–1977 drought to be optimal or complete. Instead, the Board appeared to be suggesting it should undertake a process to develop improved methods and procedures for use in future drought response. Yet this recommendation does not appear to have been acted upon.

In its 2015 in-drought retrospective, the Board noted that it was using the same basic methodology for determining water availability under different priorities of right that it had used in 1977.[151] During 2016 hearings on curtailment-related enforcement actions, testimony from Board enforcement staff suggested that there were no efforts to improve drought water availability analyses between 1978 and the 2012–2016 drought—or, at least, no institutional memory that such efforts had occurred:

> To make water availability determinations during the drought emergencies, the Division started with the 1977 Drought Report as a conceptual template. Nobody had performed an analysis like this in recent years. To respond to the significant drought emergency and extreme water shortage, Division staff adapted the 1977 template to modern data processing capabilities, using the best available supply and demand information and they did an excellent job given their urgent circumstances and tight timeline. The drought water availability analysis methodology evolved from 2014 into

> 2015, as we gathered new and better information. . . . To my knowledge, until 2014, nobody attempted this type of drought water availability analysis in modern times. A lot has changed since the 1977 drought curtailment, so this was really something nobody had done before. Still, the Division did a great job gathering information, analyzing supply and demand, and notifying right holders.[152]

Testimony from another Board staff person explained further:

> Before any notices were issued, the Division compared the water supply to reported demands. Division staff performed a similar analysis in 1977, comparing the natural water supply with water at demand by month. The starting point for the 2014 and 2015 analyses was a graphical summary prepared by the Division of Water Rights Application Section Program Manager, Mert K. Lininger, in 1977. This graphical summary, shown on the following slide, was prepared alongside the 1977 Dry Year Report, and was adapted to current conditions in 2014 and 2015, using the best available information.[153]

Together, their testimony suggests that, as the recent drought progressed, Board staff recognized a need to perform drought water availability analyses to enable effective drought water rights oversight and turned to the Board's 1978 drought retrospective report to see how it might be done. Given that some curtailment-related activity—which would have benefitted from drought water availability analysis—occurred during the 1987–1992 drought (and, to a lesser extent, the 2007–2009 drought), it seems possible that the Board has essentially rediscovered the 1977 methodology, without intervening improvements, during each drought.

5.6 Over-Reliance on In-Drought Improvisation Hindered Effective Drought Response

Instead of identifying, ahead of time, what actions might be appropriate for different drought contingencies, and developing associated processes, procedures, and information to help it select and appropriately implement them, the Board often needed to improvise important aspects of its drought response strategies on short time scales in the midst of drought crises. This means the Board spent valuable time during droughts marshalling its resources in order to make basic decisions about which response strategies to use, what to prioritize, and how to engage with stakeholders. Water users did not know what to expect from the Board in advance, and therefore found it challenging to make their own drought preparations.

Below, we explore two examples of the ad hoc nature of the Board's drought response, and problems that arose from it, during the 2012–2016 drought.

5.6.1 Example 1: Curtailment-Related Actions During the Recent Drought

The Board took its first significant water rights oversight actions of the 2012–2016 drought in 2014, the third year of the drought. Conditions looked dire from the beginning of 2014 in many parts of California. On January 17, 2014, the Board issued a general notice of potential water shortage, alerting diverters that, "if dry weather conditions persist[ed]," it would "notify water right holders in critically dry watersheds of the requirement to limit or stop diversions of water under their water right, based on their priority." The Board was slow to take further public action because staff were researching the methods the Board had used to analyze drought water availability in 1977. Although providing water users in particular watersheds with a range of

potential water shortage scenarios (accompanied by appropriate caveats) might have allowed those users to make better-informed decisions earlier in the year, the Board was not prepared to take such action. On March 1, Governor Brown signed Senate Bill 104 (enhancing the Board's emergency regulatory authority). In late April, the Board put "curtailment analysis" graphs (now called supply and demand analyses) for several watersheds on its website for the first time, projecting when more junior rights might need to be curtailed to protect senior water rights in those watersheds.[154] Graphs for the Sacramento-San Joaquin watershed indicated that water was already, or would soon become, unavailable for all post-1914 rights, and for at least some pre-1914 rights, but the Board did not yet issue notices of water unavailability for the watershed. Between January and mid-May, California had received little precipitation. In mid-to-late May, the Board worked on emergency regulations for curtailing diversions due to insufficient flow for endangered fish in three Sacramento River tributaries. Between May 27 and June 30, it sent notices of water unavailability to some or all post-1914 appropriative rights in the Sacramento, Russian, San Joaquin, and Eel River watersheds. On July 2, the Board adopted statewide emergency regulations intended to affect the way it issued future curtailments of post-1914 rights and to enable the board to acquire additional information from diverters. The Board never issued curtailment orders under those regulations.

Stakeholders were left wondering how the Board was prioritizing its actions and what might happen next. Without a clear plan for drought decision making, the Board struggled to find an appropriate balance between acting, overreacting, and doing too little too late. Even though the Board made efforts to explain its actions and reasoning as it went along, the lack of an overall plan of approach led to delays, inconsistencies, and confusion, hindering water users' ability to plan and the Board's own efforts to oversee and enforce California's water rights system and to protect high priority environmental and public health and safety uses.

In 2015, the Board generally moved more quickly, building on the work it did, and the experience it gained, in 2014. It made some curtailment analysis graphs available at the end of January, readopted the emergency regulations for curtailments related to fish flows in March, issued curtailments under those regulations in April, and sent out initial notices of water unavailability to diverters in the Sacramento and San Joaquin River watersheds in late April to early May.

Nonetheless, there were still problems. Among them: some of the entities that received notices of water unavailability sued the Board in 2015, challenging its authority to issue the notices and addressing other curtailment-related issues, such as whether the notices were consistent with water right priorities, whether the Board's Executive Director had the authority to send the notices at all, the interaction between curtailments and temporary urgency change orders, the scope of the Board's jurisdiction over pre-1914 and riparian water users, whether and what types of oversight and enforcement are appropriate for them, and related due process and takings allegations (Box C-1 in Appendix C.4.6.2). Water rights enforcement was also challenging (Appendix C.4.13). Enforcement staff were unable to carry their burden of proving that water was truly unavailable under a specific diverter's priority of right based on the group-level, watershed-wide drought water availability analyses they presented. This result drove home the Board's need for more precise, accurate, and timely information about water supply and demand, as well as for a better process for analyzing water availability.

5.5.2.2 Example 2: Actions Related to Temporary Urgency Change Petitions (TUCPs) for the State and Federal Projects During the Recent Drought

Before the 2012–2016 drought began, California reservoirs were essentially full, but by 2014, reservoir storage was low, resulting in tensions between making water deliveries and meeting flow and other water quality requirements.[155] In combination with record warmth, low streamflows contributed to poor water quality, including low dissolved oxygen levels and high temperatures in waterways that are critical for ESA-listed salmon and steelhead.[156]

Instead of planning for important contingencies in advance of drought, water managers relied heavily on TUCPs to relax water quality and flow requirements. As researchers associated with the Public Policy Institute of California (PPIC) noted, a lack of contingency planning for managing fish and wildlife under severe drought conditions led the Board "to make trade-offs on the fly . . . based on limited knowledge and almost no scientific or public review."[157] Additionally, features associated with the temporary urgency changes the Board approved did not always function as intended. We discuss two linked examples involving TUCPs for the state and federal water projects here.

SWP and CVP TUCPs

To preserve water in storage for later use—including flows for Sacramento River temperature management (see below), for salinity control in the Delta, and for agricultural and municipal use—DWR and the USBR sought, and the Board approved, multiple modifications of water quality and flow requirements for the SWP and CVP that were intended to provide near-term protection for Delta smelt and other fishes in the Delta (see Appendix C.4.3).[158] These modifications coincided with historically low populations levels of several Delta resident species, including Delta smelt and longfin smelt.[159] The Board decided how to weigh tradeoffs between competing needs on an ad hoc basis during the drought emergency, even though the need for such tradeoffs could have been predicted ahead of time. As another PPIC case study concluded, "[t]he challenges of managing cold water pools, the difficulty associated with maintaining Delta salinity, the risk of drought impacts on the Delta ecosystem, and the likely tradeoffs between water supply and aquatic habitat (and sometimes between the species themselves) were all predictable consequences of extended drought," and even the very "warm nature of this drought—although unprecedented—should also have been anticipated in light of the predicted hydrologic effects of climate warming."[160]

While the SWP and CVP temporary urgency changes allowed the projects to store substantial amounts of water for later use—including cold water critical for salmon smolt survival—there was, nonetheless, a significant failure to protect salmon.

Sacramento River Temperature Management

Under Water Right Orders 90-05 and 91-01 and a Biological Opinion, the USBR is responsible for operating Shasta Dam and other CVP infrastructure to maintain average water temperatures in the Sacramento River at Red Bluff Diversion Dam below 56 degrees Fahrenheit whenever higher temperatures would be detrimental to winter-run Chinook salmon.[161] In both 2014 and 2015, winter-run Chinook salmon in the Sacramento River experienced near total mortality of

eggs and fry due to high temperatures,[162] despite modeling by USBR that suggested "adequate flow and storage conditions would be provided to avoid such temperature impacts."[163] This was particularly concerning "given that most winter-run Chinook salmon have a three-year lifecycle."[164] Although the Board held public workshops that touched on temperature management in 2014 and 2015 and required the USBR to update its Sacramento River temperature management plan to protect winter-run Chinook salmon and other salmonids and to submit the plan for approval as a condition of TUCP approval,[165] these measures were not sufficient to avoid severe impacts to these species.

According to a PPIC case study, "[t]he warm water releases from Shasta Reservoir during summer and fall of 2014 and 2015 [we]re the result of record-setting dry and warm conditions, technical issues in monitoring and modeling the cold water pool, and choices made by USBR on balancing demands for hydropower, irrigation supplies, Delta water quality, and winter-run Chinook."[166] That case study concluded that the approaches used by USBR, the Board, and the wildlife agencies to deal with the crisis were "too ad hoc to protect species from jeopardy" and would have benefited from increased transparency, "[m]ore scenario development and testing," and pre-drought priority setting.[167]

6: Conclusions

This study has shown that one of California's central water decision makers, the State Water Resources Control Board (Board), had largely ad hoc responses to the last four major statewide droughts. The examples of improvisation described in the previous section suggest that the Board's drought response capabilities would benefit from an increased focus on proactive drought planning and preparation. While the Board's heavy reliance on in-drought improvisation likely reduced the effectiveness of drought water rights administration and oversight, its experiences also hold lessons for improving the state's future drought responses. In particular, our findings are consistent with both the need for greater institutional structure to support the Board's drought decision making and with the existence of substantial hurdles to creating and sustaining that structure.

The Board has already taken some important steps, with help from the governor and the Legislature, toward improving California's future drought responses by field-testing a range of new strategies during the recent drought. Indeed, the agency's shift to an active and experimental mode, in which it was willing to confront litigation and controversy in the pursuit of more effective drought water management, was a key component of the state's drought response. But it also supports the notion that a clearer decision-support framework would be helpful. Despite some significant and creative in-drought efforts by the Board and others, there is little precedent for proactive drought preparation that builds on the institutional memory of the Board's past experiences. If the Board had prepared for the recent drought by developing a toolbox of well-thought out strategies in advance, its in-drought actions might not have needed to be quite so improvisational, and the Board's ability to invoke some response strategies might have been more settled (and less contested). These changes, in turn, would likely have enabled a faster, more effective, and more comprehensive response that reflected reasoned policy choices about how best to reconcile competing priorities and needs.

Allocating limited water supplies among different water users has been challenging during past droughts, and continued climate change will only amplify conflicts over water, raising the stakes for effective drought response. To prepare for the more frequent and more intense droughts we expect to occur in the future, and set the stage for more timely and effective in-drought decision making under pressure, the Board can emphasize anticipatory adaptation based on drought contingency planning (see **Part 2**). At the same time, it is important to acknowledge that each drought is different, and finding the political motivation and resources to improve drought response is much easier when the drought is actually happening. Therefore, some in-drought innovation and improvisation will always be necessary—and desirable. But the Board can and should work to set itself up for better results by identifying strategies and developing tools and protocols to address predictable drought scenarios.

We know the next drought is coming, but not precisely when. A key question remains: how prepared will the Board be to address it? We explore how the Board can proactively develop the structure it needs to support more timely and effective future drought response in **Part 2**, the companion to this report.

7: Endnotes

[1] These included two workshops involving a range of stakeholders on *Data for Water Decision Making in California* hosted by the California Council on Science and Technology (CCST), the California Department of Water Resources (DWR), and the University of California Water Security and Sustainability Research Initiative (UC Water) at UC Berkeley on February 9, 2017, and UC Davis on May 8, 2017; two water data "use case" workshops with Board staff focused on curtailments and licensing on September 20, 2017; and two workshops on *Groundwater-Surface Water Interactions and Water Rights Under SGMA* hosted by the Center for Law, Energy & the Environment and UC Water at UC Berkeley on June 9 and July 18, 2017.

[2] Michael D. Dettinger, Fred Martin Ralph, Tapash Das, Paul J. Neiman, & Daniel R. Cayan, *Atmospheric Rivers, Floods and the Water Resources of California*, 3 WATER 455, 460–61 (2011), doi:10.3390/w3020445; Cal.–Nev. Climate Applications Program, Ctr. for Western Weather & Water Extremes, Southwest Climate Sci. Ctr., Cal. Dep't of Water Res., California Precipitation 1 (2015), *available at* http://www.water.ca.gov/floodmgmt/hafoo/csc/docs/CA_Precipitation_2pager.pdf.

[3] Michael D. Dettinger, *Historical and Future Relations Between Large Storms and Droughts in California*, S.F. ESTUARY & WATERSHED SCI., July 2016, at 1, 5–7, 10–11, doi:10.15447/sfews.2016v14iss2art1; Dettinger et al. 2011, *supra* note 2, at 460.

[4] CAL. DEP'T OF WATER RES., CALIFORNIA'S MOST SIGNIFICANT DROUGHTS: COMPARING HISTORICAL AND RECENT CONDITIONS 5 (2015) [hereinafter CALIFORNIA'S MOST SIGNIFICANT DROUGHTS], *available at* http://www.water.ca.gov/waterconditions/docs/a9237_CalSignficantDroughts_v10_int.pdf.

[5] Cal.–Nev. Climate Applications Program, *supra* note 2, at 1; *see also* Figure A-1 in Appendix A of this report.

[6] DAVID CARLE, INTRODUCTION TO WATER IN CALIFORNIA 3 (2016); CAL. DEP'T OF WATER RES., CALIFORNIA WATER PLAN, UPDATE 2013, at 3-36, 3-39 (2014) [hereinafter UPDATE 2013], *available at* http://www.water.ca.gov/waterplan/cwpu2013/final/index.cfm; *see also* Appendix A.1.2.

[7] CARLE, *supra* note 6, at 11.

[8] *Climate Change*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/climatechange/ (last modified Oct. 24, 2017); UPDATE 2013, *supra* note 6, at 3-28, 3-61.

[9] Pub. Policy Inst. of Cal., Storing Water 1 (Oct. 2016) [hereinafter PPIC Storing Water], *available at* http://www.ppic.org/content/pubs/report/R_1016JLR.pdf; *Groundwater*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/groundwater/ (last modified May 9, 2016).

[10] *See* Figure A-2 in Appendix A of this report (showing major California water storage and conveyance infrastructure).

[11] Dettinger 2016, *supra* note 3, at 2.

[12] UPDATE 2013, *supra* note 6, at 3-10, 3-12, 3-58; ELLEN HANAK, JAY LUND, ARIEL DINAR, BRIAN GRAY, RICHARD HOWITT, JEFFREY MOUNT, PETER MOYLE, & BARTON "BUZZ" THOMPSON, MANAGING CALIFORNIA'S WATER: FROM CONFLICT TO RECONCILIATION 199–206 (2011), *available at* http://www.ppic.org/content/pubs/report/R_211EHR.pdf; *see also* Appendix A.1.3.2.

[13] PPIC Storing Water, *supra* note 9.

[14] *Id.*

[15] *California Drought*, CAL. DEP'T OF WATER RES., https://ca.water.usgs.gov/california-drought/ (last modified Nov. 30, 2017).

[16] For example, between 1908 and 2017, the 30-year moving average of annual precipitation in Sacramento varied from more than 20 inches to less than 15 inches (a difference of nearly 30%), peaking before 1910 and from the late 1990s to ~2012, with the lowest values occurring in the late 1940s. *See* Figure A-3 in Appendix A of this report. Over the last half-decade there has been a drying trend. *See id.* Sacramento River flows reconstructed from tree rings

suggest that similar multi-decadal variations have occurred over the last 1,100 years. *See* Figure A-4 in Appendix A of this report.

[17] Michael E. Mann & Peter H. Gleick, *Climate Change and California Drought in the 21st Century*, 112 PROC. NAT'L ACAD. SCI. 3858, 3859 (2015), doi:10.1073/pnas.1503667112.

[18] Giorgos Kallis, *Droughts*, 33 ANN. REV. ENV'T & RES. 85 (2008), doi:10.1146/annurev.environ.33.081307.123117; *California Drought*, *supra* note 15.

[19] *See* Juliet Christian-Smith, Morgan C. Levy, & Peter H. Gleick, *Maladaptation to Drought: A Case Report from California, USA*, 10 SUSTAINABILITY SCI. 491 (2015).

[20] *See id.* at 493.

[21] *See id.* at 491; *Water Quantity*, CMTY. WATER CTR., http://www.communitywatercenter.org/drought (last visited Nov. 29, 2017); LAURA FEINSTEIN, RAPICHAN PHURISAMBAN, AMANDA FORD, CHRISTINE TYLER, & AYANA CRAWFORD, DROUGHT AND EQUITY IN CALIFORNIA 8, 16–17 (2017), *available at* http://pacinst.org/wp-content/uploads/2017/01/PI_DroughtAndEquityInCA_Jan_2017.pdf.

[22] *See* Christian-Smith, et al., *supra* note 19, at 498–99.

[23] *See* JEFFREY MOUNT, BRIAN GRAY, CAITRIN CHAPPELLE, GREG GARTRELL, TED GRANTHAM, PETER MOYLE, NATHANIEL SEAVY, LEON SZEPTYCKI & BARTON "BUZZ" THOMPSON, MANAGING CALIFORNIA'S FRESHWATER ECOSYSTEMS LESSONS FROM THE 2012–16 DROUGHT: LESSONS FROM THE 2012–16 DROUGHT, TECHNICAL APPENDIX: EIGHT CASE STUDIES OF ENVIRONMENTAL WATER MANAGEMENT DURING THE 2012–2016 DROUGHT, at 16 (2017), *available at* http://www.ppic.org/wp-content/uploads/1117ccr_appendix.pdf (describing how "raising the [Sacramento River] temperature target" downstream of Keswick Dam in 2015 "to create more flexibility in export pumping and reservoir storage . . . led to more than 95 percent mortality of winter-run Chinook eggs and fry below Shasta dam").

[24] *See* FEINSTEIN ET AL., *supra* note 21, at 46–49 (describing the impacts of drought, low streamflows, and high water temperatures on salmon).

[25] Aaron Davis, *Antioch Demands Equal Access to Clean, Affordable Water*, EAST BAY TIMES, May 1, 2017, http://www.eastbaytimes.com/2017/05/01/antioch-demands-equal-access-to-clean-affordable-water/; Lauren Sommer, *Record Drought Could Hurt Water Quality*, KQED, Feb. 11, 2014, https://ww2.kqed.org/science/2014/02/11/record-drought-could-hurt-water-quality/.

[26] CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 4, at 11. The period from 2000 to 2004 was also a multi-year drought, but it was more focused in southern California and so had less of an impact on statewide water supply, which comes primarily from northern California and the Sierras. *See* Figure A-1 in Appendix A of this report.

[27] *See* Figures A-2 and A-3 in Appendix A of this report.

[28] *See* Table A-2 in Appendix A of this report.

[29] Data for estimated statewide precipitation and statewide average temperature for water years 1896 to 2016 were derived by querying the "Time Series" feature of the West Wide Drought Tracker for each, using the "States" data retrieval method and the following parameters: Region: California; Start Year: 1970; End Year: 2016; Month: September; Span: 12-Month. *WestWideDroughtTracker*, W. REG'L CLIMATE CTR., http://www.wrcc.dri.edu/wwdt/time/ (last visited Nov. 8, 2017). Other information is from the following sources: Cal. Emergency Mgmt. Agency, Drought Update, Feb. 3, 2016, *available at* http://drought.ca.gov/pdf/archive/DroughtUpdate(02-03-16).pdf; CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 4, at 4–5; CAL. DEP'T OF WATER RES., DROUGHT IN CALIFORNIA 4 (2015) [hereinafter DROUGHT IN CALIFORNIA], *available at* http://www.water.ca.gov/waterconditions/docs/DWR_DroughtBroch_070815-web.pdf.; CAL. DEP'T OF WATER RES., CALIFORNIA'S DROUGHT OF 2007–2009: AN OVERVIEW i, 60–61 (2010) [hereinafter CALIFORNIA'S DROUGHT OF 2007–2009: AN OVERVIEW], *available at* http://www.water.ca.gov/waterconditions/docs/DroughtReport2010.pdf; Edmund G. Brown, Jr., A Proclamation of a State of Emergency, Jan. 17, 2014 [hereinafter 2014 Drought Proclamation], *available at* http://gov.ca.gov/news.php?id=18379; Arnold Schwarzenegger, State of Emergency — Water Shortage, Feb. 27, 2009 [hereinafter 2009 Drought Proclamation], *available at* https://www.gov.ca.gov/news.php?id=11557; Cal. Dep't of Food & Agric., 2017 California Almond Acreage Report, at 8 (Apr. 25, 2018), *available at* https://www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Almond/Acreage/201804almac.pdf (almond acreage for 2007 and 2012); WALTER EBELING, THE FRUITED PLAIN: THE STORY OF AMERICAN AGRICULTURE 369 (1979) (1976 almond acreage);

Cal. Dep't of Fish & Wildlife, State and Federally Listed Endangered and Threatened Animals of California (May 2018), *available at* https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109405.

[30] *See* RENÉE JOHNSON & BETSY A. CODY, CALIFORNIA AGRICULTURAL PRODUCTION AND IRRIGATED WATER USE 6 (2015), *available at* https://fas.org/sgp/crs/misc/R44093.pdf; PAC. INST. & NATURAL RES. DEF. COUNCIL, AGRICULTURAL WATER CONSERVATION AND EFFICIENCY POTENTIAL IN CALIFORNIA 3–4 (June 2014), *available at* http://pacinst.org/wp-content/uploads/2014/06/ca-water-ag-efficiency.pdf.

[31] Cal. Dep't of Food & Agric., 2016 Almond Acreage Report, at 1, 8 (Apr. 16, 2017), *available at* https://www.nass.usda.gov/Statistics_by_State/California/Publications/Fruits_and_Nuts/2017/201704almac.pdf.

[32] Cal. Dep't of Food & Agric., California Grape Acreage Report 2012 Crop, at 2 (Apr. 16, 2013), *available at* https://www.nass.usda.gov/Statistics_by_State/California/Publications/Grape_Acreage/2012/201204gabtb00.pdf; Cal. Agricultural Statistics Serv., California Grape Acreage 1995, at 3 (June 1996), *available at* https://www.nass.usda.gov/Statistics_by_State/California/Publications/Grape_Acreage/1990s/199506gabtb00.pdf.

[33] *See* HEATHER COOLEY, KRISTINA DONNELLY, RAPICHAN PHURISAMBAN, & MADHYAMA SUBRAMANIAN, IMPACTS OF CALIFORNIA'S ONGOING DROUGHT: AGRICULTURE 8 (2015), *available at* http://pacinst.org/app/uploads/2015/08/ImpactsOnCaliforniaDrought-Ag.pdf.

[34] Data for precipitation and mean temperature were derived by querying the "Time Series" feature of the West Wide Drought Tracker for each variable using the "States" data retrieval method and the following parameters: Region: California; Start Year: 1970; End Year: 2016; Month: September; Span: 12-Month. *WestWideDroughtTracker*, W. REG'L CLIMATE CTR., http://www.wrcc.dri.edu/wwdt/time/ (last visited Nov. 8, 2017).

[35] UPDATE 2013, *supra* note 6, at 3-59; *Climate Change*, *supra* note 8.

[36] UPDATE 2013, *supra* note 6, at 3-60, 3-64; *Climate Change*, *supra* note 8.

[37] UPDATE 2013, *supra* note 6, at 3-64.

[38] *Id.* at 3-59, 3-65 to 3-68.

[39] *See* Rusty C. Holleman & Mark T. Stacey, *Coupling of Sea Level Rise, Tidal Amplification, and Inundation*, 44 J. PHYSICAL OCEANOGRAPHY 1439 (2014), doi: 10.1175/JPO-D-13-0214.1.

[40] UPDATE 2013, *supra* note 6, at 3-59.

[41] Noah S. Diffenbaugh, Daniel L. Swain, & Danielle Touma, *Anthropogenic Warming Has Increased Drought Risk in California*, 112 PROC. NAT'L ACAD. SCI. 3931, 3934 (2015), doi:10.1073/pnas.1422385112.

[42] *Id*. at 3934–35.

[43] *See* Ralph Vartabedian, *State Officials Get Slammed for the Oroville Dam Spillway Failure at Sacramento Hearing*, L.A. TIMES, May 12, 2017, *available at* http://www.latimes.com/local/california/la-me-oroville-dam-criticism-20170512-story.html.

[44] CAL. WATER CODE § 174(a).

[45] *See History of the Water Boards: Evolution of Water Policy*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/about_us/water_boards_structure/history_water_policy.shtml (last updated Sept. 20, 2011).

[46] *See* CAL. GOV. CODE § 174; *Transfer of Drinking Water Program*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/drinking_water/programs/DW_PreJuly2014.shtml (last updated July 7, 2015); *Division of Drinking Water Programs*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/drinking_water/programs/index.shtml (last updated May 15, 2017); *see also* Nell Green Nylen, *California's Proposed Drinking Water Program Reorganization: A Primer,* LEGAL PLANET (Oct. 8, 2014), http://legal-planet.org/2014/01/21/californias-proposed-drinking-water-program-reorganization-a-primer/.

[47] CAL. GOV. CODE § 174(b).

[48] *People v. Shirokow*, 26 Cal. 3d 301, 308–09 (1980).

[49] *See* JOSEPH L. SAX, REVIEW OF THE LAWS ESTABLISHING THE SWRCB'S PERMITTING AUTHORITY OVER APPROPRIATIONS OF GROUNDWATER CLASSIFIED AS SUBTERRANEAN STREAMS AND THE SWRCB'S IMPLEMENTATION OF THOSE LAWS 1–3 (2002), *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/groundwater_classification/docs/substreamrpt2002jan20.pdf.

[50] CAL. CONST. art X, § 2; CAL. WATER CODE § 100.

[51] *See* CAL. WATER CODE §§ 10735.2–10736 (describing the Board's ability under the Sustainable Groundwater Management Act (SGMA) to intervene and establish interim groundwater sustainability plans in basins or portions of basins that lack a groundwater sustainability agency, an adequate groundwater sustainability plan, or for which plans are inadequately implemented); *see also* CAL. WATER CODE § 10721(v), (x) (defining sustainable groundwater management in terms of avoiding six undesirable results, including "[d]epletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water"); ALIDA CANTOR, DAVE OWEN, THOMAS HARTER, NELL GREEN NYLEN & MICHAEL KIPARSKY, NAVIGATING GROUNDWATER-SURFACE WATER INTERACTIONS UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT (2018), *available at* https://www.law.berkeley.edu/research/clee/research/wheeler/gw-sw/.

[52] *See Cal. Farm Bureau Fed'n v. State Water Res. Control Bd.*, 51 Cal. 4th 421, 429 (Cal. 2011), as modified (Apr. 20, 2011) (explaining that the Board "regulates all appropriative water rights acquired since 1914 . . . through a system of permits and licenses"); *see also Water Rights Frequently Asked Questions*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/board_info/faqs.shtml (last updated Aug. 14, 2017) ("If you have a pre-1914 right, you do not need a water right permit unless you have increased your use of water since 1914.").

[53] *See* CAL. CONST., art. X, § 2; CAL. WATER CODE §§ 100, 174, 275, 1058; *Light v. State Water Res. Control Bd.*, 226 Cal. App. 4th 1463, 1486–88 (2014), *as modified on denial of reh'g* (July 11, 2014), review denied (Oct. 1, 2014); *Millview Cty. Water Dist. v. State Water Res. Control Bd.*, 229 Cal. App. 4th 879, 893–94 (2014), *as modified on denial of reh'g* (Oct. 14, 2014); *see also Imperial Irr. Dist. v. State Water Res. Control Bd.*, 186 Cal. App. 3d 1160 (1986).

[54] *See Light*, 226 Cal. App. 4th at 1482–88 (citing California Supreme Court cases that have recognized or assumed the Board's ability to adopt such regulations).

[55] *See* CAL. WATER CODE §§ 1050–1055.4, 1538, 1825–1836, 5107. *But see California Water Curtailment Cases*, No. 1-15-CV-285182, Cal. Super., Santa Clara Co., Statement of Decision, Phase I Trial, at 24–31, Feb. 20, 2018.

[56] *See, e.g.*, *California Water Curtailment Cases*, No. 1-15-CV-285182, Cal. Super., Santa Clara Co., Statement of Decision, Phase I Trial, at 24–31, Feb. 20, 2018.

[57] *See* 33 U.S.C. §§ 1251–1387; CAL. WATER CODE, §§ 13000–16104; CAL. WATER CODE § 179 (giving the Board "all of the powers, duties, purposes, responsibilities, and jurisdiction vested in" its predecessor agencies "or *any other law* under which permits or licenses to appropriate water are issued, denied, or revoked or *under which the functions of water pollution and quality control are exercised*" (emphasis added)).

[58] A "water quality control plan" (also known as a "basin plan") is "a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected. (2) Water quality objectives. (3) A program of implementation needed for achieving water quality objectives." CAL. WATER CODE § 13050(j).

[59] *History of the Water Boards*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/about_us/water_boards_structure/history.shtml (last updated July 5, 2012); *see also, e.g.*, Cal. Water Code § 13000, 13140, 13141, 13240, 13241, 13245, 13160, 13170, 13245; 33 U.S.C. §§ 1311–1313.

[60] *Whom We Regulate*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/water_issues/programs/ciwqs/who_is_regulated.shtml (last updated Aug. 3, 2011); see also, e.g., 33 U.S.C. §§ 1341–1346.

[61] For example, as of Fall 2016, "the Bay-Delta Plan specifie[d] a combined requirement for flow at a single point upstream of the southern Delta on the San Joaquin River below the confluence of the tributaries," and "[t]here [wa]s no existing requirement for the flows in the major tributaries to sustain fish in the tributaries or to contribute to the flow at this compliance point." State Water Res. Control Bd., Summary of Proposed Updates to the Bay-Delta Water Quality Control Plan 3 (September 15, 2016), *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/2016_sed/docs/prp_update_sum.pdf.

[62] *San Francisco Bay/Sacramento – San Joaquin Delta Estuary (Bay-Delta) Watershed Efforts*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/ (last updated Mar. 21, 2017).

[63] *See generally* State Water Res. Control Bd., Water Quality Control Plan for the San Francisco Bay / Sacramento-San Joaquin Delta Estuary (2006) [hereinafter 2006 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/docs/2006_plan_final.pdf; State Water Res. Control Bd., Water Quality Control Plan for the San Francisco Bay / Sacramento-San Joaquin Delta

Estuary (1995) [hereinafter 1995 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/1995wqcp/docs/1995wqcpb.pdf; State Water Res. Control Bd., Water Quality Control Plan for Salinity: San Francisco Bay / Sacramento-San Joaquin Delta Estuary (1991) [hereinafter 1991 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/docs/1991wqcp.pdf; State Water Res. Control Bd., Water Quality Control Plan: Sacramento-San Joaquin Delta and Suisun Marsh (1978) [1978 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/docs/1978wqcp.pdf.

[64] *See* CAL. DEP'T OF WATER RES., 2015 URBAN WATER MANAGEMENT PLANS GUIDEBOOK FOR URBAN WATER SUPPLIERS, at 8-3 to 8-19 (2016), *available at* https://www.water.ca.gov/LegacyFiles/urbanwatermanagement/docs/2015/UWMP_Guidebook_Mar_2016_FINAL.pdf. The Legislature added the requirement for urban water shortage contingency planning to the Urban Water Management Planning Act (originally passed in 1983) in 1995. *See* Cal. Stats. 1995, ch. 854, § 9 (amending CAL. WATER CODE § 10632); Cal. Stats. 1983, ch. 1009, § 1 (the original Act).

[65] CAL. GOV'T CODE § 8607(a); *see also Standardized Emergency Management System*, CAL. GOVERNOR'S OFFICE OF EMERGENCY SERVS., http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/standardized-emergency-management-system (last visited Dec. 23, 2017); CAL. EMERGENCY MGMT. AGENCY, FOUNDATION FOR THE STANDARDIZED EMERGENCY MANAGEMENT SYSTEM (Jan. 2010), *available at* http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/SEMS_%20Foundation_ver_01-2010.pdf. State agencies must use SEMS, and local agencies are only eligible for reimbursement through state disaster assistance programs if they use it. CAL. GOV'T CODE § 8607(d), (e).

[66] *See Drought Preparedness, Water Conservation and Water Supply Emergency Response*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/DroughtPreparedness.html (last updated Feb. 14, 2018).

[67] *See* CAL. WATER CODE §§ 1425–1431.

[68] *See* CAL. WATER CODE § 1428.

[69] *See* CAL. WATER CODE §§ 1429, 1430.

[70] *See* CAL. WATER CODE §§ 1430, 1431; *Water Rights Applications: Permitting and Licensing Program*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/applications/ (last updated Jul. 12, 2016).

[71] See CAL. WATER CODE § 1707.

[72] *See* State Water Res. Control Bd., April 6, 2015, TUCP Order, at 4, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/tucp_order040615.pdf.

[73] *See id.*

[74] CAL. WATER CODE §§ 1435, 1440–1442.

[75] *See* CAL. WATER CODE § 1438.

[76] *See* CAL. WATER CODE §§ 1439, 1440.

[77] *See* CAL. WATER CODE §§ 1440, 1441.

[78] See CAL. WATER CODE §§ 109, 475, 480–484

[79] *See* CAL. WATER CODE §§ 920, 1011, 1014, 1745.07.

[80] Ellen Hanak et al., What If California's Drought Continues? Technical Appendix, at 11 (Aug. 2015), *available at* http://www.ppic.org/content/pubs/other/815EHR_appendix.pdf.

[81] *See id.*

[82] *See id.*

[83] *See* CAL. WATER CODE §§ 1725–1737.

[84] CAL. WATER CODE §§ 1725–1728.

[85] CAL. WATER CODE § 1727(d), (e).

[86] CAL. WATER CODE § 1729

[87] CAL. WATER CODE § 1726(b)

[88] *See* CAL. WATER CODE § 1726(g)

[89] *See* Arnold Schwarzenegger, Executive Order S-06-08, June 4, 2008, *available at* https://www.gov.ca.gov/news.php?id=9797; Edmund G. Brown, Jr., Executive Order B-21-13, May 20, 2013, *available at* https://www.gov.ca.gov/news.php?id=18048; Edmund G. Brown, Jr., A Proclamation of a State of Emergency, Jan. 17, 2014 [hereinafter 2014 Drought Proclamation], *available at* http://gov.ca.gov/news.php?id=18379; Edmund G. Brown, Jr., Executive Order to Redouble State Drought Actions/ A Proclamation of a Continued State of Emergency, April 25, 2014 [hereinafter April 2014 Executive Order], *available at* https://www.gov.ca.gov/news.php?id=18496.

[90] *See* CAL. WATER CODE § 1211; *Water Rights Petitions*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/petitions/ (last updated Sept. 5, 2017).

[91] 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at iii, 8. DWR had forecast greatly reduced runoff for these watersheds. *Id.* at 8.

[92] *Id.* at 8.

[93] *Id.* at 8–9.

[94] *See* ANDREW TWEET, WATER RIGHT CURTAILMENT ANALYSIS FOR CALIFORNIA'S SACRAMENTO RIVER: EFFECTS OF RETURN FLOWS 2 (2016) (M.S. thesis, University of California, Davis), *available at* https://watershed.ucdavis.edu/shed/lund/students/Andy_Tweet_MS.pdf.

[95] *See id.* at 5.

[96] Craig M. Wilson, Term 91: Stored Water Bypass Requirements 3 (2012), *available at* http://www.swrcb.ca.gov/board_info/agendas/2012/dec/120412_10.pdf.

[97] State Water Res. Control Bd., Permit Term 91, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/permits/terms/permitterm091.pdf.

[98] STATE WATER RES. CONTROL BD., RECOMMENDATIONS FOR IMPROVING THE ADMINISTRATION OF THE WATER RIGHTS PRIORITY SYSTEM IN DRY YEARS 4 (2015) [hereinafter 2015 DRY YEAR PROGRAM REPORT], *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/dryyear_report/docs/feb2015_dyr.pdf.

[99] *See* Andrew M. Schwarz, *California Central Valley Water Rights in a Changing Climate*, S.F. ESTUARY & WATERSHED SCI., June 2015, at 2, doi: http://dx.doi.org/10.15447/sfews.2015v13iss2art2.

[100] Wilson, *supra* note 96, at 3.

[101] State Water Res. Control Bd., Permit Term 93, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/permits/terms/permitterm093.pdf.

[102] *See* State Water Res. Control Bd., Resolution No. 2014-0031: To Adopt an Emergency Regulation for Statewide Drought-Related Curtailment of Water Diversions to Protect Senior Water Rights, at 3, July 2, 2014, *available at* https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2014/rs2014_0031.pdf; *see also* CAL. WATER CODE § 1052 (regarding administrative civil liability for unauthorized diversion or use); CAL. WATER CODE § 1831 (regarding cease and desist orders); CAL. WATER CODE § 1845 (regarding failure to comply with a cease and desist order).

[103] Where the legislature directs the Board to adopt regulations using emergency rulemaking procedures, it has sometimes exempted them from the general sunset provision, for example, by mandating that they remain in effect until the Board revises them. *See, e.g.*, CAL. WATER CODE § 348(b).

[104] *See* CAL. GOV'T CODE § 11346.1(b)(1).

[105] CAL. WATER CODE § 1058.5(a).

[106] *See* CAL. GOV. CODE §§ 11346.2, 11346.4, 11346.5; *see also* CAL. GOV. CODE §§ 11340.85(c).

[107] *See* CAL. GOV'T CODE §§ 11346.4(a), 11346.5(a)(15), (17); 11346.8.

[108] *See* CAL. GOV'T CODE § 11346.8(a).

[109] *See* CAL. GOV'T CODE § 11346.9.

[110] *See* CAL. GOV'T CODE § 11346.8(c).

[111] CAL. GOV'T CODE § 11346.1(a)(2), (3).

[112] *See* CAL. GOV'T CODE § 11340.85(c), (c)(10).

[113] *See* CAL. GOV'T CODE § 11349.6(b).

[114] CAL. GOV'T CODE § 11349.3(a)

[115] CAL. GOV'T CODE § 11349.1; *see also* CAL. GOV'T CODE § 11349.

[116] CAL. GOV'T CODE § 11349.6(b)

[117] *See* CAL. GOV'T CODE §§ 11349.1(a), 11349.6(b).

[118] *See* CAL. GOV'T CODE § 11349.6(b) ("The office shall disapprove the emergency regulations if it determines that the situation addressed by the regulations is not an emergency.")

[119] *See* CAL. WATER CODE § 1058.5(b) ("[A]ny findings of emergency adopted by the board, in connection with the adoption of an emergency regulation under this section, are not subject to review by the Office of Administrative Law").

[120] *See* CAL. GOV'T CODE § 11349.6(e)–(h).

[121] CAL. WATER CODE § 1058.5(c).

[122] *See* CAL. GOV'T CODE § 11145.

[123] *See* CAL. GOV'T CODE § 11145.

[124] CAL. WATER CODE § 1058.5(d).

[125] State Water Res. Control Bd., Resolution No. 2014-0023 (Corrected Version): To Adopt Emergency Regulations for Curtailment of Diversions Due to Insufficient Flow for Specific Fisheries, May 21, 2014; State Water Res. Control Bd., Resolution No. 2015-0014: To Update and Readopt a Drought-Related Emergency Regulation for Curtailment of Diversions Due to Insufficient Flow for Specific Fisheries, Mar. 17, 2015. These resolutions can be accessed at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[126] Resolution No. 2014-0031, *supra* note 102.

[127] Resolution No. 2014-0031, *supra* note 102 (as part of the Emergency Regulation for Statewide Drought-Related Curtailment of Water Diversions to Protect Senior Water Rights); State Water Res. Control Bd., Resolution No. 2015-0015: Amending and Readopting a Drought Emergency Regulation Regarding Informational Orders, Mar. 17, 2015; State Water Res. Control Bd., Resolution No. 2015-0075: To Amend and Re-Adopt a Drought Emergency Regulation Regarding Informational Orders, Dec. 1, 2015; State Water Res. Control Bd., Resolution No. 2016-0045: To Re-Adopt a Drought Emergency Regulation Regarding Informational Orders, Aug. 16, 2016. These resolutions can be accessed at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[128] State Water Res. Control Bd., Resolution No. 2014-0038: To Adopt an Emergency Regulation for Statewide Urban Water Conservation, July 15, 2014; State Water Res. Control Bd., Resolution No. 2015-0013: To Adopt an Emergency Regulations [sic] for Statewide Urban Water Conservation, Mar. 17, 2015; State Water Res. Control Bd., Resolution No. 2015-0032: To Adopt an Emergency Regulation for Statewide Urban Water Conservation, May 5, 2015; State Water Res. Control Bd., Resolution No. 2016-0007: To Adopt an Emergency Regulation for Statewide Urban Water Conservation, Feb. 2, 2016; State Water Res. Control Bd., Resolution No. 2016-0029: To Adopt an Emergency Regulation for Statewide Urban Water Conservation, May 18, 2016; State Water Res. Control Bd., Resolution No. 2017-0004 (Corrected Version): To Adopt a Regulation for Statewide Urban Water Conservation, Feb. 8, 2017. These resolutions can be accessed at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[129] State Water Res. Control Bd., Resolution No. 2015-0045: To Adopt a Drought-Related Emergency Regulation Requiring Enhanced Water Conservation and Additional Water User Information for the Protection of Specific Fisheries in Tributaries to the Russian River, June, 17, 2015; State Water Res. Control Bd., Resolution No. 2016-0012: To Update and Readopt a Drought-Related Emergency Regulation Requiring Additional Water User Information for the Protection of Specific Fisheries in Tributaries to the Russian River, Mar. 1, 2016. These resolutions can be accessed

at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[130] State Water Res. Control Bd., Resolution No. 2016-0005: To Adopt a Drought Emergency Regulation for Measuring and Reporting Water Diversions, Jan. 19, 2016, *available at* https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0005.pdf.

[131] *See* MICHAEL HANEMANN ET AL., CLIMATE VULNERABILITY AND ADAPTATION STUDY FOR CALIFORNIA: LEGAL ANALYSIS OF BARRIERS TO ADAPTATION FOR CALIFORNIA'S WATER SECTOr 9–13 (July 2012), *available at* http://www.energy.ca.gov/2012publications/CEC-500-2012-019/CEC-500-2012-019.pdf (noting that Board staff wrote a memo to the Delta Vision Blue Ribbon Task Force in September 2008 explaining its data deficiencies due to the lack of a penalty for not filing statements of diversion and use, among other things, and that the legislature subsequently introduced a penalty).

[132] 2015 DRY YEAR PROGRAM REPORT, *supra* note 98.

[133] *See, e.g.*, State Water Res. Control Bd., 2015 Combined Sacramento river Basin Senior Supply/Demand Analysis with North Delta Demand (dated Sept. 10, 2015) [hereinafter 2015 Combined Demand], *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/analysis/docs/sacndelta.pdf; *see also* CAL. DEP'T OF WATER RES., CALIFORNIA CENTRAL VALLEY UNIMPAIRED FLOW DATA FOURTH EDITION DRAFT (May 2007) [hereinafter UNIMPAIRED FLOW DATA], https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/sjrf_spprtinfo/dwr_2007a.pdf.

[134] *See* CAL. WATER CODE § 5107(b).

[135] For example, the Board can "investigate possible violations of permit or license terms or conditions." CAL. CODE REGS. tit. 23, § 823.

[136] *See* CAL. CODE REGS. tit. 23, § 820.

[137] CAL. CODE REGS. tit. 23, § 821.

[138] *See* CAL. CODE REGS. tit. 23, §§ 855–859; *Water Rights Enforcement Complaints*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/complaints/index.html (last updated Mar. 8, 2018).

[139] *See Environmental Complaint System*, CAL. EPA, https://calepacomplaints.secure.force.com/complaints/ (last visited May 2, 2018).

[140] CAL. WATER CODE § 1825.

[141] Cal. Stats. 1980, ch. 933, § 13 (adding CAL. WATER CODE § 1831); CAL. WATER CODE § 1831.

[142] Cal. Stats. 1987, ch. 756, § 1 (amending CAL. WATER CODE § 1052); CAL. WATER CODE §§ 1052, 1055, 1845, 1846.

[143] CAL. CODE REGS. tit. 23, § 822; *see also* CAL. WATER CODE §§ 1410(b)(2), 1410.1, 1611 (for permits); CAL. WATER CODE §§ 1675, 1675.1 (for licenses).

[144] CAL. CODE REGS. tit. 23, § 822; *see also* CAL. WATER CODE §§ 1410(b)(2), 1410.1, 1675, 1675.1, 1831(d)(2), 1834.

[145] *See* CAL. WATER CODE § 1052(b).

[146] *See* Appendix C.2.1 and C.3.1.

[147] *See* 1978 DRY YEAR PROGRAM REPORT, *supra* note 4.

[148] CAL. WATER CODE § 106.3.

[149] *See* GOVERNOR'S COMMISSION TO REVIEW CALIFORNIA WATER RIGHTS LAW, FINAL REPORT (1978), *available at* https://digitalcommons.law.ggu.edu/caldocs_agencies/426/.

[150] 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at 25.

[151] *See* 2015 DRY YEAR PROGRAM REPORT, *supra* note 98, at 3 ("While a standard methodology for determining water availability relative to water rights priority is currently in use and is similar to the process described in the 1978 Report, there is room for additional improvements as described in depth in section 2 of this Report.").

[152] Transcript of Joint Hearing at 100–101, 103, In the Matter of Byron Bethany Irrigation Dist. and The West Side Irrigation Dist., State Water Res. Control Bd., Mar. 21, 2016, *available at* https://www.waterboards.ca.gov/

waterrights/water_issues/programs/hearings/byron_bethany/docs/wisdbbid/bbidwsid_finaltranscript032116.pdf (testimony of Kathy Mrowka).

[153] Transcript of Joint Hearing at 107, In the Matter of Byron Bethany Irrigation Dist. and The West Side Irrigation Dist., State Water Res. Control Bd., Mar. 21, 2016, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/byron_bethany/docs/wisdbbid/bbidwsid_finaltranscript032116.pdf; *see also id.* at 107 (testimony of Brian Coats).

[154] SWRCB Drought Updates email announcing new "Curtailment Analysis Webpage," received Apr. 21, 2014.

[155] JEFFREY MOUNT BRIAN GRAY, CAITRIN CHAPPELLE, GREG GARTRELL, TED GRANTHAM, PETER MOYLE, NATHANIEL SEAVY, LEON SZEPTYCKI & BARTON "BUZZ" THOMPSON., MANAGING CALIFORNIA'S FRESHWATER ECOSYSTEMS: LESSONS FROM THE 2012–16 DROUGHT, at 8 (2017), *available at* http://www.ppic.org/wp-content/uploads/r_1117jmr.pdf.

[156] *See id*. at 10.

[157] PUBLIC POLICY INSTITUTE OF CAL., MANAGING DROUGHTS 3 (Oct. 2016), *available at* http://www.ppic.org/content/pubs/report/R_1016JM2R.pdf.

[158] *See State Water Project and Central Valley Project Temporary Urgency Change Petition*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/tucp/index.html.

[159] *See* MOUNT ET AL., *supra* note 155, at 14 tbl.2; *see also* JEFFREY MOUNT ET AL., MANAGING CALIFORNIA'S FRESHWATER ECOSYSTEMS LESSONS FROM THE 2012–16 DROUGHT, TECHNICAL APPENDIX: EIGHT CASE STUDIES OF ENVIRONMENTAL WATER MANAGEMENT DURING THE 2012–16 DROUGHT, at 28 (2017), *available at* http://www.ppic.org/wp-content/uploads/1117ccr_appendix.pdf.

[160] MOUNT ET AL., TECHNICAL APPENDIX, *supra* note 159, at 29.

[161] Order WR 90-05, at 54–55, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1990/wro90-05.pdf; *see also* MOUNT ET AL., TECHNICAL APPENDIX, *supra* note 159, at 13.

[162] MOUNT ET AL., TECHNICAL APPENDIX, *supra* note 159, at 14.

[163] State Water Res. Control Bd., April 6, 2015, TUCP Order, at 3, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/tucp_order040615.pdf.

[164] State Water Res. Control Bd., Mar. 18, 2016, TUCP Order, at 3, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/tucp/docs/notice_temp_plan031816.pdf.

[165] See State Water Res. Control Bd., April 6, 2015, TUCP Order, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/tucp_order040615.pdf.

[166] MOUNT ET AL., TECHNICAL APPENDIX, *supra* note 159, at 14.

[167] *Id.* at 17.

APPENDIX A: A Deeper Look at California Water and Droughts

This Appendix supplements Section 2 of the report by providing expanded context for understanding the administration and oversight of California's water rights system during droughts. It gives an overview of (1) California's ongoing water supply challenges and (2) droughts in California, highlighting the last four major statewide droughts.

A.1 California's Ongoing Water Supply Challenges

A.1.1 Temporal and Spatial Variability of Precipitation

California's wet season is generally short, running from October through April, and total annual precipitation comes from fewer storms over fewer days than for any other U.S. state.[1] To reflect this seasonality, water management is based around an October through September water year, instead of the calendar year. A water year is identified by the calendar year in which it ends (for example, the 2017 water year ran from October 1, 2016, through September 30, 2017).[2] In much of the state, "a third to a half of all the precipitation that falls, on average, falls in only 5 to 10 wet days per year."[3] There are no "average" water years,[4] instead water years are classified as "wet," "above normal," "below normal," "dry," or "critical."[5] A few less storms arriving (or producing less precipitation) or a few more storms arriving (or producing more precipitation) can disproportionately affect the state's water budget.[6] The outsized impact a few storms can have translates into more year-to-year variability than for any other state.[7]

Precipitation also varies significantly from place to place in California (Figure A-1). The northwestern corner of the state is the wettest, averaging more than 100 inches of precipitation per year, and much of the north coast and the Sierra Nevada average at least 35 inches per year.[8] However, much of the San Joaquin Valley and most of the southeastern portion of the state receive, on average, less than 10 inches of precipitation per year.[9]

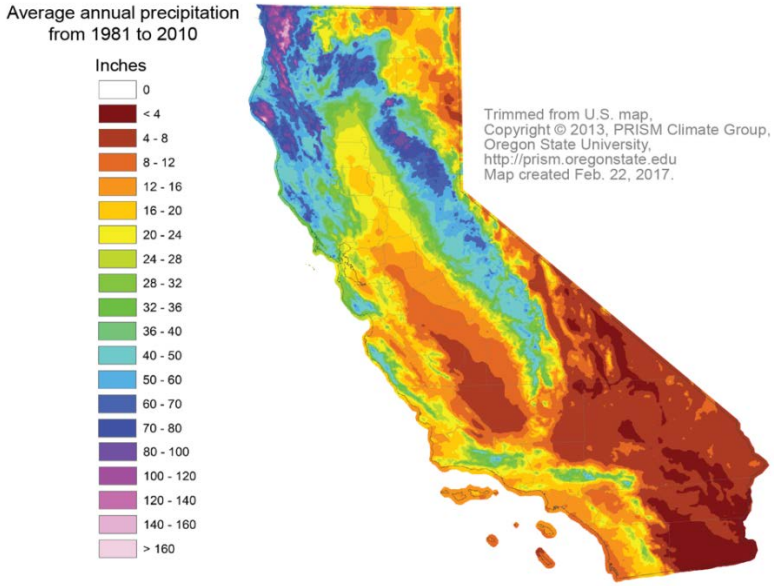


Figure A-1: Variation in Average Annual Precipitation Across the State[10]

A.1.2 Mismatched Patterns of Surface Water Supply and Demand

There is a substantial mismatch between the location and timing of surface water supply and water demand in California. First, precipitation is concentrated in less populous areas of northern California,[11] while urban and agricultural water demand is concentrated in central and southern California agricultural and metropolitan areas.[12] Second, although most precipitation occurs in the winter and spring, demand peaks in the summer.[13] In short, most of the human demand for water for drinking, agriculture, and industry is focused in the drier parts of the state, and demand is highest during the drier parts of the year.

A.1.3 Redistributing Water Resources Across Time and Space

California water managers have addressed the mismatch between surface water supply and demand by shifting water in time and space. To shift water supply in time, they have harnessed the ability of snowpack and groundwater to act as natural reservoirs and built substantial additional surface storage. This storage infrastructure is linked to extensive conveyance infrastructure that allows water to be moved around the state.

A.1.3.1 Role of Snowpack and Groundwater as Natural Reservoirs

Historically, snowpack has served as a critical short-term natural reservoir that accounts for roughly one-third of surface water supply.[14] Snow accumulates in the mountains during the winter months, and snowmelt slowly releases water to California's streams and rivers during the late spring and early summer months (usually April through July).[15]

Groundwater basins serve as longer-term natural storage reservoirs. California's alluvial groundwater basins are estimated to contain more than three times the amount of usable water that the state's surface reservoirs can hold.[16] In the average year, groundwater makes up around 38% of California's statewide water supply, but this number can grow significantly during dry years, when pumping increases to replace reduced surface water supplies.[17] Conjunctive management that uses groundwater during dry years and recharges it during wetter years can enhance water supply resilience.[18] However, some areas lack this flexibility because groundwater is the sole source of supply, year in and year out, for cities, farmers, and disadvantaged communities.

A.1.3.2 Importance and Limitations of California's Water Storage and Distribution Infrastructure

Extensive networks of state, federal, and local surface storage and conveyance infrastructure capture water in wetter times and places and store it for and/or transport it to times and areas of higher demand (Figure A-2). The two largest systems are the federal Central Valley Project (CVP), operated by the U.S. Bureau of Reclamation (USBR), and the State Water Project (SWP), operated by the California Department of Water Resources (DWR). The CVP includes 20 dams and reservoirs and 11 power plants and delivers an average of 7 million acre-feet of water each year that is used to irrigate approximately 3 million acres of agricultural land and to provide about 1 million households with drinking water.[19] More than 250 contractors in 29 California counties have long-term contracts for water deliveries from the CVP, while 29 water supply agencies have long-term contracts with the SWP.[20] The SWP includes 33 reservoirs and lakes that hold up to 5.8 million acre-feet of water and delivers an average of 3 million acre-feet each year to irrigate about 750,000 acres and to provide about 25 million people with drinking water using more than 700 miles of canals and pipelines.[21] These systems were developed to leverage snowpack as another reservoir and, therefore, rely on delayed runoff from late spring and early summer snowmelt.[22]

While it has enabled major redistributions of water resources across time and space, California's water storage and conveyance infrastructure is not without problems. This infrastructure is asked to serve multiple, sometimes conflicting purposes, including water supply, power, flood control, and maintaining adequate water quality and quantity in connected waterways to support environmental uses. As an example, reservoir operations can be a delicate dance between capturing enough runoff to support current and later uses and leaving enough capacity to accommodate potential future runoff and avoid damaging flooding.[23]

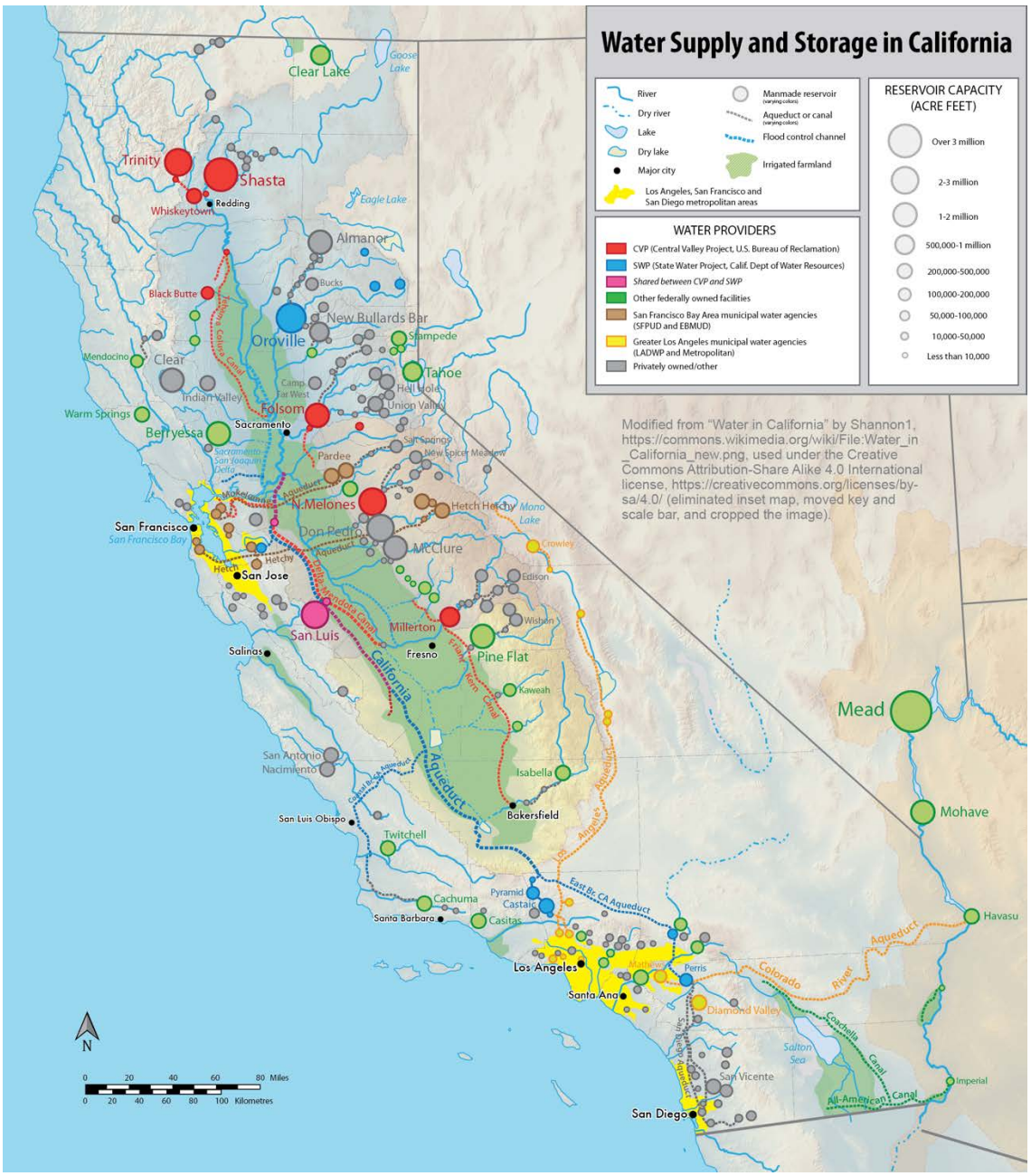


Figure A-2: Major California Water Storage and Conveyance Infrastructure[24]

Storage and conveyance infrastructure, and related water use, have also heavily modified natural flows in many areas, often with negative consequences for native ecosystems and species, including species listed as threatened or endangered under the state or federal Endangered Species Acts.[25] For species that rely on rivers, such as salmon, more than 1,400 dams around the state have flooded upstream habitat, impeded fish migration, and changed rivers' natural hydrograph (altering downstream habitat, including by changing the timing, nature, and quality of downstream flows).[26] Although reservoirs can sometimes be operated to mitigate these impacts, that is not always the case. As another example, the Sacramento-San Joaquin River Delta serves as a major conduit, and bottleneck, for conveying water from northern to southern California. When the state and federal water projects' pumps in the south Delta are operating, they can reduce freshwater flow out of the Delta, allowing the tides to move saltwater deeper inland[27] and influencing factors like primary productivity.[28] These changes may have short- and long-term effects on Delta species,[29] and may affect the quality of water available for human uses.[30] The pumps can also have more direct impacts on Delta species. For example, they can cause net flow reversals in some channels that may interfere with the movements of migratory fish,[31] and they can directly entrain and injure or kill protected fishes such as the Delta smelt.[32]

Water quality and species-based pumping restrictions meant to reflect specific environmental priorities limit the timing and amount of Delta exports.[33] But these may not provide adequate protections in the first instance for the species and ecosystems that are explicitly prioritized in law and policy, and the protections that do exist are often relaxed during times of water shortage to accommodate other environmental or non-environmental, priorities.[34]

Additionally, there are important limits to the ability of California's water storage and distribution infrastructure to respond to climatic variability. While reservoirs are well suited to dealing with seasonal variation in water supply, they are less useful as extended drought reserves.[35] And the increased temperatures, reduced snowpack, and earlier runoff expected with continued climate change will make it harder to manage reservoirs to accomplish their multiple, important but competing purposes.[36]

A.2 Droughts in California

A.2.1 What Is Drought?

Drought can be defined as an extended "period of drier-than-normal conditions that results in water-related problems."[37] Notably, in California, what would be considered "normal" (average) and "drier-than-normal" (drier than average) conditions have varied significantly over time due to multi-decadal trends in climate variability. For example, between 1908 and 2017, the 30-year moving average of annual precipitation in Sacramento varied from > 20 inches to < 15 inches (a difference of nearly 30%), peaking before 1910 and from the late 1990s to ~2012, with the lowest values occurring in the late 1940s (Figure A-3). Over the last half-decade there has been a drying trend (Figure A-3). Sacramento River flows reconstructed from tree rings suggest that similar multi-decadal variations have occurred over the last 1,100 years (Figure A-4). Dry conditions cause or exacerbate mismatches between the amount, quality, location, and timing of natural water supply and the amount, quality, location, and timing of human water demand and environmental need.[38] Droughts can be classified based on meteorological (precipitation), agricultural (soil moisture, evapotranspiration), hydrologic (streamflow, snowpack, groundwater conditions), or other indicators, used singly or in combination.[39]

A.2.3 Characteristics of the Last Four Major Statewide Droughts

State water management agencies commonly identify four major statewide droughts since 1970, in water years 1976–1977, 1987–1992, 2007–2009, and 2012–2016.[40] Although significant droughts occurred earlier in the twentieth century—and the period from about 1910 to 1935 was especially dry (see Figures A-3 and A-4)—the post-1970 period is most relevant for understanding the current role of the State Water Resources Control Board (Board) in state drought response. The 1976–1977 drought was the first significant drought following the combination of water rights and water quality responsibilities in the modern Board.[41] It was also the first time the Board attempted to provide substantial oversight of water rights, in a drought or non-drought context.[42] Additionally, many state and federal environmental laws that impact water management were passed in the late 1960s or early 1970s.[43]

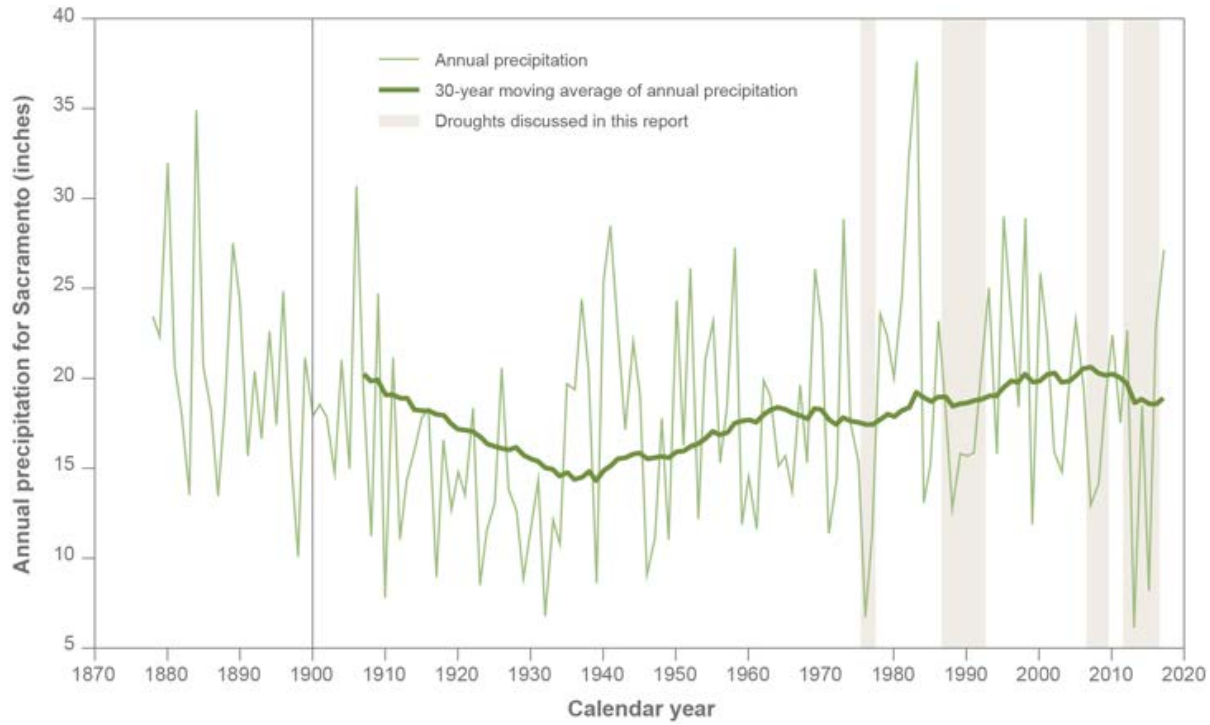


Figure A-3: Variation in Annual Precipitation and Average Annual Precipitation for Sacramento, California, from 1878 to 2017[44]

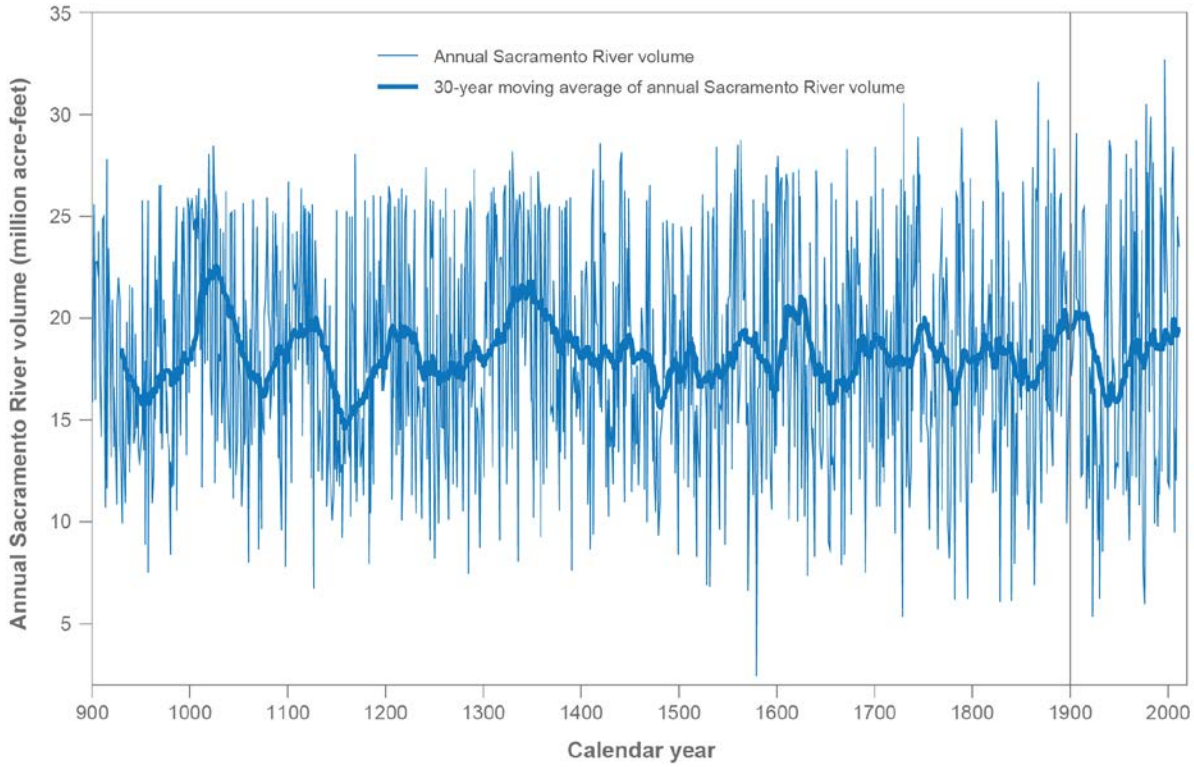


Figure A-4: Variation in Reconstructed Annual Sacramento River Flows and Average Reconstructed Annual Sacramento River Flows, from 900 to 2012[45]

This report examines the Board's responses during each of the last four major statewide droughts. These droughts share similarities but have also differed in important ways, including duration, precipitation, temperature, hydrologic conditions, legal and political context, and social, economic, and environmental impacts. We explore some of these differences below, in Table 1 and Figure 1 of the main report, and in Appendix C.

Duration: The last four major statewide droughts lasted between two (1976–1977) and six (1987–1992) water years. All else being equal, a longer drought will have more severe impacts. However, the shortest of the four droughts was in some ways the most severe (see below and Table 1 in main report).

Precipitation: Based on estimates of statewide average precipitation since water year 1896, the 1976–77 drought experienced the least precipitation in any 2-water-year period, the 2012–2016 drought experienced the least precipitation in any 3- or 4-water-year period, and the 1987–1992 drought experienced the least precipitation in any 5- or 6-water-year period (Table 1).[46] In addition, 1977 experienced the 2nd-least statewide precipitation of any water year since 1896, 2014 experienced the 3rd-least, and 1987 experienced the 4th-least.[47] During the course of a single drought, statewide precipitation sometimes varied significantly.[48]

Temperature: On average, each drought was progressively warmer than the last, and the 2012–2016 drought coincided with record-breaking average temperatures (Figures 1, A-5).[49] During the course of a single drought, temperature sometimes varied significantly (Figure 1).

Snowpack: Reduced snowpack has been a common feature during droughts, but the amount of precipitation that fell as snow in the first place, and that lingered as snowpack into the spring, varied from drought to drought. Estimated statewide average April 1 snowpack water content was 60% or less of the long-term average during both years of the 1976–1977 drought, four years of the 1987–1992 drought, one year of the 2007–2009 drought, and four years of the 2012–2016 drought (Table A-1). It hit a record low (since at least 1950, when data collection began) in 2015 (Table A-1, Figure A-5), with high temperatures likely playing a critical role.[50]

Table A-1: Estimated Statewide Average April 1 Snowpack Water Content During Major Statewide Droughts Since 1970[51]

Year	1976	1977	1987	1988	1989	1990	1991	1992	2007	2008	2009	2012	2013	2014	2015	2016
Percentage of long-term average April 1 snowpack water content	37	25	59	29	80	45	83	60	39	102	83	52	42	25	5	85

Runoff: Some of the precipitation that falls across a landscape becomes runoff that flows directly into streams or other surface waters. The rest infiltrates and becomes groundwater, evaporates, or is transpired by plants. Many factors influence the amount and timing of surface runoff in a watershed, including the form (rain vs. snow), amount, duration, and intensity of

precipitation; temperature; relative humidity; land use, vegetation, and soil characteristics; and topography.[52] The 1976–1977 drought encompassed the water years with the least and 11th least calculated statewide runoff since records began in 1901.[53] Three of the 10 lowest runoff years occurred during the 1987–1992 drought, and the 4th lowest runoff year was 2014.[54]

Water Storage: The amount of water stored in the state's reservoirs has dipped during droughts, reaching especially low levels during the 1976–1977 (Figure A-5) drought that subsequently drove the construction of new local reservoirs in especially hard hit areas like Marin County.[55] Each drought has revealed continuing reservoir storage vulnerabilities, led to increased pressure on groundwater resources, and highlighted the need for sustainable conjunctive management of groundwater and surface water resources.

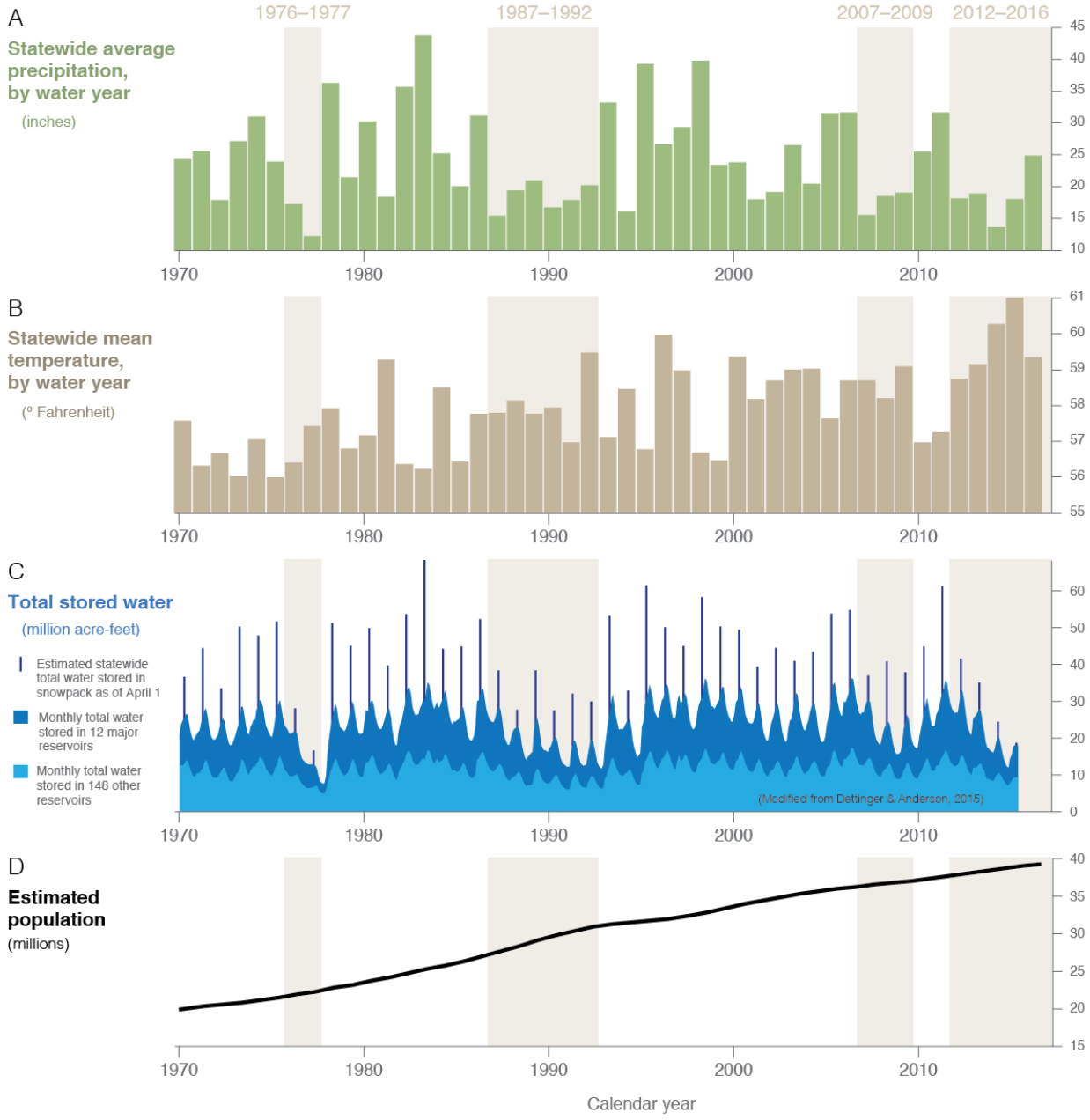


Figure A-5: Estimated Statewide Conditions from 1970 to 2016[56]

Dryness: Each of the last four major statewide droughts has a different signature of temperature and precipitation (Figure A-5).[57] Higher temperatures contribute to drier conditions than precipitation alone would suggest. Some drought indices attempt to account for the effects of both. The monthly Palmer Drought Severity Index (PDSI) estimates the accumulated surface water excess or deficit based on monthly precipitation and temperature data and soil characteristics, as well as the prior month's PDSI.[58] Figure A-6 shows the variation in PDSI across the state during June of each year from 1970 to 2017. According to this index, during the 1976–1977 drought, conditions were extremely dry along the central coast, in the Central Valley, and in parts of northern California, while limited areas of southern and eastern California remained neutral to slightly wet. In contrast, over the course of the 1987–1992 drought, PDSI suggests that areas of dryness shifted from northern California to southern California and back again. According to the index, nearly the entire state remained dry during the 2007–2009 drought and during the middle three water years of the 2012–2016 drought, and water years 2014–2015 were extremely dry.

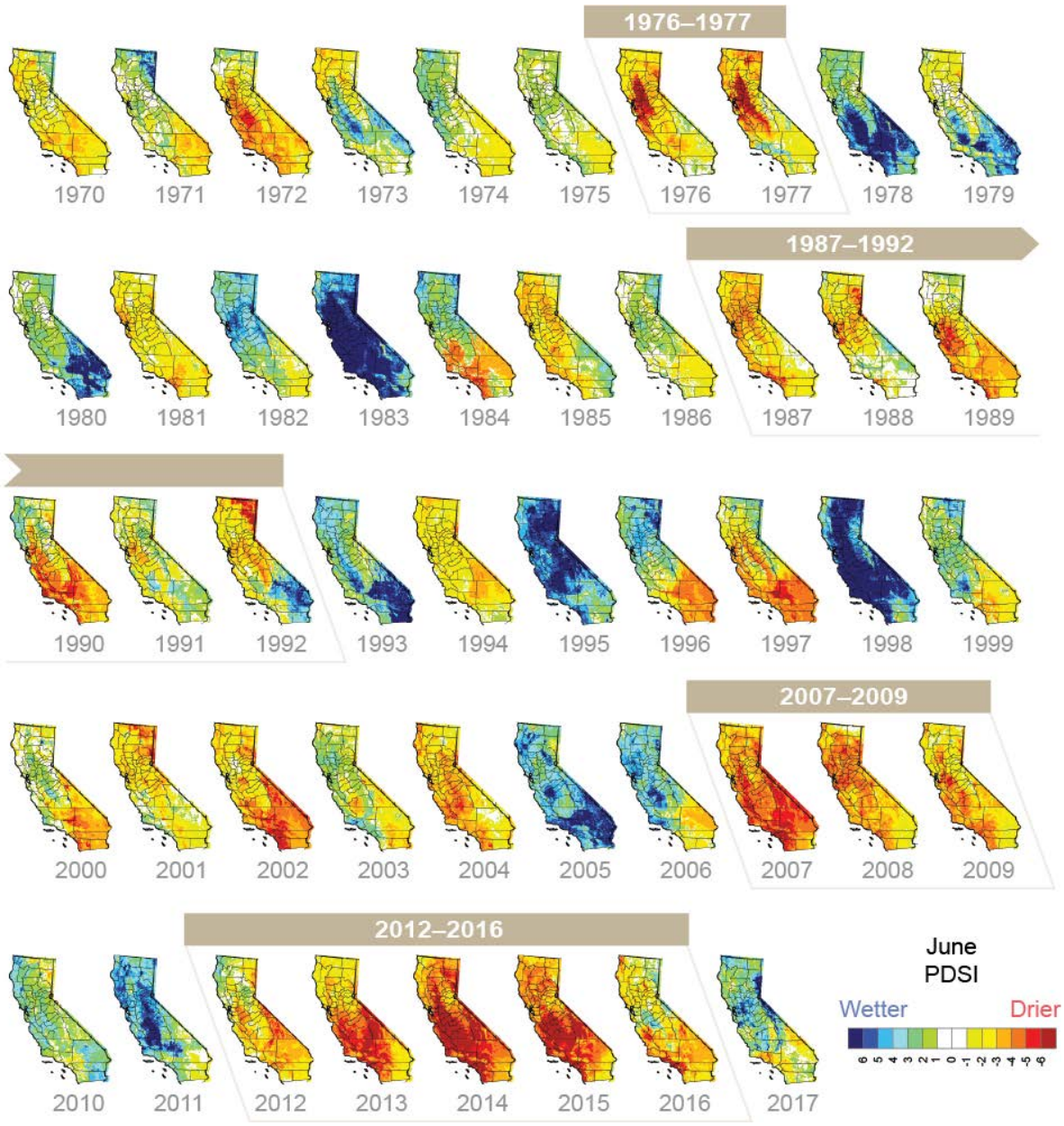


Figure A-6: Spatial Distribution of the Palmer Drought Severity Index (PDSI) for June of Each Year from 1970 to 2017[59]

Population: California's population has nearly doubled since the 1976–1977 drought (Table 1, Figure A-5). Although water use efficiency (below) has also increased over that time, this means that almost twice as many people are now depending on the state's limited and highly variable water resources, making effective stewardship more important than ever before.

Urban Water Use Efficiency: Urban conservation efforts during and after droughts have shown that there is still room to improve urban water use efficiency by replacing water-guzzling fixtures and appliances, changing water-wasting behaviors, modifying landscaping, and developing alternative water supplies such as stormwater and recycled water.[60] Droughts have

been important drivers of permanent improvements in water use efficiency, especially in California's urban water systems. For example, changes to the plumbing code following the 1976–1977 drought and 1992 and 2014 toilet retrofit requirements (during the last year of the 1987–1992 drought and the middle of the 2012–2016 drought, respectively) moved toilet water usage from about 5 gallons per flush (before 1980) to 3.6, 1.6, and finally 1.28 gallons per flush.[61] Standards for dishwashers, washing machines, shower heads, and faucets have been set at the federal or state level.[62] A Model Water Efficient Landscape Ordinance and public education campaigns have contributed to reductions in outdoor water use, and requirements for metering combined with volumetric (including tiered) pricing have increased economic incentives for conservation.[63] Furthermore, the Water Conservation Act of 2009, requires urban water retailers to reduce per capita water use by 20% by 2020.[64]

Agricultural Water Use Efficiency: Droughts, other types of water shortage, and changing irrigation costs have driven improvements in agricultural water use efficiency over time.[65] For example, drip and microsprinkler irrigation more than doubled from 1991 to 2010.[66] More efficient conveyance and irrigation technologies conserve water by reducing evaporation and conveyance losses, but they also reduce the amount of return flow and percolation to groundwater that occurs per unit of water applied.[67]

Hardened Agricultural Demand: The amount of acreage planted in permanent crops has increased dramatically in recent decades in concert with a shift away from lower-value field crops.[68] For example, estimates of California's almond acreage more than doubled from about 483,700 acres in 1995 to 930,000 acres in 2012, and almond acreage continued to increase during the 2012–2016 drought, with an estimated 1,240,000 acres in almonds in 2016, including 300,000 acres of young trees that are not yet bearing fruit (Table 1).[69] Similarly, estimated wine grape acreage increased from 354,417 to 546,000 acres between 1995 and 2012.[70] The economics of agricultural commodity prices and water availability are linked. Economically valuable permanent crops offer greater financial returns per unit of water applied than annual crops, but they also provide less flexibility in the face of hydrologic uncertainty.[71] They require considerable up-front investments of resources, and they result in a hardening of water demand. Permanent crops need water every year to stay alive, and fallowing them means losing potentially substantial returns on investments.

Changes in Environmental Law and Regulation: Earlier droughts occurred when there were fewer environmental protections, and therefore fewer environmental restrictions on water diversions (Table A-2). For example, the federal Endangered Species Act (ESA) was passed only a few years prior to the 1976–1977 drought, and the Delta watershed did not have state or federal ESA-listed fishes until after the 1976–1977 drought. Winter-run Chinook salmon were federally listed in 1989, and several other species were federally listed prior to the 2007–2009 drought, including Delta smelt (1993), central coast Coho salmon (1996), central coast steelhead (1997), Central Valley steelhead (1998), spring run Chinook salmon (1999), green sturgeon (2006), and longfin smelt (2009).[72] To implement ESA protections, wildlife agencies produced biological opinions that governed state and federal water project operations, restricting Delta exports (see Appendix C.3.1.2). In some cases, operational decisions meant to protect one listed species could cause harm to another, as when reducing reservoir releases to maintain cold water to support salmon migration later in the year results in Delta conditions that are unfavorable for Delta smelt in the near term.[73]

Political Leadership: How the governor and Legislature decide to respond to a drought affects the way the Board responds (see Section 5.4.3 and Appendix C). During some droughts, most notably the 2012–2016 drought, these political leaders have directed the Board to take specific actions or provided the Board with additional tools. During other droughts, like the 1987–1992 drought and the beginning of the 2007–2009 drought, these leaders focused less on the Board, and other state agencies played more dominant roles in the state's drought response efforts.

Table A-2: Some Significant Developments in Environmental Law and Regulation, 1968–2016[74]
Developments during drought periods are shaded beige. Board actions are identified in **bold** text.

Year	Development
1968	Congress passed Wild and Scenic Rivers Act
1969	Congress passed National Environmental Policy Act (NEPA)
1969	Legislature passed Porter-Cologne Water Quality Control Act
1970	Legislature passed California Environmental Quality Act (CEQA)
1970	Legislature passed California Species Preservation Act and initial California Endangered Species Act
1971	California Supreme Court applied public trust doctrine to ecosystems (*Marks v. Whitney*, 6 Cal. 3d 251, 259–60 (1971))
1972	Congress passed Clean Water Act (CWA)
1972	Legislature passed California Wild and Scenic Rivers Act, designating 5 rivers as wild and scenic
1973	Congress passed Endangered Species Act (ESA)
1974	Congress passed Safe Drinking Water Act
1978	**Board** set Delta water quality standards in Bay-Delta Plan
1978	**Board** implemented Delta water quality standards by amending CVP and SWP permits in Decision 1485
1981	Secretary of the Interior approved federal designation of 5 state-designated wild and scenic rivers
1983	California Supreme Court held that Board had ongoing duty to protect public trust uses when feasible (*Nat'l Audubon Soc'y v. Superior Court*, 33 Cal. 3d 419, 446–47 (1983))
1984	Legislature significantly amended California Endangered Species Act (CESA)
1986	California Court of Appeal held that the project-centric Delta water quality standards and Decision 1485 were insufficient to reasonably protect fish and wildlife uses in the Delta (*United States v. State Water Resources Control Bd.* (Racanelli), 182 Cal. App. 3d 82 (1986))
1989	CFGC listed Sacramento River winter-run Chinook salmon as endangered; NOAA Fisheries listed winter-run Chinook salmon as threatened
1989	California Court of Appeal held that fisheries in non-navigable waterways are a public trust resource (*California Trout, Inc. v. State Water Res. Control Bd*., 207 Cal. App. 3d 585, 626, 629–32 (1989))
1990	NOAA Fisheries listed Sacramento River winter-run Chinook salmon as threatened
1991	**Board** adopted updated Bay-Delta Plan
1991	EPA disapproved of most Bay-Delta Plan objectives for fish and wildlife as not sufficiently protective
1992	Legislature added Water Code § 1707, allowing dedications of water rights to instream use
1992	Congress passed Central Valley Project Improvement Act (CVPIA)
1993	USFWS and CFGC listed Delta smelt as threatened
1994	EPA published draft Bay-Delta water quality standards to protect beneficial uses EPA had determined were not adequately protected by the Board standards EPA reviewed in 1991
1994	NOAA Fisheries upgraded Sacramento River Winter-run Chinook salmon to endangered
1994	Bay-Delta Accord to coordinate Delta activities adopted; CALFED Bay-Delta Program initiated
1995	**Board** adopted updated Bay-Delta Plan, consistent with the Bay-Delta Accord
1996	NOAA Fisheries listed Central California coast Coho salmon as threatened

1997	NOAA Fisheries listed Central California coast steelhead as threatened
1998	NOAA Fisheries listed California Central Valley steelhead as threatened
1999	NOAA Fisheries and CFGC listed Central Valley spring-run Chinook salmon as threatened
2000	CALFED Record of Decision established program objectives, elements, and solution principles
2000	**Board** implemented provisions of the 1995 Bay-Delta Plan through Decision 1641
2005	NOAA Fisheries upgraded Central California coast Coho salmon to endangered; CFGC listed it as endangered
2006	NOAA Fisheries listed Green sturgeon as threatened
2006	**Board** adopted updated Bay-Delta Plan, identifying emerging issues
2007	SWP pumping curtailed due to high concentrations of Delta smelt near pumps
2008	USFWS issued BiOp on Long-Term Operational Criteria and Plan (OCAP) for CVP & SWP (Delta smelt)
2009	NOAA Fisheries issued BiOp on long-term CVP and SWP operations (for salmonids, green sturgeon)
2009	Legislature passed 5-bill water policy package, including Delta Reform Act and Water Conservation Act
2009	CFGC listed longfin smelt as threatened
2009	NOAA Fisheries requested frost protection regulation for the Russian River
2010	Delta Stewardship Council created to achieve the 2009 Delta Reform Act's "coequal goals" for the Delta (more reliable water supply + protecting, restoring, and enhancing the Delta ecosystem)
2010	CFGC upgraded Delta smelt to endangered
2011	**Board** adopted Russian River Frost Protection Regulation (CAL. CODE REGS. tit. 23, § 862)
2014	California Court of Appeal held that Board can enact regulations to prevent unreasonable water use (*Light v. State Water Res. Control Bd.*, 226 Cal. App. 4th 1463 (2014))
2014	Legislature passed Sustainable Groundwater Management Act
2015	Legislature passed SB 88, requiring diversion measurement and reporting enhancements

Statewide Drought Emergency Proclamations: The California Emergency Services Act[75] confers emergency powers "upon the Governor and upon the chief executives and governing bodies of political subdivisions of this state" to ensure that the state can respond nimbly "to mitigate the effects of . . . emergencies" and "protect the health and safety and preserve the lives and property of the people of the state."[76] If a local government requests it, or the governor determines "that local authority is inadequate to cope," the governor can proclaim a state of emergency for any area of the state experiencing "conditions of disaster or of extreme peril to the safety of persons and property," including those caused by drought.[77] After declaring a state of emergency, the governor can suspend regulatory statutes or the orders, rules, or regulations of a state agency that would interfere with effective emergency response and can make or amend regulations as necessary "to effectuate the purposes of" the California Emergency Services Act.[78] Notably, however, the governor cannot give an agency powers it does not already have or supersede constitutional due process protections.

During the two most recent major statewide droughts, the serving governor issued a statewide proclamation of drought emergency, something never done prior to 2009.[79] These emergency proclamations, and related executive orders, directed the Board and other state agencies to carry out certain drought response tasks. Both the proclamations were made during the third year of drought, but the 2009 proclamation came toward the end of the 2007–2009 drought, while the 2014 proclamation came toward the middle of the 2012–2016 drought and (likely in partial consequence) had more far-reaching consequences for drought response.

Local Drought Emergency Declarations: During each of the last four major statewide droughts, some of California's 58 counties declared local drought emergencies, ranging from 9 counties during the 2007–2009 drought to 47 counties during the 1976–1977 drought.[80]

A.3 Endnotes

[1] Michael D. Dettinger, Fred Martin Ralph, Tapash Das, Paul J. Neiman, & Daniel R. Cayan, *Atmospheric Rivers, Floods and the Water Resources of California*, 3 WATER 455, 460–61 (2011), doi:10.3390/w3020445; Cal.–Nev. Climate Applications Program, Ctr. for Western Weather & Water Extremes, Southwest Climate Sci. Ctr., Cal. Dep't of Water Res., California Precipitation 1 (2015), *available at* http://www.water.ca.gov/floodmgmt/hafoo/csc/docs/CA_Precipitation_2pager.pdf.

[2] CAL. DEP'T OF WATER RES., CALIFORNIA'S MOST SIGNIFICANT DROUGHTS: COMPARING HISTORICAL AND RECENT CONDITIONS 5 (2015) [hereinafter CALIFORNIA'S MOST SIGNIFICANT DROUGHTS], *available at* http://www.water.ca.gov/waterconditions/docs/a9237_CalSignficantDroughts_v10_int.pdf.

[3] Dettinger et al. 2011, *supra* note 1, at 460–61.

[4] Michael D. Dettinger, *Historical and Future Relations Between Large Storms and Droughts in California*, S.F. ESTUARY & WATERSHED SCI., July 2016, at 1, 2, 5, doi:10.15447/sfews.2016v14iss2art1. CAL. DEP'T OF WATER RES., CALIFORNIA WATER PLAN, UPDATE 2013, at 3-27 (2014) [hereinafter UPDATE 2013], *available at* http://www.water.ca.gov/waterplan/cwpu2013/final/index.cfm.

[5] *WSIHIST: Chronological Reconstructed Sacramento and San Joaquin Valley Water Year Hydrologic Classification Indices*, CAL. DEP'T OF WATER RES., CAL. DATA EXCHANGE CTR., http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST (last updated Mar. 21, 2017).

[6] Dettinger et al. 2011, *supra* note 1, at 461.

[7] Dettinger 2016, *supra* note 4, at 1, 5–7, 10–11; Dettinger et al. 2011, *supra* note 1, at 460.

[8] Cal.–Nev. Climate Applications Program, *supra* note 1, at 1.

[9] *Id.*

[10] Trimmed from U.S. map, Copyright © 2013, PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu (map created Feb. 22, 2017). The map was downloaded from *30-Year Normals*, PRISM CLIMATE GROUP, http://prism.oregonstate.edu/normals, by selecting "precipitation" as the "Climate variable" and "annual values" for the "Temporal period."

[11] DAVID CARLE, INTRODUCTION TO WATER IN CALIFORNIA 3 (2016).

[12] UPDATE 2013, *supra* note 4, at 3-36, 3-39.

[13] CARLE, *supra* note 11, at 11.

[14] *Climate Change*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/climatechange/ (last modified Oct. 24, 2017); UPDATE 2013, *supra* note 4, at 3-28, 3-61.

[15] UPDATE 2013, *supra* note 4, at 3-61.

[16] Pub. Policy Inst. of Cal., Storing Water 1 (Oct. 2016) [hereinafter PPIC Storing Water], *available at* http://www.ppic.org/content/pubs/report/R_1016JLR.pdf.

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[19] *About the Central Valley Project*, U.S. BUREAU RECLAMATION, https://www.usbr.gov/mp/cvp/about-cvp.html (last updated Apr. 18, 2017).

[20] *California State Water Project and the Central Valley Project*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/swp/cvp.cfm (last modified Apr. 29, 2008).

[21] *Id.*; *California State Water Project Today*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/swp/swptoday.cfm (last modified July 18, 2008); *California State Water Project Overview*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/swp/index.cfm (last modified Aug. 11, 2010).

[22] Noah S. Diffenbaugh, Daniel L. Swain, & Danielle Touma, *Anthropogenic Warming Has Increased Drought Risk in California*, 112 PROC. NAT'L ACAD. SCI. 3931 (2015), doi:10.1073/pnas.1422385112; UPDATE 2013, *supra* note 4, at 3-61.

[23] Dettinger 2016, *supra* note 4, at 2.

[24] Modified from "Water in California" by Shannon1, https://commons.wikimedia.org/wiki/File:Water_in_California_new.png, used under the Creative Commons Attribution-Share Alike 4.0 International license, https://creativecommons.org/licenses/by-sa/4.0/ (modified from original by eliminating inset map, moving key and scale bar, and cropping the image).

[25] UPDATE 2013, *supra* note 4, at 3-10, 3-12, 3-58; NAT'L RESEARCH COUNCIL, SUSTAINABLE WATER AND ENVIRONMENTAL MANAGEMENT IN THE CALIFORNIA BAY-DELTA 38 (2012), *available at* https://www.nap.edu/catalog/13394/sustainable-water-and-environmental-management-in-the-california-bay-delta; ELLEN HANAK, JAY LUND, ARIEL DINAR, BRIAN GRAY, RICHARD HOWITT, JEFFREY MOUNT, PETER MOYLE, & BARTON "BUZZ" THOMPSON, MANAGING CALIFORNIA'S WATER: FROM CONFLICT TO RECONCILIATION 199–206 (2011), *available at* http://www.ppic.org/content/pubs/report/R_211EHR.pdf.

[26] JEFFREY F. MOUNT, CALIFORNIA RIVERS AND STREAMS: THE CONFLICT BETWEEN FLUVIAL PROCESS AND LAND USE 326–35 (1995); Alvar Escriva-Bou, Jeffrey Mount, & Jelena Jezdimirovic, Dams in California (Sept. 2017), *available at* http://www.ppic.org/wp-content/uploads/JTF_DamsJTF.pdf.

[27] *See* NAT'L RESEARCH COUNCIL, A SCIENTIFIC ASSESSMENT OF ALTERNATIVES FOR REDUCING WATER MANAGEMENT EFFECTS ON THREATENED AND ENDANGERED FISHES IN CALIFORNIA'S BAY-DELTA 26 n.2 (2010), *available at* https://www.nap.edu/catalog/12881/a-scientific-assessment-of-alternatives-for-reducing-water-management-effects-on-threatened-and-endangered-fishes-in-californias-bay-delta (explaining that "Old and Middle Rivers . . . are affected by the pumping of water for export" such that "[a]t high negative flows, that is, flows away from the sea towards the pumps in the south, the normal seaward flow associated with ebb tides can be completely eliminated," and noting that salinity management in the Delta involves "adjusting flows of fresh water from delta reservoirs, as well as . . . adjusting pumping rates").

[28] *See* NAT'L RESEARCH COUNCIL 2012, *supra* note 25, at 70–71.

[29] *See* Peter B. Moyle, Larry R. Brown, John R. Durand & James A. Hobbs, *Delta Smelt: Life History and Decline of a Once-Abundant Species in the San Francisco Estuary*, S.F. ESTUARY & WATERSHED SCI., July 2016, at 13 (noting that "[s]alvage mortality [of delta smelt, a species with an annual life cycle,] tends to be highest at times when the Old–Middle River flow is most negative (i.e., flows are reversed) and turbidity is high" and "when exports are high relative to outflow, so a greater proportion of the water is moving towards the pumps . . . chang[ing] the pattern of water movement through the central and south Delta" and that modeling suggests "periodic entrainment losses may have adversely affect the Delta Smelt population"); NAT'L RESEARCH COUNCIL 2010, *supra* note 27, at 23–24 (stating that salmon "that enter the Old and Middle Rivers (OMR) can be drawn towards the SWP and CVP pumps" and that those "drawn into the central and southern delta by reverse flows are more vulnerable to predation than those that take a more direct path to the ocean"); *id.* at 26 n.1, 27 (stating that there is a substantial "correlation between OMR flows and salvage" and that "delta smelt are now largely absent from the central and southern delta"); Wim J. Kimmerer, *Losses of Sacramento River Chinook Salmon and Delta Smelt to Entrainment in Water Diversions in the Sacramento–San Joaquin Delta*, S.F. ESTUARY & WATERSHED SCI., June 2008, at 1,4 (quantifying losses of fish that "are directly attributable to pumping operations" as distinguished from "indirect" losses " that are "due to altered hydrodynamic conditions or migration cues in the Delta," and noting that "export pumping has substantial impacts on flow patterns in the Delta").

[30] *See, e.g.*, Jay Lund, *California's Agricultural and Urban Water Supply Reliability and the Sacramento–San Joaquin Delta*, S.F. ESTUARY & WATERSHED SCI., Oct. 2016, at 5; Wei-Hsiang Chen, Kristine Haunschild, Jay R. Lund & William Fleenor, *Current and Long-Term Effects of Delta Water Quality on Drinking Water Treatment Costs from Disinfection By-Product Formation*, S.F. ESTUARY & WATERSHED SCI., Sept. 2010, at 2, 6; Jeffrey Mount, Ellen Hanak, Greg Gartrell & Brian Gray, *Accounting for Water "Wasted to the Sea,"* S.F. ESTUARY & WATERSHED SCI., Apr. 2018, at 3 (describing Delta "outflow required to meet salinity standards for in-Delta water users and exports," including for "agricultural, municipal, and industrial uses of Delta water").

[31] *See* Lund, *supra* note 30, at 7; NAT'L RESEARCH COUNCIL 2010, *supra* note 27, at 23–24 (stating that salmon "that enter the Old and Middle Rivers (OMR) can be drawn towards the SWP and CVP pumps" and that those "drawn into the central and southern delta by reverse flows are more vulnerable to predation than those that take a more direct path to the ocean").

[32] MOUNT, *supra* note 26, at 335; Peter B. Moyle et al., supra note 29, at 13.

[33] Leon F. Szeptycki & Brian E. Gray, *California's Drought and the Environment: An Introduction*, 23 HASTINGS WEST NORTHWEST J. OF ENVTL. L. & POL'Y 51, 53–54 (2017); MAC TAYLOR, LEGISLATIVE ANALYST'S OFFICE, ACHIEVING STATE GOALS FOR THE SACRAMENTO-SAN JOAQUIN DELTA 7, 10–12 (2015), *available at* http://www.lao.ca.gov/reports/2015/res/delta/sac-sj-delta-011515.pdf.

[34] *See, e.g.*, Section 5.6 in main report.

[35] PPIC Storing Water, *supra* note 16.

[36] *Id.*

[37] *California Drought*, CAL. DEP'T OF WATER RES., https://ca.water.usgs.gov/california-drought/ (last modified Nov. 30, 2017).

[38] Michael E. Mann & Peter H. Gleick, *Climate Change and California Drought in the 21st Century*, 112 PROC. NAT'L ACAD. SCI. 3858, 3859 (2015), doi:10.1073/pnas.1503667112.

[39] Giorgos Kallis, *Droughts*, 33 ANN. REV. ENV'T & RES. 85 (2008), doi:10.1146/annurev.environ.33.081307.123117; *California Drought*, *supra* note 15.

[40] CAL. DEP'T OF WATER RES., CALIFORNIA'S MOST SIGNIFICANT DROUGHTS: COMPARING HISTORICAL AND RECENT CONDITIONS 11 (2015) [hereinafter CALIFORNIA'S MOST SIGNIFICANT DROUGHTS], *available at* http://www.water.ca.gov/waterconditions/docs/a9237_CalSignficantDroughts_v10_int.pdf. The period from 2000 to 2004 was also a multi-year drought, but it was more focused in southern California and so had less of an impact on statewide water supply, which comes primarily from northern California and the Sierras. *See* Figure A-1 in this Appendix.

[41] *See* Section 3.3.

[42] *See* Appendix C.1.1.3.

[43] *See* Table A-2.

[44] Annual precipitation data are from *Sacramento 5 ESE, CA, Total of Precipitation (Inches)*, W. REG'L CLIMATE CTR., https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7633 (last updated May 9, 2018).

[45] Reconstructed Sacramento River annual volume data are from DAVID A. MEKO, CONNIE A. WOODHOUSE & RAMZI TOUCHAN, KLAMATH/SAN JOAQUIN/SACRAMENTO HYDROCLIMATIC RECONSTRUCTIONS FROM TREE RINGS, APPENDIX A, at 16–18 (2014), *available at* https://www.water.ca.gov/LegacyFiles/waterconditions/docs/tree_ring_report_for_web.pdf (providing data for reconstructed Sacramento River (Four Rivers) unimpaired runoff).

[46] *See also* Table 1 and Figure 1 in main report.

[47] *See* Table 1 in main report.

[48] *See* Figure 1 in main report.

[49] *See also* Table 1 and Figure 1 in main report.

[50] CAL. DEP'T OF WATER RES., DROUGHT IN CALIFORNIA 9 (2015) [hereinafter DROUGHT IN CALIFORNIA], *available at* http://www.water.ca.gov/waterconditions/docs/DWR_DroughtBroch_070815-web.pdf.

[51] Cal. Dep't of Water Res., April 1 Snowpack Water Content: Statewide Percent of Average, *available a*t http://cdec.water.ca.gov/cgi-progs/products/April_1_SWC.pdf (last visited May 12, 2018).

[52] *Surface Runoff - The Water Cycle*, U.S. GEOLOGICAL SURVEY, https://water.usgs.gov/edu/watercyclerunoff.html (last modified Dec. 15, 2016).

[53] *See* CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 2, at 7, 48.

[54] *Id.*

[55] DROUGHT IN CALIFORNIA, *supra* note 50, at 4.

[56] Data for precipitation and mean temperature were derived by querying the "Time Series" feature of the West Wide Drought Tracker for each variable using the "States" data retrieval method and the following parameters: Region: California; Start Year: 1970; End Year: 2016; Month: September; Span: 12-Month. *WestWideDroughtTracker*, W. REG'L CLIMATE CTR., http://www.wrcc.dri.edu/wwdt/time/ (last visited Nov. 8, 2017). The total stored water chart (C) was modified from Michael D. Dettinger & Michael L. Anderson, *Storage in California's Reservoirs and Snowpack in This Time of Drought*, at 2, S.F. ESTUARY & WATERSHED SCI., June 2015, doi:10.15447/sfews.2015v13iss2art1. Estimated population data are from CAL. DEP'T OF FINANCE, Spreadsheet *E-7. California Population Estimates, with Components of Change and Crude Rates, July 1, 1900–2016*, available at http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-7/ (Dec. 2016).

[57] *See also* Table 1 and Figure 1 in main report.

[58] *WestWideDroughtTracker: About,* W. REG'L CLIMATE CTR., https://wrcc.dri.edu/wwdt/about.php (last visited Nov. 8, 2017); Aiguo Dai & Nat'l Ctr. for Atmospheric Research Staff, The Climate Data Guide: Palmer Drought Severity Index (PDSI) (last modified July 12, 2017), *available at* https://climatedataguide.ucar.edu/climate-data/palmer-drought-severity-index-pdsi. Despite the fact that PDSI treats "all precipitation as immediately available rainfall (i.e., no delayed runoff from melting snow)" and imprecisely treats some other processes, "PDSI values are significantly correlated with measured soil moisture content in the warm season and streamflow over many regions over the world, and satellite observed land water storage changes." Dai & Nat'l Ctr. for Atmospheric Research Staff, *supra* this note.

[59] Images are from the West Wide Drought Tracker, derived by selecting the following "Climate Product Options" for June of each year: Variable>Drought Index>Palmer Index>PDSI; Select Month: 6. *WestWideDroughtTracker WRCC/UI Data Source - PRISM*, W. REG'L CLIMATE CTR., https://wrcc.dri.edu/wwdt/archive.php?folder=pdsi (downloaded Nov. 8, 2017).

[60] *See* Kirsten James, *Water Reuse in California: Overcoming the Barriers to Its Expansion*, WATER DEEPLY, Oct. 5, 2016, https://www.newsdeeply.com/water/community/2016/10/05/water-reuse-in-california-overcoming-the-barriers-to-its-expansion; State Water Res. Control Bd., August 2016 Statewide Conservation Data Fact Sheet, *available at* http://www.waterboards.ca.gov/water_issues/programs/conservation_portal/docs/2016oct/fs100516_august_factsheet.pdf; Matt Weiser, *Tapping Storm Flows to Boost California's Urban Water Supplies*, WATER DEEPLY, Sept. 26, 2016, https://www.newsdeeply.com/water/articles/2016/09/26/tapping-storm-flows-to-boost-californias-urban-water-supplies; PAC. INST. & NATURAL RES. DEF. COUNCIL, URBAN WATER CONSERVATION AND EFFICIENCY POTENTIAL IN CALIFORNIA (June 2014), *available at* http://pacinst.org/wp-content/uploads/2014/06/ca-water-urban.pdf.

[61] *See* UPDATE 2013, *supra* note 4, at 3-16.

[62] *Id.* at 3-16 to 3-19.

[63] *Id.* at 3-5.

[64] *See* S.B. X7-7, 2009–2010 7th Extraordinary Sess., CAL. WATER CODE § 10608.16(a).

[65] *See* RENÉE JOHNSON & BETSY A. CODY, CALIFORNIA AGRICULTURAL PRODUCTION AND IRRIGATED WATER USE 20 (2015), *available at* https://fas.org/sgp/crs/misc/R44093.pdf; PAC. INST. & NATURAL RES. DEF. COUNCIL, AGRICULTURAL WATER CONSERVATION AND EFFICIENCY POTENTIAL IN CALIFORNIA 3–4 (June 2014), *available at* http://pacinst.org/wp-content/uploads/2014/06/ca-water-ag-efficiency.pdf.

[66] JOHNSON & CODY, *supra* note 65, at 20.

[67] *See* Kelly M. Cobourn, *Externalities and Simultaneity in Surface Water-Groundwater Systems: Challenges for Water Rights Institutions*, 97 AM. J. AGRIC. ECON. 786 (2015).

[68] JOHNSON & CODY, *supra* note 65, at 6.

[69] Cal. Dep't of Food & Agric., 2016 Almond Acreage Report, at 1, 8 (Apr. 16, 2017), *available at* https://www.nass.usda.gov/Statistics_by_State/California/Publications/Fruits_and_Nuts/2017/201704almac.pdf.

[70] Cal. Dep't of Food & Agric., California Grape Acreage Report 2012 Crop, at 2 (Apr. 16, 2013), *available at* https://www.nass.usda.gov/Statistics_by_State/California/Publications/Grape_Acreage/2012/201204gabtb00.pdf; Cal. Agricultural Statistics Serv., California Grape Acreage 1995, at 3 (June 1996), *available at* https://www.nass.usda.gov/Statistics_by_State/California/Publications/Grape_Acreage/1990s/199506gabtb00.pdf.

[71] *See* HEATHER COOLEY, KRISTINA DONNELLY, RAPICHAN PHURISAMBAN, & MADHYAMA SUBRAMANIAN, IMPACTS OF CALIFORNIA'S ONGOING DROUGHT: AGRICULTURE 8 (2015), *available at* http://pacinst.org/app/uploads/2015/08/ImpactsOnCaliforniaDrought-Ag.pdf.

[72] *See* Cal. Dep't of Fish & Wildlife, State & Federally Listed Endangered & Threatened Animals of California, at 4–6 (Oct. 2017), *available at* https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109405.

[73] NAT'L RESEARCH COUNCIL, COMMITTEE ON SCIENTIFIC ISSUES IN THE ENDANGERED SPECIES ACT, SCIENCE AND THE ENDANGERED SPECIES ACT 113–16 (1995), *available at* https://www.ncbi.nlm.nih.gov/books/NBK232374/.

[74] This table is based on the cases noted in the table, other information provided in this report, and information from the following sources: ELLEN HANAK, JAY LUND, ARIEL DINAR, BRIAN GRAY, RICHARD HOWITT, JEFFREY MOUNT, PETER MOYLE, & BARTON "BUZZ" THOMPSON, MANAGING CALIFORNIA'S WATER: FROM CONFLICT TO RECONCILIATION 19–69 (2011), *available at* http://www.ppic.org/content/pubs/report/R_211EHR.pdf; Cal. Dep't of Fish & Wildlife, State & Federally Listed Endangered & Threatened Animals of California, at 4–6 (Oct. 2017), *available at* https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109405; *Endangered and Threatened Marine Species under NMFS' Jurisdiction*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., http://www.nmfs.noaa.gov/pr/species/esa/listed.htm; *Delta Smelt*, U.S. FISH & WILDLIFE SERV., ENVTL. CONSERVATION ONLINE SYSTEM, https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=E070 (last visited Jan. 16, 2018); Mike Taugher, *Delta Pumps Turned Off to Protect Fish*, EAST BAY TIMES, June 1, 2007, *available at* https://www.eastbaytimes.com/2007/06/01/delta-pumps-turned-off-to-protect-fish/; Daniel W. McGovern, U.S. EPA Regional Administrator, Letter to W. Don Maughan, Chairman, State Water Res. Control Bd., at 2, Sept. 3, 1991, *available at* https://www.epa.gov/sites/production/files/documents/epa-approval-disapproval-baydelta-wqcp-1991.pdf.

[75] CAL. GOV'T CODE §§ 8550–8668.

[76] CAL. GOV'T CODE § 8550.

[77] CAL. GOV'T CODE §§ 8558(b), 8625.

[78] *See* CAL. GOV'T CODE §§ 8567, 8571, 8627.

[79] *See* Table 1 in main report.

[80] *See* Table 1 in main report.

APPENDIX B: California Water Rights Administration and Oversight

B.1 California Water Rights

Historically, California has distinguished surface water and groundwater rights and, for each, rights based in ownership of land (riparian rights and overlying rights) and rights based on the actual beneficial use of water (appropriative rights) (Figure 2). These systems have developed through, and been clarified by, judicial opinions, constitutional changes, legislation, and administrative decisions and interpretations by the Board and its predecessors.[1] We summarize the main types of surface water and groundwater rights here.[2]

B.1.1 Surface Water Rights and Priorities

Unlike most U.S. states, which select one or the other, California's surface water rights are organized under a hybrid system that recognizes both rights based in the ownership of land adjacent to a stream or lake (riparian rights) and rights based on the actual beneficial use of water (appropriative rights).[3] Of these, only post-1914 appropriative rights are subject to approval and permitting by the Board.

B.1.1.1 Riparian Rights

As a general rule, under a riparian right, the owner of land adjacent to a surface waterbody has the right to use its natural flow to support reasonable beneficial use on that land.[4] Riparian rights are correlative, so that during "times of water shortage all riparians [on a stream system] must reduce their usage proportionately."[5] Riparian rights generally cannot be transferred separately from ownership of that land and are not lost through non-use.[6] Water for riparian use cannot be stored during a wet period for use during a subsequent dry period, although temporary impoundment to regulate the rate of use may be appropriate in some cases.[7] Although riparian rights are not subject to the permitting and licensing jurisdiction of the Board, it does have authority under the California constitution and other laws to ensure that riparian uses are reasonable and beneficial.

B.1.1.2 Appropriative Surface Water Rights

Acquiring an appropriative right does not depend on land ownership but on the actual diversion and use of water. Water may be appropriated "provided that the water is used for reasonable and beneficial uses and is surplus to that used by riparians or earlier appropriators."[8] Rights with earlier priority dates are more senior. Under classic appropriative rights principles, a more senior appropriator is entitled to have their reasonable needs met before any more junior appropriator may claim water. Other principles may soften the application of the principle of priority of right.

Pre-1914 Appropriative Rights — During the gold rush, miners adopted a "first in time, first in right" rule for the water they appropriated to mine placer deposits, and "California courts looked to principles of equity and of real property law to adjudicate conflicting claims."[9] At that time, appropriation involved simply "diverting [water] and putting it to use."[10] The priority of a pre-1914 appropriative right established under common law is determined based on the date of the initial diversion, or an act in furtherance of eventual diversion (like the date on which construction of the diversion works began), if actual diversion and application to

beneficial use occurred within a reasonable amount of time. Beginning in 1872, state statute introduced the option of initiating an appropriative right by posting notice "in a conspicuous place at the point of intended diversion" and recording the notice with the county recorder to protect the right from subsequent claimants.[11] For rights established under the 1872 Civil Code, priority is determined by the date notice was posted. Pre-1914 appropriative rights are not subject to Board permitting. These rights were acquired before the Water Commission Act of 1913 created the Board's predecessor to administer surface water rights, and the Legislature chose to exempt them from subsequent permitting requirements.[12]

Post-1914 Appropriative Rights — On December 19, 1914, the 1913 Water Commission Act[13] became effective. It created an administrative procedure for acquiring new appropriative rights.[14] Since then, those wanting to begin or expand appropriative uses of surface water have been required to seek a permit from the Board or its predecessor agency.[15] The standard process for acquiring a new water right is described in Section B.3.1. The priority of a post-1914 appropriative right is determined by the date the water right application was filed.[16]

B.1.1.4 Summary of Priority Rules for Surface Water Rights

Riparian rights, as a class, are generally senior to all appropriative rights. Exceptions to this general rule occur because a private riparian right arises at the time land is transferred from state or federal ownership, and federal law makes such transfers "subject to any vested and accrued water rights."[17] Therefore appropriative rights that were established before a private riparian right will take priority over it.[18]

The relative seniority of different appropriative rights depends on their individual priority dates. Those with more recent priority dates are more junior. Therefore, valid pre-1914 rights are senior to post-1914 rights, and, within each category, rights with more recent priority dates are more junior. When the flow of a river or stream is insufficient to satisfy all appropriative claims, a more senior appropriator is generally entitled to take the full amount of water subject to appropriation that they are legally entitled to under their right before a more junior appropriator may take any.

B.1.1.5 SWP and CVP Water Provided Under Contract

The state and federal water projects—SWP and CVP—appropriate water under permits and licenses and provide water under contract to various entities around the state. DWR has long-term water supply contracts with 29 local water agencies who have agreed to repay the costs associated with building and operating the SWP.[19] These contractors do not hold the underlying water rights, instead DWR does. The USBR has around 270 contracts to deliver CVP water.[20] As for the SWP, these include water service contracts. However, there are also several categories of contracts with entities that held, or still hold, senior water rights affected by the existence and operation of the CVP, and who therefore receive priority access to water during times of shortage, including San Joaquin River Exchange Contractors, Sacramento River Settlement Contractors, and South of Delta Settlement Contractors.[21] During droughts, DWR and the USBR have sometimes significantly reduced water allocations under these contracts due to diminished surface water supplies and the need to meet water quality and flow requirements.[22]

B.1.2 Groundwater Rights and Priorities

While rights to use water from "subterranean streams flowing in known and definite channels" are governed under the same rules as surface water rights, rights to use groundwater defined as "percolating" are primarily based in common law. The most common types of percolating groundwater rights are overlying, appropriative, and prescriptive rights. Overlying rights, largely analogous to riparian rights to use surface water, are associated with parcels of land that overlie a groundwater basin. Appropriative groundwater rights share much in common with appropriative surface water rights and are acquired by pumping groundwater and putting it to reasonable beneficial use on other land. In aggregate, groundwater extractions may not exceed a groundwater basin's "safe yield."[23] These rights are described in more detail below.

B.1.2.1 Rights to Use Water From "Subterranean Streams"

In California, surface water rights law extends to water in so-called "subterranean streams flowing through known and definite channels," with riparian, pre-1914 appropriative, and post-1914 appropriative uses possible.[24] Post-1914 rights to water from subterranean streams are therefore subject to Board permitting. While the distinction between subterranean streams and percolating groundwater lacks a clear hydrogeologic basis, it gives the Board direct regulatory control over post-1914 appropriations of some groundwater that is strongly interconnected with, and whose use imminently affects, surface water (although it is important to note that some subterranean streams are completely disconnected from surface water).[25]

The California Court of Appeal has upheld the Board's use of a four-part test for determining whether groundwater is percolating or flows in a subterranean stream.[26] The test requires (1) the presence of a subsurface channel, (2) with relatively impermeable bed and banks, (3) whose course is known or capable of being determined by reasonable inference, and (4) within which groundwater is flowing.[27]

B.1.2.2 Overlying Rights

Overlying rights are largely analogous to riparian rights to use surface water.[28] The owner of land overlying a groundwater basin has the right to extract a reasonable amount of native groundwater to support beneficial uses on that land.[29] Overlying rights are correlative so that, during times of shortage, each overlying user is limited to that user's "proportionate fair share of the total amount available based upon his [or her] reasonable need."[30] These rights are not lost through non-use.

B.1.2.3 Appropriative Rights

Groundwater that is not needed for the reasonable beneficial uses of those with overlying rights is considered surplus groundwater, available for appropriation for non-overlying use within the basin (including municipal use) or for export.[31] Like appropriative rights to use surface water, the priority of appropriative rights to use groundwater depends on the date of first use, with earlier rights having higher priority.[32]

B.1.2.4 Prescriptive Rights

Prescriptive rights only come into play in basins that have experienced conditions of overdraft, and only have practical consequences during times of overdraft.[33] If an appropriator continues to pump when there is no surplus, that taking of groundwater is wrongful, but it may "ripen into" a prescriptive right if certain conditions are met.[34] Specifically, the use must be "actual, open and notorious, hostile and adverse to the original owner, continuous and uninterrupted

for the statutory period of five years, and under claim of right."[35] "Acquisition of a prescriptive right in groundwater rearranges water rights priorities among water users, elevating the right of the one acquiring it above that of an appropriator to a right equivalent in priority to that of a landowner."[36] A prescriptive right is limited to "the volume of water pumped during the prescriptive period."[37]

A number of cases suggest that overlying users can protect their interests from prescription by continuing to pump during times of no surplus (this is termed "self-help").[38] However, the practical repercussions are not clear, especially for overlying users in unadjudicated areas, since prescriptive rights are generally only recognized and confirmed through an adjudication or other litigation.[39]

B.1.2.5 Summary of Priority Rules for Groundwater Rights

Overlying rights, as a class, are generally senior to all appropriative rights to use groundwater, and the relative seniority of appropriative groundwater rights depends on their individual priority dates. However, the lack of permitting or recordation requirements means it can be much more difficult to determine the priority date and amount of an appropriative groundwater right than of an appropriative surface water right.[40] To the extent an appropriator has gained a prescriptive right against an overlying user, case law implies that the prescriptive right might take on the priority of an overlying right.[41]

In aggregate, groundwater extractions may not exceed a groundwater basin's "safe yield,"[42] "the maximum that could be withdrawn without adverse effects on the basin's long term supply."[43] If extractions exceed this amount, the basin is considered to be in overdraft.

B.1.2.6 The Sustainable Groundwater Management Act

In 2014, in the midst of the 2012–2016 drought, the California Legislature passed the Sustainable Groundwater Management Act (SGMA), requiring local, sustainable management of medium- and high-priority alluvial groundwater basins around the state. SGMA explicitly states that it does not determine or change water rights or priorities.[44] It defines sustainable management in terms of avoiding six undesirable results and "sustainable yield" as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result."[45] This is a version of the common law conception of "safe yield" described above. The Board has the authority to intervene if local groundwater managers are not fulfilling their responsibilities under SGMA. For more about SGMA and how it might interface with groundwater rights, see our June 2017 report, *Trading Sustainably: Critical Considerations for Local Groundwater Markets Under the Sustainable Groundwater Management Act*.[46] SGMA also has important implications for surface water rights (see our March 2018 report, *Navigating Groundwater-Surface Water Interactions under the Sustainable Groundwater Management Act*[47]).

B.1.3 Groundwater Rights and Water Right Priorities in Mixed Systems

In some areas, surface water and groundwater rights have been integrated, as a practical matter, through joint adjudications, litigation by an injured party to protect their surface water rights against groundwater pumping or their groundwater rights against surface water diversions, or other means.[48] In general, in these situations, all correlative rights (riparian and overlying) are treated as jointly senior.[49] Appropriative rights to both surface and groundwater then have

seniority in order of their priority dates.[50] While these rules seem straightforward, applying them in a particular factual context may be challenging due to differences in hydrologic connectivity, which will affect whether and to what extent the exercise of certain rights would actually injure other legal users of water.[51]

More generally, although groundwater rights have largely not been regulated or adjudicated to protect senior rights to surface water, the Board regulates surface water diversions to protect senior rights to groundwater. In particular, the Board does not consider water to be available for appropriation to the extent it is needed for recharge to meet the needs of overlying groundwater users, and it will not approve a water right change petition if the change would injure legal users of water, including groundwater users.[52]

B.2 Internal Limitations and Other Constraints on Water Rights

B.2.1 Reasonable and Beneficial Use in the Public Interest

The constitutionally defined goals of the water rights system—which were themselves grounded in prior common law and practice—have held steady for more than 90 years. As Article X, § 2, of the California Constitution declares:

> [B]ecause of the conditions prevailing in this State[,] the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the *reasonable and beneficial use thereof in the interest of the people and for the public welfare*. The right to water or to the use or flow of water in or from any natural stream or water course in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water.[53]

B.2.1.1 Reasonable Use

As Article X, § 2, and subsequent case law make clear, California does not recognize a property right in an unreasonable use of water.[54] Instead, a water right is limited to the amount of water that is "reasonably required for the beneficial use to be served."[55] What is considered reasonable necessarily changes with time and "with the facts and circumstances" of each case[56] but "cannot be resolved in vacuo isolated from state-wide considerations of transcendent importance," such as the need for conservation.[57]

The constitutional requirement for reasonable use injects some uncertainty into the water rights system, but it also provides flexibility in the face of changing hydrologic conditions and societal values and needs. Earlier case law largely examined reasonable use and method of use as critical to conserving "scarce water resources to accommodate new consumptive demands as California's population and economy continued to grow."[58] These cases often determined that downstream riparians who relied on flood flows (to, for example, replenish marketable sand and gravel supplies) could not prevent upstream appropriators from using some portion of the natural flow for reasonable appropriative uses.[59] While instream flow considerations were not at issue in these early cases, they are more common now. Subsequent judicial decisions have increasingly "emphasized that fish, wildlife, recreation, and other in-stream uses . . . are also

important societal interests that must be taken into account," mirroring the addition or evolution of state policy priorities, for example, the California Wild and Scenic Rivers Act and an expanded view of the public trust doctrine, respectively.[60] Although instream uses may conflict with consumptive uses in some cases, they are not necessarily mutually exclusive (as when the consumptive uses are downstream of the instream uses).

In addition to case law, statutes flag issues that are relevant to analyzing reasonableness. For example, Water Code Section 100.5 explains that, although local custom is one of the factors to consider when determining whether a use, method of use, or method of diversion is reasonable, it must not be determinative. As another example, California law prioritizes domestic use as "the highest use of water," followed by irrigation,[61] and recognizes a Human Right to Water—the right to "safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes"—which the Board must take into account when developing polices, regulations, and grant criteria.[62]

Analysis of reasonableness frames and shares significant overlap with analysis of the public interest and the public trust.

B.2.1.2 Beneficial Use

Case law, state statutes, and regulations have all helped to define which purposes of use are considered "beneficial," another relative and evolving principle. Beneficial uses include municipal use, industrial use, electricity generation, irrigation, recreational use, support of fish and wildlife, protection of water quality, and others.[63]

B.2.1.3 Use in the Public Interest

The California Water Code elaborates on the California constitution's requirement for "reasonable and beneficial use" of water resources "in the interest of the people and for the public welfare."[64] It declares a general state policy of paramount public interest in all water use and tasks the state with determining "what water . . . can be converted to public use or controlled for public protection."[65] The Water Code requires the Board to reject an application to appropriate water or a petition for a water right change the Board determines is not in the public interest.[66] The California Court of Appeal has described the Board's "role . . . in acting upon permit applications . . . as a 'necessary balancing process' requiring 'maximum flexibility' in considering competing demands of flows for instream purposes and diversions for agricultural, industrial, domestic and other consumptive uses to arrive at the public interest."[67] When determining whether a proposed appropriation is in the public interest, and what "terms and conditions" are needed to ensure that it remains so,[68] the Board must consider factors such as the following:

- "The relative benefit to be derived from . . . all beneficial uses of the water concerned"[69];
- Plans regarding "the control, protection, development, utilization, and conservation of the water resources of the State," including the California Water Plan and water quality control plans[70];
- "[S]treamflow requirements proposed for fish and wildlife purposes"[71]; and
- "[T]he state goal of providing a decent home and suitable living environment for every Californian.[72]

B.2.2 The Public Trust Doctrine

The public trust doctrine addresses some aspects of the public interest. Under the doctrine, the State of California holds all navigable waterways and non-navigable streams that sustain a fishery in trust for the benefit of the public.[73] Public trust uses include fishing, boating, and preserving navigable waterways in their natural state and as environments that support fish and other wildlife.[74] The doctrine imposes a duty on state courts and agencies, including the Board, "to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible" and requires them to exercise "continuing supervision over the taking and use" of water.[75] The California Supreme Court has stated that, if past allocation decisions turn out to be "incorrect in light of current knowledge or inconsistent with current needs," the Board must reconsider them and may change water allocations.[76]

B.2.3 State and Federal Environmental Statutes and Regulations

A host of state and federal environmental statutes and regulations potentially affect water diversion and use in California. They include (1) water quality protections under the federal Clean Water Act (CWA) and state Porter-Cologne Water Quality Control Act[77]; (2) wildlife and species protections under the federal Endangered Species Act (ESA)[78] and its state counterpart the California Endangered Species Act (CESA)[79] as well as other statutes, like California Fish and Game Code Section 5937, which requires dam owners to ensure sufficient water passes over, around, or through the dam to maintain fish below it "in good condition"; and (3) environmental review requirements under the National Environmental Policy Act (NEPA)[80] and the California Environmental Quality Act (CEQA).[81] Although some environmental protections have been operationalized in water rights-related approvals and other decisions, many are inadequately defined or implemented (see Section 3.3 and **Part 2**).

B.2.3.1 Environmental Review Under CEQA

Many of the Board's decisions and actions must undergo environmental review under CEQA.

CEQA requires state and local agencies to evaluate the environmental impacts of proposed projects over which they have discretionary approval power and to mitigate or avoid significant effects on the environment whenever feasible.[82] A project is "an activity which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment," and that a public agency undertakes, supports, or issues "a lease, permit, license, certificate, or other entitlement for use" for.[83] The public agency with "principal responsibility," known as the "lead agency," must prepare (or contract for the preparation of) an environmental impact report (EIR) for any project that it intends "to carry out or approve which may have a significant effect on the environment."[84] A "significant effect on the environment" is "a substantial, or potentially substantial, adverse change in the environment."[85] The EIR is meant to provide the public and public agencies with information about the likely effects of a proposed project, how the significant negative impacts can be minimized, and potential alternatives to the project.[86]

An EIR is not required for a proposed project that will not have significant environmental effects, or for which revisions agreed to by the applicant would avoid any significant effects.[87] In these cases, a "negative declaration" or "mitigated negative declaration" is sufficient.[88] An agency can conduct an initial study to determine whether an EIR is needed.[89]

CEQA review can be tiered, with a more general EIR for a broadly applicable decision like "a policy, plan, program or ordinance" and subsequent "narrower or site-specific" EIRs that incorporate relevant discussions from the general EIR by reference.[90]

CEQA does not apply to non-discretionary approvals, projects the agency ends up rejecting or disapproving, certain emergency-related actions, certified state regulatory programs, or other projects with specific statutory or categorical exemptions.[91]

Drought-Related CEQA Exemptions and Suspensions

Although the Board's decisions on water right applications, petitions for water right changes (including transfers), and water quality certifications generally require CEQA review, a number of exceptions may apply during times of drought. For example, for "[s]pecific actions necessary to prevent or mitigate an emergency."[92] Additionally, after declaring a drought emergency, the governor can suspend CEQA compliance if it would interfere with effective emergency response.

Table B-1: Board Actions Listed as Taken Under CEQA Suspension During the 2012–2016 Drought[93]

Category	Actions
Section 401 Water Quality Certifications	• 2015 Emergency Drought Barrier Project • El Dorado Hydroelectric Project *(twice)* • Spring Gap-Stanislaus Hydroelectric Project and Beardsley/Donnells Hydroelectric Project
Waste Discharge Requirements (WDRs)	• Draft General Waste Discharge Requirements for Recycled Water Use
Temporary Urgency Change Petition (TUCP) Approvals	• State Water Project (DWR) and Central Valley Project (USBR) *(multiple petitions)* • Montague Water Conservation District • El Dorado Irrigation District *(wastewater change)* • Cambria Community Services District • Sonoma County Water Agency • Mendocino County Russian River Flood Control & Water Conservation Improvement Dist. • June Lake Public Utility District

During the 2012–2016 drought, Governor Brown suspended CEQA requirements for a variety of Board actions, including processing water transfer petitions, adopting requirements related to recycled water, helping water utilities establish temporary water supply connections to mitigate drought impacts (Table B-1).[94] The Board maintained a webpage that shows actions it took under CEQA suspension during the drought, although this list may be incomplete (see Appendix C.4.3).[95]

B.3 The State Water Resources Control Board's Role in California Water Management

B.3.1 Water Rights Responsibilities – Administration of Post-1914 Rights

The Board has clear regulatory authority over appropriative surface water rights acquired on or after December 19, 1914, when the Legislature created the Board's predecessor agency and first established requirements for water right permitting.[96] A permit or license from the Board is now a prerequisite to begin diverting water from a stream or lake for use on nonadjacent property, and permittees and licensees must petition the Board to make temporary or permanent changes to their water rights, including transferring them to another party.

The following subsections describe the standard processes for acquiring a permanent appropriative water right, requesting a permanent water right change, and requesting a long-term or permanent water transfer. Section 4.1 (in the main report) addresses requests for temporary water rights, temporary water rights changes, and short-term transfers.

B.3.1.1 Standard Water Right Process — Permits, Licenses, and Registrations

The standard process for acquiring a new appropriative surface water right has three distinct phases: application, permit, and license.[97] First, the prospective surface-water user submits a water right application to the Board. If the Board approves the application, the applicant receives a permit that sets the conditions and time frame for constructing the diversion project and making beneficial use of the diverted water. Once the project is complete, the permittee can receive a license for the amount of water actually diverted and put to beneficial use consistent with the terms of the permit.

Once the Board has declared a stream system to be fully appropriated, it generally may not accept or approve applications for permits to appropriate water on that system absent compliance with the terms of the declaration for exemptions or revision.[98] This restriction does not extend to temporary permits.[99]

Application — To establish a new appropriative surface water right in California, a prospective water user must generally apply for a permit from the Board. The applicant must describe the proposed water source, the type and amount of use, the place of diversion, any diversion and conveyance infrastructure, the place of use, and the timeline for infrastructure construction and actual use.[100] After receiving the complete application, the Board will issue public notice and direct the applicant to post or publish it, depending on whether the project is minor or major (for less or more than 3 cubic feet per second or 200 acre-feet per year of storage).[101] If protests are received but not resolved, the Board will conduct a field investigation (for minor projects) or hold a hearing (for major projects).[102]

To approve a permit, the Board must find that the application meets a series of requirements. These include demonstrating that unappropriated water is available from the proposed source,[103] that the intended use is beneficial,[104] and that the application is in the public interest[105] and conforms with applicable instream flow requirements[106] and water quality control plans.[107] In making these determinations, the Board can consider potentially affected groundwater uses, in addition to other surface water uses.[108] Review under the CEQA is required. CEQA directs state and local agencies to evaluate the environmental impacts of proposed projects over which they have discretionary approval power and to mitigate or avoid significant effects on the environment whenever feasible (see Section B.2.3, above). The Board must specifically consider

the effects of the proposed diversion project on public trust resources, protecting them where feasible (Section B.2.2). To help the Board make this determination, the application must provide available information about potential fish and wildlife impacts and proposed measures for protecting fish and wildlife.[109]

Finally, any protests[110] to the application must be resolved,[111] and the Board must include appropriate permit conditions, including mitigation measures, if necessary.[112]

Permit — A permit provides legal authorization for a permittee to develop the proposed diversion project and to divert specified quantities of water from a specified source, at specified locations, for specified uses and places of use, at specified times, subject to specified conditions within a specified time frame.[113] Any changes must be approved by the Board (see discussion on water right changes, below). If, a permittee has been diligently pursing project development but needs more time to make "full anticipated beneficial use of water," it can petition for an extension of time.[114]

License — When the project is complete, and the Board receives a report of completion from a permit holder, it verifies diversion and use through a field inspection, issues a license, and records the license with the appropriate county recorder.[115] The license reflects the permittee's actual permit-compliant diversion and use "in terms of source, amount, season, place of use, point(s) of diversion, and purpose(s) of use, by direct diversion and/or storage."[116] Any unused portion of a permitted water right is lost at the time of licensing.[117] Licensing can be a time consuming and complex process. The Board has flagged that it "is unable to promptly inspect all projects reported ready for licensing."[118]

Registration — Appropriative surface water rights for some small projects—small domestic uses, small irrigation uses, and livestock stockponds that meet program criteria—can be established through an expedited water right registration process.[119] This option has been available since January 1989, when the Water Rights Permitting Reform Act went into effect. Once an applicant submits a registration packet, the Board reviews it to ensure it meets program criteria then issues a certificate of registration including conditions, such as special conditions developed by the California Department of Fish and Wildlife (CDFW).[120] Certifications must be renewed every five years.[121]

B.3.1.2 Standard (Permanent) Water Right Changes

A water right change alters where, when, or how water is diverted or used. A change involving a transfer also alters *who* diverts and uses the water. Any change that requires the discretionary approval of a state or local agency must comply with CEQA, unless an exemption or suspension applies (Section B.3.1).

Those with pre-1914 appropriative rights or riparian rights do not need the Board's permission for changes in the point of diversion, place of use, or purpose of use,[122] but they can petition to dedicate some portion of their water right to instream flow.[123] Furthermore, any changes, including changes involving transfers, must not cause injury to other legal users of water.[124] Changes in the source, rate, or season of diversion require a new water right permit, as do enlargements of water rights that would injure other legal users of water. Riparian rights are not subject to Board permitting, so riparian users do not need to seek Board approval for changes in water diversion or use. However, changes (aside from dedication to instream flow)

that lead to non-riparian uses, like storing water or switching to off-parcel use, would generally require a new water right permit.

Post-1914 appropriative right holders can seek changes to their existing permits or licenses by petitioning the Board. They need the Board's permission to modify the point of diversion, method of diversion, place of use, purpose of use, or other terms or conditions of the water right.[125] A change petition must "[i]nclude sufficient information to demonstrate a reasonable likelihood that the proposed change will not injure any other legal user of water"—for example, by reducing stream flow or water quality—as well as information about the extent of potential impacts to fish and wildlife and proposed measures for their protection.[126] Water right changes are subject to CEQA.[127] The Board can request supplemental information about various issues to help it make its decision.[128] To approve a petition, the Board must find that the proposed change, including appropriate conditions, (1) would not initiate a new water right, (2) would not injure other legal users of water (including the environment), (3) is in the public interest.[129]

Standard change petitions can take many years to address—the Board currently estimates 5 to 7 years to the point of decision for "regular priority projects."[130]

Wastewater Changes — Changing the point of discharge, place of use, or purpose of use of treated wastewater in a way that reduces the flow in any part of a watercourse requires the Board's water rights approval under Water Code Section 1211, in addition to any water quality approval required under federal or state water quality law. The Board will evaluate proposed wastewater changes as it would other change petitions.[131]

B.3.1.3 Long-Term and Permanent Water Right Transfers

To approve a transfer of one year or longer, the Board must find that the changes required for the transfer would not cause "substantial injury" to other legal users of the water or unreasonably affect fish, wildlife, or other instream beneficial uses.[132] CEQA review is required for long-term transfers.

Transfers of Pre-1914 Appropriative Rights — Although transfers involving pre-1914 appropriative rights do not require Board approval, such transfers must not cause injury to other legal users of water.[133] This restriction protects both more senior water rights holders from more junior diverters and more junior water rights holders from changes that would reduce the quantity or quality of the water they legally rely upon.[134] It is typically interpreted to mean that the amount of water a water right holder can transfer is limited to the amount that would not change the quantity of water that would have been consumptively used, if not for the transfer.[135] While they do not need to seek the Board's permission for transfers, pre-1914 appropriators are now required to report transfers along with annual diversion data.[136]

Transfer Approvals by Other Agencies — Transfers may require the approval of other agencies and must be consistent with applicable local, state, and federal laws. Transfers of pre- or post-1914 appropriative rights that require conveyance through the SWP, CVP, or regional or local agency facilities need the approval of the relevant agency (DWR, the USBR, or the local agency).[137] Their analysis will focus on determining "the amount of surface water under the transferor's right that can be transferred without injuring other users,"[138] and ensuring that the transfer will not "unreasonably affect[] fish, wildlife, or other instream beneficial uses" or "the overall economy or the environment of the county from which the water is being transferred."[139]

Compliance with the National Environmental Policy Act (NEPA) is required for transfers that involve the use of federal facilities.

B.3.2 Adopting Regulations to Implement Responsibilities

The Board has broad authority to make regulations on its own initiative to help it carry out its statutory responsibilities.[140] Sometimes the Legislature or the governor has specifically directed the Board to develop regulations to implement a particular statute or policy.

B.3.2.1 Standard Process for Adopting Regulations

As part of the standard rulemaking process, the Board must follow certain procedural requirements, including providing public notice of a proposed regulation and seeking and addressing public feedback. The California Administrative Procedure Act[141] establishes the minimum procedural requirements the Board must follow when adopting, amending, or repealing regulations.[142]

For all proposed regulations, the Board must prepare the proposed text, an initial statement of reasons for the regulation, an economic and fiscal impact statement, and a notice of proposed regulatory action.[143] The Board then issues the notice by publishing it in the California Regulatory Notice Register, mailing it to those who have requested notice of regulation action, and posting the notice, text, and initial statement of reasons on its website.[144] It must allow at least 45 days for public comment.[145] The Board can hold a public hearing on the proposed regulation and must do so if any interested person submits a written request that a hearing be held.[146] At a hearing, the public can offer both written and oral comments.[147] Subsequent changes to a proposed regulation must be non-substantial or "sufficiently related to the original text that the public was adequately placed on notice that the change could result from the originally proposed regulatory action."[148] After making "sufficiently related" changes, the Board must allow at least 15 days for additional public comment.[149] In its final statement of reasons, the Board must summarize and respond to timely comments regarding the proposed regulation or the procedures it has followed.[150]

Before regulations can go into effect, the Office of Administrative Law (OAL) must review them. The Board must submit regulations and related documents to the OAL for review within 1 year of issuing notice.[151] The review will determine whether the record demonstrates that the Board followed applicable procedural requirements and complied with applicable legal standards (authority, reference, consistency, clarity, nonduplication, and necessity).[152] Within 30 working days of receiving a regulation, OAL must approve or disapprove of it.[153]

B.3.2.2 Process for Adopting Emergency Regulations

The Board can use a streamlined process to develop and adopt emergency regulations to help it carry out its water rights and water quality responsibilities under certain circumstances.

General Emergency Rulemaking Authority Under the Government Code

California Government Code § 11346.1 allows a state agency to expedite the rulemaking process when (1) an emergency exists, (2) there is a need for immediate action, and (3) substantial evidence supports "the need for the proposed regulation to effectuate the statute being implemented, interpreted, or made specific and to address only the demonstrated emergency."[154] Because "[w]hat constitutes an emergency is primarily a matter for the agency's discretion,"[155] the availability of this emergency rulemaking authority is not contingent upon

the governor proclaiming a state of emergency. On the other hand, such a proclamation would likely help an agency make the case that an emergency regulation is warranted.

The Government Code exempts emergency rulemaking from most of the public participation procedures usually required when a state agency adopts regulations and most of the provisions governing OAL review of proposed regulations.[156] However, the Board must provide notice of "[t]he specific language proposed to be adopted" and its "finding of emergency" "[a]t least five working days" prior to submitting the regulation to OAL unless "the emergency situation clearly poses such an immediate, serious harm that delaying action to allow public comment would be inconsistent with the public interest."[157] The OAL must review a submitted emergency regulation within 10 days to determine whether (1) it addresses an emergency situation; (2) it meets 6 substantive standards for necessity, authority, clarity, consistency, reference, and nonduplication; and (3) the agency complied with the public notice requirement and other provisions of § 11346.1.[158] Additionally, OAL must post a notice when a proposed emergency regulation is filed and must generally allow at least 5 days for public comment.[159]

Drought Emergency Rulemaking Authority Under the Water Code

In addition to the general emergency rulemaking authority available to all state agencies, during times of drought, the Board can invoke expanded emergency rulemaking authority under Water Code § 1058.5. This expanded authority (which was amended several times during the recent drought) makes it easier for an emergency regulation to clear OAL review, allows the regulation to remain in effect longer, and enhances its enforceability. More specifically, if the Board makes findings that an emergency regulation meets certain threshold requirements, these findings are unreviewable by the OAL,[160] the regulation can remain in effect for up to 270 days,[161] and violations are subject to fines of up to $500 a day.[162]

The two threshold requirements for using the expanded emergency rulemaking authority address the regulation's content and context. First, the regulation must be designed to

1. "prevent the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion, of water";
2. "promote water recycling or water conservation";
3. "require curtailment of diversions when water is not available under the diverter's priority of right"; or
4. "require reporting of diversion or use or the preparation of monitoring reports" in support of these.[163]

Second, the Board must adopt the emergency regulation in a specific context: "in response to conditions which exist, or are threatened, in a critically dry year immediately preceded by two or more consecutive below normal, dry, or critically dry years **or** during a period for which the Governor has issued a proclamation of a state of emergency under the California Emergency Services Act . . . based on drought conditions."[164]

B.3.3 The Intersection of Water Quality and Water Rights – The Bay-Delta Plan

A good example of the nexus between water quality and water rights is the Board's Bay-Delta Water Quality Control Plan (Bay-Delta Plan). Through the Bay-Delta Plan, the Board "establishes water quality control measures needed to provide reasonable protection of

beneficial uses of water in the Bay-Delta Watershed."[165] These include flow and other water quality standards designed to support municipal and industrial, agricultural, and fish and wildlife uses. Versions were adopted in 1978, 1991, 1995, and 2006.[166] The Bay-Delta Plan's history of adoption and amendment has an interesting relationship with droughts.

B.3.3.1 The 1978 Bay-Delta Plan

Development of the 1978 Bay-Delta Plan was deeply connected to the 1976–1977 drought. Although it followed several earlier water quality control plans and water right decisions, the Plan marked the first time "the Board's water quality and water right authorities . . . [were] so closely integrated" for the Delta.[167] Hearings for the plan took place in the midst of the drought, and the plan itself referenced two related actions taken in attempts to mitigate drought impacts on uses of Delta water: an interim water quality control plan the Board adopted in February 1977 and an emergency regulation the Board adopted in June 1977[168] when the interim plan proved to be inadequate and the projects were struggling to manage Delta salinity.[169] The emergency regulation substantially relaxed Delta water quality objectives[170] by temporarily suspending whole "provisions of existing water rights entitlements and water quality control plans" to maintain enough water in Lake Oroville "for emergency municipal, domestic and other essential uses including protection against massive intrusion of seawater into the . . . Delta . . . should 1978 be a low runoff year."[171] In late summer and fall of 1977, DWR constructed multiple temporary physical salinity barriers within the Delta to limit the extent of salinity intrusion.[172] The emergency regulation also severely limited Delta exports. It was readopted in mid-December 1977, and then repealed on February 9, 1978, after a wet start to the 1978 calendar year. Jointly with adopting the 1978 Bay-Delta Plan, the Board issued Water Rights Decision 1485, which revised the terms and conditions of the water right permits associated with the state and federal water projects—some of the most junior diverters in the watershed—to implement components of the plan.[173]

In the 1986 "Racanelli" decision, the California Court of Appeal held that the water quality standards in the 1978 Bay-Delta Plan, which focused on the effects of the state and federal projects on water quality for the purposes of protecting existing rights, and the permit amendments associated with Decision 1485 were insufficient to reasonably protect fish and wildlife uses in the Delta. Instead, the court concluded, the Board needed to first develop water quality standards sufficient to reasonably protect beneficial uses and to then implement them through water rights amendments and other means.[174] The court ordered the Board to approach plan updates with this in mind.

B.3.3.2 The 1991 Bay-Delta Plan

In 1991, in the midst of the 1987–1992 drought, the Board approved an updated Bay-Delta Plan. The 1991 Plan included (1) salinity objectives intended to protect municipal and industrial uses, Delta agriculture, agriculture served by Delta exports, and fish and wildlife in the estuary; and (2) temperature and dissolved oxygen objectives for Delta fisheries.[175] The Board portrayed the Plan as setting the stage for addressing the Racanelli decision's directive to extend responsibility for meeting Delta water quality requirements to diverters beyond the state and federal projects.[176] However, the U.S. Environmental Protection Agency (EPA), which has oversight authority over state water quality standards under the federal Clean Water Act, disapproved of most of the Plan's objectives for fish and wildlife, concluding they were not sufficiently protective.[177]

B.3.3.3 The 1995 Bay-Delta Plan

In 1994, a group of state and federal agencies (known as CALFED) adopted the Bay-Delta Accord to coordinate their Delta-related water supply and environmental protection activities.[178] The following year, the Board adopted an updated Bay-Delta Plan that was consistent with the Bay-Delta Accord. The 1995 Plan made minor modifications to water quality objectives for agricultural beneficial uses, but replaced existing salinity, temperature, flow, and operational objectives for fish and wildlife uses.[179] The Board implemented the 1995 Plan's flow objectives in 1999 through Water Rights Decision 1641, which continued the interim responsibility of DWR and the USBR to meet certain requirements, and recognized agreements among various parties to meet others.[180] In early 2006, the California Court of Appeal concluded that the Board could not "implement alternate [less protective] flow objectives agreed to by various interested parties in lieu of the flow objectives actually provided for in the 1995 Bay–Delta Plan" or delay implementing objectives in a way that effectively amends the Plan without following applicable procedural requirements.[181]

B.3.3.4 The 2006 Bay-Delta Plan

In late 2006, the Board made minimal changes to the 1995 Plan, highlighting concerns "about the adequacy of scientific information available on which to base substantive changes to the water quality objectives or the program of implementation for those objectives."[182] Instead of making significant changes, the Board identified four important areas for future work: (1) the decline of pelagic organisms, (2) the effects of climate change, (3) salinity in the Delta and Central Valley, and (4) San Joaquin River flows.[183]

B.3.3.5 In-Progress Bay-Delta Plan Updates

The Board is again working on updates to the Bay-Delta Plan. This iteration of updates was initiated in 2009,[184] during the 2007–2009 drought, and continued through the 2012–2016 drought and beyond. It is occurring in several "phases."

Phase I: Update of San Joaquin River Flow and South Delta Water Quality Objectives (2009–present) — In September 2016, the Board released draft proposed amendments associated with Phase I. First, to protect fish and wildlife in ecological crisis, the Board is proposing to increase instream flow objectives for the San Joaquin River and add flow requirements for three of its tributaries.[185] The proposal would establish an "adaptive flow range" of 30 to 50 percent of the unimpaired flow to allow optimization of "the balance between fishery and human uses, while rewarding actual improvements in biological conditions that support native fish" and enabling "a nimble response to changing information and changing conditions while minimizing unintended impacts."[186] Water users and environmental interests have raised objections to the proposal.[187] Second, the Board plans to increase the Southern Delta salinity objectives that protect in-Delta agriculture based on information about the suitability of salinity conditions for irrigated crops.[188] The Board expects to consider adopting these changes, with some revisions, in Mid-2018.[189]

Phase II: Delta Outflows, Sacramento River and Delta Tributary Inflows, Cold Water Habitat, and Interior Delta Flows (2012–present) — The Board released its Final Science Report associated with Phase II updates in October 2017.[190] Staff are working to develop draft changes that "are meant to provide for a flow regime that supports a connected and functioning ecosystem linking and integrating inflow, cold water habitat, Delta outflow, and interior Delta flow requirements as well as habitat and other nonflow measures by others."[191]

The Board plans to implement these updates through water rights changes and other means.

B.4 Other State and Federal Agencies with Water Responsibilities

In addition to the Board, various other state and federal agencies play roles in California water resource management. A non-exhaustive list includes the following:

B.4.1 Other State Agencies

Regional Water Quality Control Boards (Regional Boards) — Each of the nine Regional Boards serves as the frontline water quality regulator in its region, developing and enforcing water quality control plans and carrying out water quality related permitting.[192]

California Department of Water Resources (DWR) — DWR operates the State Water Project (SWP), an extensive water storage and conveyance network that redistributes water from wetter parts of the state to drier parts of the state, using the Sacramento-San Joaquin River Delta (Delta) as an intermediary.[193] It collects and distributes California water data, carries out state-level water resources planning, and is charged with flood management and emergency response.[194] DWR also runs the state's Watermaster Program to oversee water allocation according to court adjudications or water user agreements.[195] It shares responsibility for oversight over local implementation of the Sustainable Groundwater Management Act.[196]

California Department of Fish and Wildlife (CDFW) — The CDFW collects ecosystem and species data, partners with various entities on conservation planning and projects, and consults with the Board, the Regional Boards, and the state and federal projects on how much and what quality of water is needed for fish and wildlife, including making instream flow recommendations to the Board.[197] The CDFW also steps into the role of water user as the manager of state wildlife refuges. It is responsible for environmental review of activities that would "substantially divert or obstruct" the natural flow of water or cause substantial lake or streambed alterations.[198]

B.4.2 Federal Agencies

U.S. Bureau of Reclamation (USBR) — The USBR operates the Central Valley Project (CVP), California's other major water storage and conveyance network.[199] The SWP and CVP share certain Delta infrastructure and part of the California Aqueduct, which they jointly operate.

U.S. Environmental Protection Agency (EPA) — Although the EPA has authorized the state (the Board and Regional Boards) to assume permitting authority under the federal Clean Water Act[200] and primary enforcement responsibilities under the Safe Drinking Water Act,[201] it retains ultimate responsibility for enforcing federal water quality laws and engages in related oversight and enforcement activities.[202]

U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) — The USFWS and NOAA Fisheries work together to implement and enforce the federal Endangered Species Act (ESA). NOAA Fisheries has primary responsibility for marine species, the USFWS is primarily responsible for non-marine species, and they have joint responsibility for anadromous fish.[203] Among other things, these agencies develop and implement species recovery plans and cooperative agreements with states, consult on federal actions that might affect listed species—like CVP and joint SWP and CVP operations—in order to minimize negative impacts, and investigate potential ESA violations.[204] The USFWS also acts as a water user in managing National Wildlife Refuges.[205]

U.S. Geological Survey (USGS) — Unlike the other federal agencies mentioned here, which have significant regulatory and management responsibilities, the USGS is primarily a science agency that produces and disseminates information to support natural resource decision making.[206] In California, the agency's water-related work includes monitoring water quality and quantity, studying wildlife health and status, and studying how climate change may affect the quantity and quality of water supplies and, ultimately, wildlife habitat, drinking water, and agriculture.[207] The USGS coordinates its work with other agencies and researchers.[208]

B.5 Endnotes

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[1] Legal scholars have described the development of California water rights law, from its beginnings as a way for miners to establish appropriative rights for placer mining to broad recognition of riparian rights, the creation of a permit system, and a focus on reasonable use and consideration of the public interest. *See generally*, William R. Attwater & James Markle, *Overview of California Water Rights and Water Quality Law*, 19 PACIFIC L.J. 957 (1988).

[2] Less common rights, notably federal reserved rights and pueblo rights, also exist, but are not discussed here. For a brief discussion of federal reserved rights and pueblo rights. *See* NELL GREEN NYLEN, MICHAEL KIPARSKY, KELLY ARCHER, KURT SCHNIER & HOLLY DOREMUS, TRADING SUSTAINABLY: CRITICAL CONSIDERATIONS FOR LOCAL GROUNDWATER MARKETS UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT 16 (2017), *available at* https://www.law.berkeley.edu/research/clee/research/wheeler/trading-sustainably/.

[3] *El Dorado Irr. Dist. v. State Water Res. Control Bd.*, 142 Cal. App. 4th 937, 961 (2006).

[4] *See* CAL. CONST. art. X, § 2; *see also The Water Rights Process*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/board_info/water_rights_process.shtml (last visited Oct. 14, 2016).

[5] *United States v. State Water Res. Control Bd.*, 182 Cal. App. 3d 82, 101 (1986) (citing *Prather v. Hoberg*, 24 Cal. 2d 549, 559–60 (Cal. 1944)).

[6] *See United States v. Fallbrook Pub. Util. Dist.*, 101 F. Supp. 298, 303 (S.D. Cal. 1951) ("By the common law the right of the riparian proprietor to the flow of the stream is inseparably annexed to the soil, and passes with it, not as an easement or appurtenance, but as part and parcel of it." (quoting *Lux v. Haggin*, 69 Cal. 255, 390 (1886)); *People v. Shirokow*, 26 Cal. 3d 301, 307 n.7 (1980); *Rancho Santa Margarita v. Vail*, 11 Cal. 2d 501, 538 (Cal. 1938) ("[W]here the owner of a riparian tract conveys away a noncontiguous portion of the tract by a deed that is silent as to riparian rights, the conveyed parcel is forever deprived of its riparian status." (citing *Anaheim Union Water Co. v. Fuller*, 150 Cal. 327, 331 (Cal. 1907)); *see also* CAL CONST. art. X, § 2; CAL. WATER CODE § 101; *Water Rights Frequently Asked Questions*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/board_info/faqs.shtml (last updated Aug. 14, 2017). However, a riparian landowner can enter into an agreement whereby another entity exercises the riparian owner's water right and provides the riparian with the water or substitute water. For example, riparian land owners downstream of the Friant Dam on the San Joaquin River contracted with the U.S. Bureau of Reclamation to allow it to exercise "their rights . . . in exchange for the agreement of the Bureau to provide [them with] 'substitute water.'" *Westlands Water Dist. v. Firebaugh Canal*, 10 F.3d 667, 669 (9th Cir. 1993).

[7] *See Moore v. California Oregon Power Co.*, 22 Cal. 2d 725, 734–35 (1943) (concluding that "periodic storage" that "occurs during the dry season of the year when there is a scarcity of water" is a non-riparian use, even where storage lasts only a few hours or days); *Water Rights Frequently Asked Questions*, *supra* note 6.

[8] *United States v. State Water Res. Control Bd.*, 182 Cal. App. 3d 82, 101, 227 (1986).

[9] *People v. Shirokow*, 26 Cal. 3d 301, 307–08 (1980).

[10] *Id.* at 308.

[11] *See* CAL. CIV. CODE § 1415; *see also* CAL CIV. CODE §§ 1414, 1416–1422.

[12] *See Cal. Farm Bureau Fed'n v. State Water Res. Control Bd.*, 51 Cal. 4th 421, 429 (2011), as modified Apr. 20, 2011 (explaining that the Board "regulates all appropriative water rights acquired since 1914 . . . through a system of permits and licenses"); *see also Water Rights Frequently Asked Questions*, *supra* note 6. ("If you have a pre-1914 right, you do not need a water right permit unless you have increased your use of water since 1914.").

[13] Water Commission Act of 1913, Cal. Stats. 1913, ch. 586, at 1012.

[14] *See Shirokow*, 26 Cal. 3d at 308.

[15] *See Cal. Farm Bureau Fed'n*, 51 Cal. 4th at 428–29; *Shirokow*, 26 Cal. 3d at 308; *United States v. Fallbrook Pub. Util. Dist.*, 165 F. Supp. 806, 830 (S.D. Cal. 1958) (stating that, "[i]f this procedure was not the exclusive method of appropriating water after 1914, it became so in 1923 when this method of appropriation was made exclusive by amendment to the Water Commission Act (Stat.1923, c. 87)"; "[a]ppropriation by pre-emption or self help was thus terminated at least by 1923"); *see also* CAL. WATER CODE §§ 102, 1228.1–1229.1 (describing registration requirements, and their applicability, for small domestic use, small irrigation use, and livestock stockpond use); CAL. WATER CODE §§ 1375–1415 (describing permits); *see also* State Water Res. Control Bd. Process for Water Right Licensing (2013), *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/docs/licensing.pdf (explaining that "[t]he water right process has three phases: (a) application, (b) permit, and (c) license"); *Water Rights Applications: Permitting and Licensing Program*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/applications/ (last updated Jul. 12, 2016).

[16] CAL. WATER CODE § 1450.

[17] 43 U.S.C. § 661.

[18] *See Lux v. Haggin*, 69 Cal. 255, 372–76 (1886).

[19] *See SWPAO – Water Supply Contracts*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/swpao/wsc.cfm (last modified Nov. 6, 2017).

[20] *See* U.S. Bureau of Reclamation, Central Valley Project (CVP) Water Contracts Fact Sheet (Mar. 2016), *available at* https://www.usbr.gov/mp/cvp-water/docs/cvp-water-contracts-fact-sheet.pdf.

[21] *Id.*; *see also Tehama-Colusa Canal Auth. v. U.S. Dep't of the Interior*, 819 F. Supp. 2d 956, 970–71 (E.D. Cal. 2011), *aff'd sub nom. Tehama-Colusa Canal Auth. v. U.S. Dep't of the Interior*, 721 F.3d 1086 (9th Cir. 2013). Federal courts have explained different types of CVP contracts as follows:

> In CVP Federal water service contracting, there are at least three categories of contracts. The first are "Exchange Contracts" which give express contractual priority to CVP water service to designated "Exchange Contractors" on the basis of their pre-existing pre–1914 riparian and appropriative rights to the San Joaquin River. The Exchange Contractors "traded" their preexisting water rights to the Bureau, which obtained water permits from the SWRCB based on these exchanged water rights, for which the Bureau in turn granted priority access to CVP water supply to the Exchange Contractors in federal water service contracts. This enabled the Bureau to provide water for a proposed CVP expansion in other areas of the San Joaquin Valley.
>
> The second category of CVP contracts are Settlement Contracts including the Sacramento River Settlement ("SRS") Contracts, which grant a contractual priority to CVP water supply through limitations on shortage provisions. The SRS Contracts' priority arises from: "[T]he CVP's water rights are subject to the Settlement Contractors' [pre-existing water rights]" which include riparian, appropriative, and other water rights recognized by the State Board.
>
> The third category of contracts are held by CVP contractors, north-of-Delta, in-Delta, and south-of-Delta. All of these third category CVP contractors, which include TCCA and its Members, (except Glen–Colusa), SLDMA and Westlands, held no pre-existing water rights to offer as consideration for CVP water service and have no priority access rights to CVP water supply or deliveries in times of shortage; no guarantee of 100% contract water deliveries; and no recognition they include pre-existing water rights. The Bureau allocates reduced CVP water supplies during Shortages to the third category of CVP water service contractors on a CVP-wide basis in accordance with the terms of all these contracting Districts' water service contracts.

Id. (citations omitted).

[22] *See, e.g.*, CAL. DEP'T OF WATER RES., CALIFORNIA'S MOST SIGNIFICANT DROUGHTS: COMPARING HISTORICAL AND RECENT CONDITIONS 62 figs.4,2, 4.3 (2015) [hereinafter CALIFORNIA'S MOST SIGNIFICANT DROUGHTS], *available at* http://www.water.ca.gov/waterconditions/docs/a9237_CalSignficantDroughts_v10_int.pdf. at; U.S. Bureau of Reclamation, Summary of Water Supply Allocations (2017), *available at* https://www.usbr.gov/mp/cvo/vungvari/water_allocations_historical.pdf.

[23] *City of Santa Maria v. Adam*, 211 Cal. App. 4th 266, 279 (2012), *as modified on denial of reh'g* (Dec. 21, 2012); *see also City of Los Angeles v. City of San Fernando*, 14 Cal. 3d 199, 278 (1975) (explaining that the trial court defined "safe yield" as

"the maximum quantity of water which can be withdrawn annually from a ground water supply under a given set of conditions without causing an undesirable result").

[24] *See North Gualala Water Co. v. State Water Res. Control Bd.*, 139 Cal. App. 4th 1577, 1592–93 (2006); CAL. WATER CODE §§ 1200, 1221, 5100; *see also* Joseph L. Sax, *We Don't Do Groundwater: A Morsel of California Legal History*, 6 U. DENVER WATER L. REV. 269, 273 (2003).

[25] *See* JOSEPH L. SAX, REVIEW OF THE LAWS ESTABLISHING THE SWRCB'S PERMITTING AUTHORITY OVER APPROPRIATIONS OF GROUNDWATER CLASSIFIED AS SUBTERRANEAN STREAMS AND THE SWRCB'S IMPLEMENTATION OF THOSE LAWS 1–3 (2002), *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/groundwater_classification/docs/substreamrpt2002jan20.pdf.

[26] *North Gualala Water Co.*, 139 Cal. App. at 1606.

[27] *Id.* at 1585.

[28] *See City of Barstow v. Mojave Water Agency*, 23 Cal. 4th 1224, 1240 (2000); *Tehachapi-Cummings Cnty. Water Dist., v. Armstrong*, 49 Cal. App. 3d 992, 1001 (1975); *see also* CAL. DEP'T OF WATER RES. & STATE WATER RES. CONTROL BD., BACKGROUND AND RECENT HISTORY OF WATER TRANSFERS IN CALIFORNIA 8 (July 2015), *available at* http://www.water.ca.gov/watertransfers/docs/Background_and_Recent_History_of_Water_Transfers.pdf.

[29] *See Mojave*, 23 Cal. 4th at 1253; *Tehachapi-Cummings*, 49 Cal. App. 3d at 1000–1001 n.6; *United States v. Fallbrook Public Utility District*, 165 F.Supp. 806, 824-825 (S.D. Cal. 1958)); *City of Pasadena v. City of Alhambra*, 33 Cal. 2d 908, 925, 926 (1949); *City of San Bernardino v.* City of Riverside, 186 Cal. 7, 16 (1921); *Katz v. Walkinshaw*, 141 Cal. 116, 134 (1903).

[30] *Tehachapi-Cummings*, 49 Cal. App. 3d at 1001; *see also Pasadena*, 33 Cal. 2d at 926; *Hudson v. Dailey*, 156 Cal. 617, 625 (1909); *Burr v. Maclay Rancho Water Co.*, 154 Cal. 428, 434–35 (Cal. 1908); *Katz*, 141 Cal. at 136–37.

[31] *See Pasadena*, 33 Cal. 2d at 925–26 ("Any water not needed for the reasonable beneficial uses of those having prior rights is excess or surplus water. In California surplus water may rightfully be appropriated on privately owned land for nonoverlying uses, such as devotion to a public use or exportation beyond the basin or watershed."); *City of Los Angeles v. City of San Fernando*, 14 Cal. 3d 199, 277–78 (1975).

[32] *See Pasadena*, 33 Cal. 2d at 926.

[33] *See City of Santa Maria v. Adam*, 211 Cal. App. 4th 266, 297 (2012), as modified on denial of reh'g (Dec. 21, 2012).

[34] *Pasadena*, 33 Cal. 2d at 926–27; see also *See San Fernando*, 14 Cal. 3d. at 278 (noting that "on the commencement of overdraft there is no surplus available" and "appropriations of water in excess of surplus then invade senior basin rights, creating the element of adversity against those rights prerequisite to their owners' becoming entitled to an injunction and thus to the running of any prescriptive period against them.").

[35] *See Pasadena*, 33 Cal. 2d at 926–27; *see also*, *e.g.*, *City of Barstow v. Mojave Water Agency*, 23 Cal. 4th 1224, 1241 (2000).

[36] *City of Santa Maria v. Adam*, 211 Cal. App. 4th at 297; *see also City of Santa Maria v. Adam*, No. H041133, 2016 WL 3517417, at *1 (Cal. Ct. App. June 24, 2016).

[37] *City of Santa Maria v. Adam*, 248 Cal. App. 4th 504, 511 (2016), reh'g denied (July 18, 2016), review denied (Sept. 14, 2016) (calling prescriptive rights "fixed," in contrast to overlying rights).

[38] *Pasadena*, 33 Cal. 2d at 931–933; *see also City of Santa Maria v. Adam*, 211 Cal. App. 4th at 279; *City of Los Angeles v. City of San Fernando*, 14 Cal. 3d. 199, 293–294 (1975); *Hi–Desert County Water Dist. v. Blue Skies Country Club, Inc.*, 23 Cal. App. 4th 1723, 1731–1732 (1994).

[39] *City of Santa Maria v. Adam*, No. H041133, 2016 WL 3517417, at *3–*6 (Cal. Ct. App. June 24, 2016).

[40] *See United States v. Eastern Municipal Water Dist.*, No. CV 04-8182 CBM RNBX, 2009 WL 2407688, at *55 (C.D. Cal. Aug. 4, 2009).

[41] *See City of Los Angeles v. City of San Fernando*, 14 Cal. 3d at 293 n.100; *City of Pasadena v. City of Alhambra*, 33 Cal. 2d. 908, 926 (1949).

[42] *City of Santa Maria v. Adam*, 211 Cal. App. 4th at 279; *see also City of Los Angeles v. City of San Fernando*, 14 Cal. 3d at 278 (explaining that the trial court defined "safe yield" as "the maximum quantity of water which can be withdrawn annually from a ground water supply under a given set of conditions without causing an undesirable result").

[43] *City of Los Angeles v. City of San Fernando*, 14 Cal. 3d at 277–278 (stating also that "[o]verdraft commences whenever extractions increase, or the withdrawable maximum decreases, or both, to the point where the surplus ends").

[44] *See* CAL. WATER CODE §§ 10720.1, 10720.3(d), 10720.5, 10726.4(a), 10726.8(b), 10735.8(d), (e), (i), 10736.4.

[45] CAL. WATER CODE §§ 10721(v), (w), (x); *see also* CAL. WATER CODE § 10721(r).

[46] *See* GREEN NYLEN, ET AL., *supra* note 2, at 16.

[47] ALIDA CANTOR, DAVE OWEN, THOMAS HARTER, NELL GREEN NYLEN & MICHAEL KIPARSKY, NAVIGATING GROUNDWATER-SURFACE WATER INTERACTIONS UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT (2018), *available at* https://www.law.berkeley.edu/research/clee/research/wheeler/gw-sw/.

[48] *See, e.g.*, Sax, *supra* note 49, at 87–89; Scott River Adjudication, Decree No. 30662, In the Matter of Determination of the Rights of the Various Claimants to the Waters of Scott River Stream System, Except Rights to Water of Shackleford Creek, French Creek, and all Streams Tributary to Scott River Downstream from the U.S. Geological Survey Gaging Station, in Siskiyou County, California, Jan. 16, 1980 (Siskiyou Cnty. Super. Ct.), *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/judgments/docs/scottriver_jd.pdf.

[49] *See e.g.*, *Miller v. Bay Cities Water Co.*, 157 Cal. 256 (1910); *Hudson v. Dailey*, 156 Cal. 617 (1909); *McClintock v. Hudson*, 141 Cal. 275, 281 (1903).

[50] *See*, *e.g.*, *Cohen v. La Canada Land & Water Co.*, 142 Cal. 437 (1904); *City of Lodi v. East Bay Mun. Util. Dist.*, 7 Cal. 2d 316 (1936).

[51] *See* Sax, *supra* note 49, at 90–91.

[52] *See* CAL. WATER CODE §§ 1253, 1255, 1257; *see also City of Lodi v. East Bay Mun. Util. Dist.*, 7 Cal.2d at 323; State Water Res. Control Bd., Water Transfer Program Information 5, 6–7, 8 (Sept. 2013), *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/docs/transproginfo.pdf.

[53] CAL. CONST. art X, § 2 (emphasis added); *see also* CAL. WATER CODE § 100.

[54] *Joslin v. Marin Mun. Water Dist.*, 67 Cal. 2d 132, 144, 145 (1967) (denying a takings claim on the basis that "since there was and is no property right in an unreasonable use, there has been no taking or damaging of property by the deprivation of such use and, accordingly, the deprivation is not compensable"); *Peabody v. City of Vallejo*, 2 Cal. 2d 351, 383 (1935) (concluding that "the rule of reasonable use . . . applies to all water rights enjoyed or asserted in this state, whether the same be grounded on the riparian right or the right, analogous to the riparian right, of the overlying land owner, or the percolating water right, or the appropriative right").

[55] CAL. CONST. art X, § 2; CAL. WATER CODE § 100.

[56] *In re Waters of Long Valley Creek Stream System*, 25 Cal. 3d 339, 354, 599 P.2d 656, 665 (1979); *see also Joslin*, 67 Cal. 2d at 139–140; *Light v. State Water Res. Control Bd.*, 226 Cal. App. 4th 1463, 1488 (2014), *as modified on denial of reh'g* (July 11, 2014), *review denied* (Oct. 1, 2014).

[57] *Joslin*, 67 Cal. 2d at 139–140.

[58] Brian E. Gray, *The Reasonable Use Doctrine in California Water Law and Policy*, *in* SUSTAINABLE WATER: CHALLENGES AND SOLUTIONS FROM CALIFORNIA, at 83, 89 (Allison Lassiter ed., 2015).

[59] *See Joslin*, 67 Cal. 2d at 138–139 (mentioning various cases).

[60] Gray, *supra* note 58, at 89–90; *see also, e.g.*, CAL. PUB. RES. CODE § 5093.50; *Nat'l Audubon Soc'y v. Superior Court*, 33 Cal. 3d 419, 445 (1983).

[61] See CAL. WATER CODE § 106 (establishing as state policy that "the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation"); CAL. WATER CODE § 1460 ("The application for a permit by a municipality for the use of water for the municipality or the inhabitants thereof for domestic purposes shall be considered first in right, irrespective of whether it is first in time.").

[62] CAL. WATER CODE § 106.3.

[63] *See, e.g.*, CAL. WATER CODE § 12581 ("In studying water development projects, full consideration shall be given to all beneficial uses of the State's water resources, including irrigation, generation of electric energy, municipal and industrial consumption of water and power, repulsion of salt water, preservation and development of fish and wildlife resources, and recreational facilities, but not excluding other beneficial uses of water, in order that

recommendations may be made as to the feasibility of such projects and for the method of financing feasible projects."); *see also, e.g.*, CAL. WATER CODE §§ 1004, 1005.1, 1005.2, 1005.4, 1010, 1011.5, 1017, 1202, 1242.5–1244, 1257, 1425, 1435, 1727, 1745.07; CAL. CODE REGS. tit. 23, § 659 ("Beneficial use of water includes those uses defined in this subarticle. The [Board] will determine whether other uses of water are beneficial when considering individual applications to appropriate water."); *see also* CAL. CODE REGS. tit. 23, §§ 660–672.

[64] CAL. CONST. art X, § 2; CAL. WATER CODE § 100.

[65] CAL. WATER CODE § 104; *see also* CAL. WATER CODE § 105 (declaring that "the protection of the public interest in the development of the water resources of the State is of vital concern to the people of the State and that the State shall determine in what way the water of the State, both surface and underground, should be developed for the greatest public benefit").

[66] CAL. WATER CODE § 1255; *see also Water Rights Petitions*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/petitions/ (last updated Sept. 5, 2017).

[67] *United States v. State Water Res. Control* Bd., 182 Cal. App. 3d 82, 126 (1986).

[68] CAL. WATER CODE §§ 1253, 1257.

[69] CAL. WATER CODE § 1257; *see also United States v. State Water Res. Control* Bd., 182 Cal. App. 3d at 103, 126.

[70] CAL. WATER CODE §§ 1256, 1258.

[71] CAL. WATER CODE § 1257.5; *see also* Cal. Water Code §§ 1243(a), 1243.5.

[72] CAL. WATER CODE § 1259.

[73] *See Nat'l Audubon Soc'y v. Superior Court*, 33 Cal. 3d 419, 445 (1983); *Cal. Trout, Inc. v. State Water Res. Control Bd.*, 207 Cal. App. 3d 585, 630 (1989).

[74] *See Marks v. Whitney*, 6 Cal. 3d 251, 259–60 (1971).

[75] *Nat'l Audubon,* 33 Cal. 3d at 443, 446–447 (explaining that "[a]ll uses of water, including public trust uses, must . . . conform to the standard of reasonable use"); *see also El Dorado Irr. Dist. v. State Water Res. Control Bd.*, 142 Cal. App. 4th 937, 966 (2006).

[76] *Nat'l Audubon,* 33 Cal. 3d at 447 (holding that "[n]o vested rights bar such reconsideration").

[77] 33 U.S.C. §§ 1251–1387; CAL. WATER CODE, §§ 13000–16104.

[78] 16 U.S.C. §§ 1531–1544.

[79] CAL. FISH & GAME CODE §§ 2050–2115.5.

[80] 42 U.S.C. §§ 4321–4370m-12.

[81] CAL. PUB. RES. CODE §§ 21000–21189.57.

[82] *See* CAL. PUB. RES. CODE §§ 21001.1, 21002, 21002.1, 21080; *see also* CAL. PUB. RES. CODE § 21061.1 (defining "feasible" as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors"); CAL. PUB. RES. CODE § 21063 (defining "public agency"); CAL. CODE REGS. tit. 14, § 15021.

[83] CAL. PUB. RES. CODE §§ 21065, 21160.

[84] *See* CAL. PUB. RES. CODE §§ 21067, 21080.1(a), 21100(a), 21151, 21165.

[85] CAL. PUB. RES. CODE § 21068; *see also* CAL. PUB. RES. CODE § 21083(b) (directing the development of guidelines that "require a finding that a project may have a "significant effect on the environment" if one or more of the following conditions exist: (1) A proposed project has the potential to degrade the quality of the environment, curtail the range of the environment, or to achieve short-term, to the disadvantage of long-term, environmental goals. (2) The possible effects of a project are individually limited but cumulatively considerable. As used in this paragraph, "cumulatively considerable" means that the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects. (3) The environmental effects of a project will cause substantial adverse effects on human beings, either directly or indirectly.").

[86] CAL. PUB. RES. CODE §§ 21002.1(a), 21061, 21100(b); *see also* CAL. CODE REGS. tit. 14, §§ 15120–15132 (describing the contents of an EIR).

[87] *See* CAL. PUB. RES. CODE § 21064 (regarding negative declarations); CAL. PUB. RES. CODE § 21064.5 (regarding mitigated negative declarations).

[88] *See* CAL. PUB. RES. CODE §§ 21064, 21064.5.

[89] *See* CAL. PUB. RES. CODE §§ 21165; CAL. CODE REGS. tit. 14, § 15063.

[90] CAL. PUB. RES. CODE § 21068.5.

[91] *See* CAL. PUB. RES. CODE § 21080, 21080.5, 21084; CAL. CODE REGS. tit. 14, §§ 15250–15253 (regarding certified state regulatory programs); CAL. CODE REGS. tit. 14, §§ 15260–15285 (regarding statutory exemptions); CAL. CODE REGS. tit. 14, §§ 15300–15333 (regarding categorical exemptions).

[92] CAL. PUB. RES. CODE § 21080(b)(4). For the purposes of CEQA, an "emergency" is "a sudden, unexpected occurrence, involving a clear and imminent danger, demanding immediate action to prevent or mitigate loss of, or damage to, life, health, property, or essential public services." CAL. PUB. RES. CODE § 21060.3. This "includes such occurrences as fire, flood, earthquake, or other soil or geologic movements, as well as such occurrences as riot, accident, or sabotage." *Id.*

[93] *See State Water Board Drought Year Water Actions Taken with California Environmental Quality Act Suspensions*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/wb_actions.shtml (last updated Aug. 29, 2016).

[94] During the recent drought, the governor issued three proclamations or executive orders that included CEQA exemptions. *See* Edmund G. Brown, Jr., A Proclamation of a State of Emergency, Jan. 17, 2014 [hereinafter 2014 Drought Proclamation], *available at* http://gov.ca.gov/news.php?id=18379; Edmund G. Brown, A Proclamation of a Continued State of Emergency, Apr. 25, 2014, *available at* http://gov.ca.gov/news.php?id=18496; Edmund G. Brown, Executive Order B-28-14, Dec. 22, 2014, *available at* https://www.gov.ca.gov/news.php?id=18815.

[95] *See State Water Board Drought Year Water Actions Taken with California Environmental Quality Act Suspensions*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/wb_actions.shtml (last updated Aug. 29, 2016).

[96] *See Cal. Farm Bureau Fed'n v. State Water Res. Control Bd.*, 51 Cal. 4th 421, 429 (Cal. 2011), as modified (Apr. 20, 2011) (explaining that the Board "regulates all appropriative water rights acquired since 1914 . . . through a system of permits and licenses"); *see also Water Rights Frequently Asked Questions*, *supra* note 6 ("If you have a pre-1914 right, you do not need a water right permit unless you have increased your use of water since 1914.").

[97] *See* CAL. WATER CODE §§ 1250–1410.2; *Water Rights Applications: Permitting and Licensing Program*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/applications/ (last updated Jul. 12, 2016).

[98] *See* CAL. WATER CODE § 1206.

[99] *See* CAL. WATER CODE § 1206(c).

[100] *See* CAL. WATER CODE § 1260(a)–(j). Additional information is required if the proposed use is agricultural, "for power purposes," for municipal water supply, or "for mining purposes" or if the water will be stored in a reservoir before use. *See* CAL. WATER CODE §§ 1262–1266.

[101] Cal. Water Code § 1300–1324.

[102] *See* CAL. WATER CODE §§ 1333, 1340, 1345, 1351.

[103] *See* CAL. WATER CODE § 1375(d); *see also id.* § 1260(k).

[104] *See* CAL. WATER CODE § 1375(c).

[105] *See* CAL. WATER CODE §§ 1255–1257; *see also id.* §§ 1254, 1257.5–1259.

[106] *See* CAL. WATER CODE § 1257.5.

[107] *See* CAL. WATER CODE § 1258.

[108] *See* CAL. WATER CODE §§ 1253, 1255, 1257; *see also City of Lodi v. East Bay Mun. Util. Dist.*, 7 Cal.2d 316, 323 (1936).

[109] *See* CAL. WATER CODE § 1260(a)–(j). Additional information is required if the proposed use is agricultural, "for power purposes," for municipal water supply, or "for mining purposes" or if the water will be stored in a reservoir before use. *See* CAL. WATER CODE §§ 1262–1266.

[110] *See* CAL. WATER CODE §§ 1330–1335.

[111] *See* CAL. WATER CODE §§ 1347, 1350, 1351

[112] *See* CAL. WATER CODE § 1391.

[113] *See* CAL. WATER CODE § 1260.

[114] State Water Res. Control Bd. Process for Water Right Licensing (2013), *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/docs/licensing.pdf.

[115] *See* CAL. WATER CODE § 1600–1650.

[116] Process for Water Right Licensing, *supra* note 114.

[117] *Id.*

[118] *Id.*

[119] *See* CAL. WATER CODE §§ 1228–1229.1; *Water Rights Registrations Program*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/registrations/ (last updated Oct. 19, 2017).

[120] *Water Rights Registrations Program*, *supra* note 119.

[121] *See* CAL. WATER CODE § 1228.5.

[122] *See Cal. Farm Bureau Fed'n v. State Water Res. Control Bd.*, 51 Cal. 4th 421, 429 (2011), *as modified* (Apr. 20, 2011) (explaining that the Board "regulates all appropriative water rights acquired since 1914 . . . through a system of permits and licenses"); *see also Water Rights Frequently Asked Questions*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/board_info/faqs.shtml (last updated Aug. 14, 2017).

[123] *See* CAL. WATER CODE § 1707.

[124] *See* CAL. WATER CODE § 1706.

[125] *See* CAL. WATER CODE §§ 1700–1707.

[126] *See* CAL. WATER CODE §§ 1701.1–1702.

[127] *See* CAL. WATER CODE § 1701.3(b)(3).

[128] *See* CAL. WATER CODE §§ 1701.3, 1701.4

[129] *See Water Rights Petitions*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/petitions/ (last updated Sept. 5, 2017); CAL. WATER CODE §§ 1704, 1705.

[130] *Water Rights Petitions*, *supra* note 129.

[131] *See* CAL. WATER CODE § 1211; *Water Rights Petitions*, *supra* note 129

[132] *See* CAL. WATER CODE §§ 1735–1737; *see also* CAL. CODE REGS. tit. 23, §§ 794(b), (c) and 801 (requiring consultation with the California Department of Fish and Wildlife regarding potential effects on fish, wildlife, and water quality).

[133] *See* CAL. WATER CODE § 1706.

[134] CAL. DEP'T OF WATER RES. & U.S. BUREAU RECLAMATION, DRAFT TECHNICAL INFORMATION FOR PREPARING WATER TRANSFER PROPOSALS: INFORMATION FOR PARTIES PREPARING PROPOSALS FOR WATER TRANSFERS REQUIRING DEPARTMENT OF WATER RESOURCES OR BUREAU OF RECLAMATION APPROVAL 1, 7 fig. 1-2, 5 (2016) [hereinafter WATER TRANSFER WHITE PAPER], *available at* http://www.water.ca.gov/watertransfers/docs/2016_Water_Transfer_White_Paper.pdf; STATE WATER RES. CONTROL BD., A GUIDE TO WATER TRANSFERS (DRAFT) 3-7 to 3-9(1999), *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/docs/watertransferguide.pdf (Note: There is no "final" version available for this document, but it is still used by the Board).

[135] *See* ALVAR ESCRIVA-BOU, HENRY MCCANN, ELISA BLANCO, BRIAN GRAY, ELLEN HANAK, JAY LUND, BONNIE MAGNUSON-SKEELS, & ANDREW TWEET, ACCOUNTING FOR CALIFORNIA'S WATER: TECHNICAL APPENDIX 23 (2016), *available at* http://www.ppic.org/content/pubs/report/R_716EHR.pdf.

[136] *See* CAL. WATER CODE §§ 348, 5103, 5104; CAL. CODE REGS. tit. 23, § 920(c)(10).

[137] *See* WATER TRANSFER WHITE PAPER, *supra* note 134, at 1, 7 fig. 1-1.

[138] WATER TRANSFER WHITE PAPER, *supra* note 134, at 2.

[139] CAL. WATER CODE § 1810(d); *see also id.* §§ 10505, 10505.5, 11460, 11463 (regarding county-of-origin and watershed protections).

[140] *See* CAL. GOV. CODE § 1058 (providing that "[t]he Board may make such reasonable rules and regulations as it may from time to time deem advisable in carrying out its powers and duties").

[141] CAL. GOV'T CODE §§ 11340–11361 (consisting of nine articles).

[142] CAL. GOV'T CODE § 11346; *see also The Regular Rulemaking Process*, OFFICE OF ADMIN. LAW, http://www.oal.ca.gov/Regular_Rulemaking_Process.htm (last visited Nov. 7, 2016); Office of Admin. Law, OAL Review (June 2014), *available at* https://www.oal.ca.gov/wp-content/uploads/sites/28/2017/05/Regular-Rulemaking-Flowchart_FINAL_June-2014-2.pdf.

[143] *See* CAL. GOV. CODE §§ 11346.2(b), 11346.3, 11346.5; *see also The Regular Rulemaking Process*, *supra* note 142. Before publishing notice of large or complex proposed regulations, the Board is generally supposed to "involve parties who would be subject to the proposed regulations in public discussions regarding those proposed regulations," but this requirement is not externally enforceable. CAL. GOV. CODE § 11346.45 (providing that the requirement for public discussion is not subject to judicial review or to OAL review).

[144] *See* CAL. GOV. CODE §§ 11346.2, 11346.4, 11346.5; *see also* CAL. GOV. CODE §§ 11340.85(c).

[145] *See* CAL. GOV'T CODE §§ 11346.4(a), 11346.5(a)(15), (17); 11346.8.

[146] *See* CAL. GOV'T CODE § 11346.8(a).

[147] *See* CAL. GOV'T CODE § 11346.8(a).

[148] *See* CAL. GOV'T CODE § 11346.8(c).

[149] *See* CAL. GOV'T CODE § 11346.8(c).

[150] *See* CAL. GOV'T CODE § 11346.9.

[151] *See* CAL. GOV'T CODE § 11346.4(b).

[152] *See* CAL. GOV'T CODE § 11349.1; *see also* CAL. GOV'T CODE § 11349 (defining necessity, authority, clarity, consistency, reference, and nonduplication).

[153] *See* CAL. GOV'T CODE § 11349.3.

[154] *See* CAL. GOV'T CODE § 11346.1(a)(1), (b)(2) (describing substantive and procedural requirements for a state agency to adopt, amend, or repeal an emergency regulation); *see also Emergency Regulations Adoption Process*, OFFICE OF ADMIN. LAW, http://www.oal.ca.gov/Emergency_Regulation_Process.htm (last visited July 23, 2014); Office of Admin. Law, Emergency Rulemaking Process – Timeline (2008), *available at* http://www.oal.ca.gov/res/docs/pdf/Emergency_Rulemaking_Process_Timeline_Chart.pdf.

[155] *Schenley Affiliated Brands Corp. v. Kirby*, 21 Cal. App. 3d 177, 194-95 (1971); *see also Doe v. Wilson*, 57 Cal. App. 4th 296, 312 (1997).

[156] *See* CAL. GOV'T CODE § 11346.1(a)(1); *see also* CAL. GOV'T CODE §§ 11346–11348 (public participation procedures); CAL. GOV'T CODE §§ 11349–11349.6 (governing OAL review).

[157] CAL. GOV'T CODE § 11346.1.

[158] *See* CAL. GOV'T CODE § 11349.6; *see also* CAL. GOV'T CODE §§ 11346.1, 11349, 11349.1.

[159] *See* CAL. GOV'T CODE § 11349.6(b) (eliminating the public comment period when "the emergency situation clearly poses such an immediate serious harm that delaying action to allow public comment would be inconsistent with the public interest").

[160] *Compare* CAL. WATER CODE § 1058.5 (b) (amended effective March 1, 2014) ("Notwithstanding Sections 11346.1 and 11349.6 of the Government Code, any findings of emergency adopted by the board, in connection with the adoption of an emergency regulation under this section, are not subject to review by the Office of Administrative Law."), *with* CAL. GOV'T CODE §§ 11346.1(a)(1), 11349.6(b) (requiring the Office of Administrative Law to review emergency regulations and disapprove them if "the situation addressed by the regulations is not an emergency, or . . . the

regulation fails to meet the standards set forth in Section 11349.1, or . . . the agency failed to comply with Section 11346.1").

[161] *Compare* CAL. WATER CODE § 1058.5(c) ("An emergency regulation adopted by the board under this section may remain in effect for up to 270 days, . . . [and] may be renewed if the board determines that the conditions specified in paragraph (2) of subdivision (a) are still in effect."), *with* CAL. GOV'T CODE § 11346.1(e), (h) ("No regulation, amendment, or order of repeal initially adopted as an emergency regulatory action shall remain in effect more than 180 days . . . , [and] [r]eadoption shall be permitted only if the agency has made substantial progress and proceeded with diligence to comply with subdivision (e) . . . .").

[162] *See* CAL. WATER CODE § 1058.5(d) ("In addition to any other applicable civil or criminal penalties, any person or entity who violates a regulation adopted by the board pursuant to this section is guilty of an infraction punishable by a fine of up to five hundred dollars ($500) for each day in which the violation occurs."); CAL. GOV'T CODE § 11145 ("No state agency shall adopt or enforce any rule or regulation a violation of which can result in the imposition of a fine or imprisonment, or both, unless a statute specifically authorizes the imposition of such fine or imprisonment, or both, for a violation of the rule or regulation."). CAL. GOV'T CODE § 11346.1 does not specifically authorize a fine for violation of emergency regulations.

[163] CAL. WATER CODE § 1058.5(a)(1).

[164] CAL. WATER CODE § 1058.5(a)(2) (emphasis added).

[165] *San Francisco Bay/Sacramento – San Joaquin Delta Estuary (Bay-Delta) Watershed Efforts*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/ (last updated Mar. 21, 2017).

[166] *See generally* State Water Res. Control Bd., Water Quality Control Plan for the San Francisco Bay / Sacramento-San Joaquin Delta Estuary (2006) [hereinafter 2006 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/docs/2006_plan_final.pdf; State Water Res. Control Bd., Water Quality Control Plan for the San Francisco Bay / Sacramento-San Joaquin Delta Estuary (1995) [hereinafter 1995 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/1995wqcp/docs/1995wqcpb.pdf; State Water Res. Control Bd., Water Quality Control Plan for Salinity: San Francisco Bay / Sacramento-San Joaquin Delta Estuary (1991) [hereinafter 1991 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/docs/1991wqcp.pdf; State Water Res. Control Bd., Water Quality Control Plan: Sacramento-San Joaquin Delta and Suisun Marsh (1978) [1978 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/docs/1978wqcp.pdf.

[167] 1978 Bay-Delta Plan, *supra* note 166, at IV-I.

[168] *See id*. at I-2, IV-6.

[169] CAL. DEP'T OF WATER RES., THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW 26 (1978), *available at* http://www.water.ca.gov/waterconditions/docs/9_drought-1976-77.pdf.

[170] STATE WATER RES. CONTROL BD., DROUGHT 77: DRY YEAR PROGRAM 19 (1978) [hereinafter 1978 DRY YEAR PROGRAM REPORT].

[171] 1977 Cal. Regulatory Notice Reg. 54.2–54.2.1 (Revision Record No. 24, June 11, 1977); *see also* 1978 DRY YEAR PROGRAM REPORT, *supra* note 170, at iv, 19.

[172] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 169, at 26.

[173] 1978 Bay-Delta Plan, *supra* note 166, at I-2; State Water Res. Control Bd., Water Right Decision 1485, Aug. 1978, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1485.pdf.

[174] *United States v. State Water Res. Control Board* (Racanelli), 182 Cal. App. 3d 82, 116–120 (1986); *see also* CAL. WATER CODE §§ 13000, 13241.

[175] 1991 Bay-Delta Plan, *supra* note 166, at ii–iii.

[176] *Id*. at iii.

[177] Daniel W. McGovern, U.S. EPA Regional Administrator, Letter to W. Don Maughan, Chairman, State Water Res. Control Bd., at 2, Sept. 3, 1991, *available at* https://www.epa.gov/sites/production/files/documents/epa-approval-disapproval-baydelta-wqcp-1991.pdf.

[178] *See* 1995 Bay-Delta Plan, *supra* note 166, at 5–6.

[179] *Id.* at 2.

[180] State Water Res. Control Bd., Water Right Decision 1641, Dec. 29, 1999, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1641_1999dec29.pdf; State Water Res. Control Bd., Phase II Update of the Bay-Delta Plan: Inflows to the Sacramento River and Delta and Tributaries, Delta Outflows, Cold Water Habitat and Interior Delta Flows 2 (Oct. 4, 2017) [hereinafter Phase II Fact Sheet], *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/201710_phaseII_factsheet.pdf.

[181] *State Water Res. Control Bd. Cases*, 136 Cal. App. 4th 674, 726–35 (2006).

[182] State Water Res. Control Bd., Notice of Preparation and of Scoping Meeting for Environmental Documentation for the Update and Implementation of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: Southern Delta Salinity and San Joaquin River Flows at 7, Feb. 13, 2009, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/environmental_review/docs/nop2009feb13.pdf.

[183] 2006 Bay-Delta Plan, *supra* note 166, at 5–7.

[184] Notice of Preparation and of Scoping Meeting, *supra* note 182, at 7.

[185] STATE WATER RES. CONTROL BD., RECIRCULATED DRAFT SUBSTITUTE ENVIRONMENTAL DOCUMENT IN SUPPORT OF POTENTIAL CHANGES TO THE WATER QUALITY CONTROL PLAN FOR THE SAN FRANCISCO BAY–SACRAMENTO SAN JOAQUIN DELTA ESTUARY: SAN JOAQUIN RIVER FLOWS AND SOUTHERN DELTA WATER QUALITY ES-1 (2016), *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/2016_sed/docs/00_es.pdf; *see also* Summary of Proposed Updates to the Bay-Delta Water Quality Control Plan, *supra* note 61, at 3.

[186] Summary of Proposed Updates to the Bay-Delta Water Quality Control Plan, *supra* note 61, at 3–4.

[187] *See, e.g.*, Chuck Winn & Katherine Miller, *State's Plan for River Flows Spells Disaster for San Joaquin Region*, MODESTO BEE, Apr. 4, 2017, *available at* http://www.modbee.com/opinion/opn-columns-blogs/community-columns/article139157638.html; Elizabeth Stevens, *Stakeholders Make Arguments on Water Flow Issue*, CENTRAL VALLEY BUSINESS J., Jan. 4, 2017, *available at* https://cvbj.biz/2017/01/04/water-flow-hearings/ ("Hundreds of people turned out in Stockton, Modesto, Merced and Sacramento for public hearings with the State Water Quality Board in December and January to speak out on plans to increase water flows in three of the region's rivers. Most, but not all, argued the state's plan would deny too much water to agriculture and cities in the Central Valley.").

[188] RECIRCULATED DRAFT SUBSTITUTE ENVIRONMENTAL DOCUMENT, *supra* note 185, at ES-1 (2016).

[189] *See San Francisco Bay/Sacramento – San Joaquin Delta Estuary (Bay-Delta) Watershed Efforts*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/ (last updated Dec. 15, 2017).

[190] Phase II Update of the Bay-Delta Plan: Delta Outflows, Sacramento River and Delta Tributary Inflows, Cold Water Habitat and Interior Delta Flows, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/comp_review.shtml (last updated Nov. 17, 2017).

[191] *See* STate Water Res. Control Bd., Phase II Update of the Bay-Delta Plan: Inflows to the Sacramento River and Delta and Tributaries, Delta Outflows, Cold Water Habitat and Interior Delta Flow, at 2 (updated Oct. 4, 2017), https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/201710_phaseII_factsheet.pdf.

[192] *See Water Board's Structure*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/about_us/water_boards_structure/ (last updated July 5, 2012).

[193] *See About Us – Overview*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/aboutus.cfm (last modified July, 19, 2016).

[194] *See id.; see also State Water Project*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/state_water_project_home.cfm (last modified Oct. 23, 2012); *Data*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/data_home.cfm (last modified Oct. 23, 2012); *California Water Plan*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/waterplan/ (last modified April 19, 2017).

[195] *See Watermaster Services*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/watermaster/ (last modified July 7, 2015); *see also* CAL. WATER CODE § 4000–4407.

[196] *See* CAL. WATER CODE §§ 10733–10733.8, 10735–10736.6.

[197] *See Water and Watershed Conservation*, CAL. DEP'T OF FISH & WILDLIFE, https://www.wildlife.ca.gov/Conservation/Watersheds (last visited Apr. 23, 2017); *Water Rights*, CAL. DEP'T OF FISH & WILDLIFE, https://www.wildlife.ca.gov/Conservation/Watersheds/Water-Rights (last visited Apr. 23, 2017); *Instream Flow Program*, CAL. DEP'T OF FISH & WILDLIFE, https://www.wildlife.ca.gov/Conservation/Watersheds/Instream-Flow ((last visited Apr. 23, 2017); *Water Quality*, CAL. DEP'T OF FISH & WILDLIFE, https://www.wildlife.ca.gov/Conservation/Watersheds/Water-Quality (last visited Apr. 23, 2017).

[198] *See* CAL. FISH & GAME CODE § 1602; *Lake and Streambed Alteration Program*, CAL. DEP'T OF FISH & WILDLIFE, https://www.wildlife.ca.gov/Conservation/LSA (last visited Apr. 23, 2017).

[199] *About the Central Valley Project*, U.S. BUREAU RECLAMATION, https://www.usbr.gov/mp/cvp/about-cvp.html (last updated Apr. 18, 2017).

[200] *See National Pollutant Discharge Elimination System (NPDES)*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/water_issues/programs/npdes/ (last updated April 6, 2017); *NPDES State Program Information*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/npdes/npdes-state-program-information (last updated Feb. 6, 2017); *see also* 33 U.S.C. § 1342(b) (regarding delegation); 40 C.F.R. Part 123 (regarding state program requirements).

[201] *See Primary Enforcement Responsibility for Public Water Systems*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/dwreginfo/primacy-enforcement-responsibility-public-water-systems (last updated Nov. 2, 2016); 33 U.S.C. §§ 300g-2, 300h–h-8(4), 1413; 40 C.F.R. Part 142 (regarding state primacy requirements).

[202] *See* 33 U.S.C. § 1319(a); 42 U.S.C. § 300g-3; *NPDES Program Management and Oversight*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/npdes/npdes-program-management-and-oversight (last updated Dec. 16, 2016).

[203] *See* 50 C.F.R. § 401.1.

[204] *See* 16 U.S.C. §§ 1535–1536, 1539.

[205] *See The Refuge Water Supply 3406 (b)(3) and Conveyance 'Wheeling' 3406 (d)(1)(2)&(5) Programs*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/cno/fisheries/cvpia/RefugeWaterSupply1.cfm (last updated Dec. 19, 2012).

[206] *See About Us*, U.S. GEOLOGICAL SURVEY, https://www.usgs.gov/about/about-us (last visited Nov. 11, 2017); *Mission Areas: Overview*, U.S. GEOLOGICAL SURVEY, https://www.usgs.gov/science/mission-areas (last visited Nov. 11, 2017).

[207] *See* U.S. Geological Survey, USGS Science at Work in the San Francisco Bay and Sacramento-San Joaquin Delta Estuary, Fact Sheet 2013-3037 (2013), *available at* https://pubs.usgs.gov/fs/2013/3037/pdf/fs2013-3037.pdf.

[208] *See id*.

APPENDIX C: Overview of the Board's Responses During Specific Droughts

C.1 The 1976–1977 Drought

C.1.1 Overview

The 1976–1977 drought was the briefest, but also one of the most severe we analyzed. It had record low precipitation for any two-year period since 1896, and 1977 experienced record low runoff, had very low snowpack, and record low surface water storage (37% of average in major reservoirs on October 1, 1977).[1] Diminished availability of surface water led to heavy reliance on groundwater, lowering groundwater levels in many areas.[2] On the other hand, it was cooler than the other three droughts and California's population was considerably smaller (Section 2.2.3). Many environmental laws were just a few years old at the time the drought started, no Delta fish species had yet been listed as threatened or endangered, and water rights and water quality were just beginning to be integrated (Section 2.2.3, Appendix A.2.3).

C.1.1.1 Direction from Political Leadership

Governor Jerry Brown announced a drought emergency program on the final day of 1976, including (1) activation of a drought information center, (2) development of drought contingency plans by local water agencies, (3) preparation and distribution of water conservation guidelines, (4) encouragement of water exchanges, (5) providing loans and equipment for emergency water supplies, (6) extension of federal disaster relief, (7) establishment of a commission to review and recommend changes in California water rights law,[3] and (8) holding a special hearing on water quality in the Delta.[4] To coordinate drought efforts and communication, in March 1977, the governor established a Drought Emergency Task Force made up of representatives from various state and federal agencies and some private entities and headed by the Commander of the California National Guard.[5]

The state Legislature passed a number of drought-related bills that were signed into law. Among other things, these amended the definition of "emergency" in the California Emergency Services Act to include drought, prohibited public agencies from irrigating "greenbelt areas" with potable water when recycled water was available, provided emergency loans, and authorized the adoption of conservation plans by water retailers.[6]

Congress also passed several laws to assist drought response and drought relief in California and other affected states through grants, loans, and other actions.[7] One of these laws, the Emergency Drought Act of 1977, established a federal drought water bank.[8]

C.1.1.2 Drought Impacts

Many water agencies, lulled by a perception that water storage and conveyance infrastructure made relatively ample water accessible to most parts of the state, were not prepared for the impacts of such a severe drought.[9]

Delta water quality, especially salinity and its repercussions for municipal and agricultural use, was a major concern. Working with already depleted reservoirs, the state and federal projects were unable to both meet applicable water quality requirements and maintain carryover storage in case the drought continued.[10] On February 8, 1977, the Board adopted an interim water

quality control plan for the Delta that relaxed water quality standards to allow the projects to release less water from storage (Appendix B.3.3). When hydrologic conditions turned out to be worse than projected, the Board held an emergency hearing and adopted an emergency regulation that "temporarily eliminat[ed] most water quality standards and limit[ed] SWP exports to unstored water."[11] At the time, USBR refused to accept any responsibility for water quality standards in the Delta, leaving it to DWR.[12] DWR mitigated negative water quality consequences in the Delta in a number of ways[13]: It built physical salinity barriers in Rock Slough and Indian Slough (to improve water quality at the Contra Costa Canal Intake for municipal water supply, with a connection to the Mokelumne Aqueduct and a new pump station on Middle River to bring CVP water from Middle River to Indian Slough), Old River (to protect water quality in the South Delta), and the San Joaquin River (to protect Southern Delta agriculture from locally poor water quality conditions), and in Dutch Slough (with the intent to provide additional protection from saltwater intrusion into the western Delta). To provide higher quality agricultural water to some users on Sherman Island, DWR constructed new diversion facilities, pumping fresher water from the central canal into Mayberry Slough at the southern end of the island. It also built facilities to provide better quality water to wildlife habitat in Suisun Marsh.

Contractual deliveries of water to state and federal water project customers were significantly reduced. In 1977, SWP's municipal users received 90% of their entitlements and agricultural users received 40%.[14] That year CVP Sacramento River Settlement and San Joaquin River Exchange contractors[15] received 75% of their contract entitlements, other agricultural users received 25%, and municipal and industrial users received 50%.[16]

In some cases, exchanges among SWP contractors and transfers within CVP's service area were used to redistribute the available water.[17] These included a complex set of exchanges through which DWR delivered part of Metropolitan Water District's entitlement to the severely water short Marin Municipal Water District by way of the South Bay Aqueduct, several intermediate steps, and finally through a pipeline quickly constructed across the Richmond-San Rafael Bridge.[18] Additionally, under the federal Emergency Drought Act of 1977, the USBR purchased water from non-CVP users (including some from the SWP) within the CVP's service area to make more water available for its contractors through its drought water bank.[19]

Urban water conservation was a major theme of the drought. Many municipalities and special districts eventually introduced mandatory water conservation or rationing programs, including the City of San Francisco, East Bay Municipal Utility District, the City of Los Angeles, several member agencies or sub-agencies of Metropolitan Water District, many cities in the Contra Costa Water District service area, most communities in the Sonoma County Water Agency service area, the City of Santa Cruz, communities served by the Amador canal in the Central Sierra foothills, and communities in Butte County.[20]

Agriculture experienced significant drought impacts. In 1977, approximately 125,000 acres of irrigated land was reportedly idled, field crop producers suffered about $112 million in losses, fruit and nut producers suffered about $40 million in losses, and poor range and pasture conditions were estimated to have caused more than $400 million in livestock losses.[21]

The drought also had negative impacts on fish and wildlife. Fish spawning and migration were impaired by low flows and warmer water temperatures, higher salinity in Suisun Marsh and

San Francisco Bay reduced the habitat available for freshwater fish, and the quality and quantity of forage for waterbirds and other wildlife decreased.[22]

C.1.1.3 Summary of the Board's Drought Response Actions

Addressing Urgent Water Right Requests — The Board addressed at least 5 petitions for temporary water rights and at least 4 requests for temporary changes in water right terms and conditions, including regarding the state and federal water projects' obligations to meet water Delta water quality standards. It also addressed 2 transfer proposals.

Providing Oversight of Existing Diversions — The Board actively engaged in significant water rights oversight for the first time. Concerned that surface water shortages might lead farmers to "inadvertently interfere" with more senior water rights if they did not receive warning of water shortages, the Board established a "Dry Year Program" in its Division of Water Rights in early 1977.[23] The Board's goals included identifying areas experiencing severe drought impacts, providing water conservation information to water users there, ensuring that water rights were exercised appropriately, and taking actions against those violating the conditions of their permits or licenses, making illegal diversions, and those wasting or unreasonably using surface water.[24] It focused its efforts on irrigation diversions in central and northern California on the basis that agriculture was then the state's "No. 1 industry" and accounted for the largest diversions of surface water.[25] The Board sent more than 3,800 notices of potential water shortage and more than 4,800 notices of water unavailability to surface water diverters in 1977.

Providing Oversight of Water Use by End Users — The Board engaged in several conservation-related activities, including issuing irrigation conservation guidelines and adopting a reclaimed water policy. It also made at least one individual determination that a proposed water use would constitute a waste and unreasonable use of water.

Cross-Cutting Strategies — The Board adopted two drought-related emergency regulations. It collected new data about water use during the drought and made recommendations for improving decision-related information for future droughts. Additionally, it used a variety of methods to track compliance with notices of water unavailability and to identify unauthorized diversions and instances of waste or unreasonable use of water. Finally, it pursued enforcement actions for about 30 violations.

C.1.1.4 Drought Retrospective by the Board

In 1978, the Board prepared a 29-page report with more than 180 pages of appendices that summarized the goals of its "Dry Year Program" and actions taken under the program, evaluated how well the program worked, and made recommendations for future activities.[26] The program is described in some detail. For example, it explained the organization of program teams that focused on different aspects of administration, oversight, and enforcement. It included data about how many curtailment-related notices were sent to different types of diverters in different parts of the state. It described how program personnel responded to complaints and identified illegal diversions, and included data on site visits, cases recommended for referred to the Attorney General, and cases dealt with in other ways. It described how farmers, DWR, and the USBR responded to Board activities and estimated how much the program had cost.

One of the primary recommendations of the report was that more planning and preparation were needed to improve drought response (as well as non-drought water rights administration and oversight). It stated:

> Special efforts should be made by the staff to plan and standardize methodology and procedures to better administer water rights during the normal year and future droughts. The staff should have lead time to plan for the worst on the assumption that the dry conditions of 1976–77 will continue for another year. Even if this assumption is not true, almost every year has several months of deficient flow in many streams. . . . Consequently, the operation of a program similar to this year's Dry Year Program should continue in order to properly administer water rights priorities as needed year after year.[27]

C.1.2 New Water Rights

In 1976, the Board approved at least one application for a temporary water right permit.[28] In 1977, the Board held expedited hearings on drought-related temporary water rights permits,[29] renewed the temporary permit granted in 1976, approved at least two additional temporary permits, and denied at least one (on the basis that there was no unappropriated water available).[30]

C.1.3 Temporary Water Right Changes

During the 1976–1977 drought, the Board addressed at least four TUCPs (or TUCP-like requests).

City of Santa Cruz — In March 1977, the Board approved the City of Santa Cruz's request to temporarily reduce "minimum bypass flows [required] for preservation of fish and wildlife" on the San Lorenzo River to avoid "operational deficiencies."[31] However, the following month, the Board denied the City's request to temporarily "modify a license condition requiring release of water from storage for preservation and maintenance of fishing and recreational waters" on Newell Creek, a tributary to the San Lorenzo River, finding that the risk of harm to trout, salmon, and steelhead fisheries was not justified.[32]

DWR / Marin Municipal Water District — In April 1977, the Board concluded that DWR's request to add a new temporary point of rediversion on Middle River for water originally diverted at Oroville Dam to allow "emergency delivery of 11,000 af of [SWP] water to the Marin Municipal Water District" using a "temporary pipeline across the Richmond-San Rafael Bridge" for a single season was not a substantial change requiring further Board approval.[33] (*See also* Section C.1.1.2, above).

Humboldt Bay Municipal Water District — In October 1977, the Board approved reduced minimum flow requirements for Mad River that the Humboldt Bay Municipal Water District had negotiated with CDFW and two companies (served by the District) which operated pulp mills.[34]

SWP and CVP — Managing Delta salinity during the drought was challenging. One of the Board's 1977 emergency regulations essentially functioned as a temporary urgency change for the state and federal projects and led to development and adoption of the 1978 Bay-Delta Plan (Appendix B.3.3). Although it followed several earlier water quality control plans and water right decisions, the Plan marked the first time "the Board's water quality and water right

authorities . . . [were] so closely integrated" for the Delta.[35] Hearings for the Plan took place in the midst of the drought, and the plan itself referenced two related actions taken in attempts to mitigate drought impacts on uses of Delta water: an interim water quality control plan the Board adopted in February 1977 and the Board's June 1977 emergency regulation,[36] adopted when the interim plan proved to be inadequate, and the state and federal projects were struggling to manage Delta salinity.[37]

The emergency regulation substantially relaxed Delta water quality objectives[38] by temporarily suspending whole "provisions of existing water rights entitlements and water quality control plans" to maintain enough water in Lake Oroville to serve "emergency municipal, domestic and other essential uses including protection against massive intrusion of seawater into the . . . Delta . . . should 1978 be a low runoff year."[39] DWR constructed multiple temporary physical salinity barriers within the Delta to try to limit the extent of salinity intrusion and mitigate the relaxation of water quality standards for some users.[40] The emergency regulation also severely limited Delta exports. It was readopted in mid-December 1977 and then repealed on February 9, 1978, after a wet start to the 1978 calendar year.

C.1.4 Short-Term Water Transfers

Most transfers during the 1976–1977 drought were not deemed to require Board approval, as they were portrayed as involving only exchanges between parties within the SWP or transfers between parties within the CVP's service area.[41] These included transfers facilitated by a federal drought water bank authorized by Congress and run by the USBR.[42] However, the Board did become involved in two transfer proposals.

City of Roseville — First, the Board sued the City of Roseville, a CVP contractor, obtaining a temporary restraining order to prevent the City from going through with an August 1977 agreement to sell treated wastewater effluent to several water users along Dry Creek.[43] Since 1925, the City had discharged its effluent into Dry Creek, and 32 water users downstream of the outfall had acquired rights to appropriate the return flows.[44] The Board argued that the City had no right to the water, and, therefore, no right to sell it. The agreement was eventually terminated.[45]

Anderson Farms — Second, the Board denied a transfer proposal which purported to free up surface water in Northern California based on groundwater substitution to make water indirectly available to an SWP-dependent Southern California irrigation district using the SWP as an intermediary.[46] The proposed seller, Anderson Farms Company, claimed both riparian and pre-1914 appropriative rights to a surface water source in Yolo County known as the Toe Drain, which received water from the Delta as a result of tidal action.[47] The Board explained that "[e]ven though the proposal involves groundwater over which the Board has limited jurisdiction, the referral and complaints have collectively raised . . . three related issues over which the Board has jurisdiction."[48] The Board found that the proposed transfer "would result in an export of water from the Delta" in violation of a recently adopted emergency regulation (see Appendix B.3.3), did "not appear to be in the public interest," and "could result in an unreasonable method of diversion" that negatively impacted both the quality and quantity of water available under others' surface water and groundwater rights.[49]

C.1.5 Analyzing Water Supply, Demand, and Availability in Particular Watersheds

During the 1976–1977 drought, the Board performed curtailment analyses (water availability analyses aimed at determining whether water supply was available to meet demand) for different priority classes of water rights in major watersheds.

The Board had become "concerned that water users would inadvertently interfere with the water rights of others unless forewarned of the extent of availability of water to them."[50] Therefore, in 1977, it consulted with DWR to identify "critical streams" and drought impacts around the state, compiling lists of "significant irrigation appropriative diverters"—agricultural appropriators with permits or licenses to divert at least 3 cubic feet per second in the Sacramento and San Joaquin watersheds or at least 0.5 cubic feet per second in other basins.[51] Because DWRs runoff forecasts suggested that "the available supply would not meet the irrigation demands of riparian and appropriative water users in the [Central Valley]," the Board focused much of its effort there in an attempt to ensure that water would be used "in accordance with California water rights laws, and to conserve and extend available supplies to mitigate drought impacts."[52] It analyzed the Sacramento and San Joaquin River Basins and the Delta "as one continuous hydrologic system for analysis of available water supplies to satisfy water demands under different levels of water rights priorities."[53]

The Board estimated monthly supply, demand, and availability for riparians, pre-1914 appropriative users, and post-1914 appropriative users in certain watersheds as follows:

Monthly water availability for riparian rights[54]

- Supply: The Board estimated natural inflows for each month from DWR's runoff forecasts for the Sacramento and San Joaquin Basins and, for Sacramento River tributaries without forecasts, from 1976 data from streamflow gages. It added estimated natural accretions from groundwater and subtracted estimated return flows (not available to riparians).

- Demand: The Board used riparian demand information from existing studies, where available, estimating monthly water demands for other areas based on riparian acreage computed from county assessors' maps using a set of assumptions about the amount of irrigated land, monthly variations in demand, the effects of conservation efforts, and other factors. It assumed that other Delta demands—like riparian vegetation, evaporation from the surface of the water, and the state and federal projects' Delta outflow index—would be "satisfied co-equally" with riparian demands.

- Availability: Comparison of monthly water supply and monthly water demand helped the Board identify "the approximate dates when the riparian diverters had to take a deficiency or completely go without water supplies." The Board sent notices to riparians to let them know "the approximate percentage of availability" relative to full supply, for May, June, July, and August of 1977.

Monthly water availability for pre-1914 appropriative rights

- Supply: The Board estimated the supply available to pre-1914 appropriators as "the residual natural supply after riparian demands are satisfied, plus the return flow from use of ground and project (stored or imported) water in the basin."

- Demand: The Board relied primarily on Statements of Water Diversion and Use submitted by pre-1914 appropriators to estimate their monthly demands. (Note that these were likely very incomplete, as there was no penalty for failure to file until decades later.)

- Availability: Comparison of monthly water supply and monthly water demand identified "months when the diverters with pre-1914 rights had to take a deficiency or completely go without water supplies." The Board sent notices to pre-1914 appropriators, estimating "the impact of the drought on their share of the available water supplies in relation to a normal year."

Monthly water availability for post-1914 appropriative rights

- Supply: The water supply available for post-1914 appropriators was the residual supply left after pre-1914 availability was taken into account.

- Demand: The Board relied on the permits and licenses in its files to estimate the monthly demands of post-1914 appropriators.

- Availability: Again, the Board compared monthly supply and demand, and sent notices to post-1914 appropriators estimating "the impact of the drought on their share of available supplies during a normal year."

C.1.6 Providing Curtailment-Related Information and Curtailing Water Diversions

C.1.6.1 Notices of Potential Water Shortage

During the 1976–1977 drought, the Board notified several groups of diverters, or potential diverters, of the possibility of a water shortage later in the year. On February 11, 1977, 941 significant diverters in the Central Coast, North Coast, San Francisco Bay, Sacramento, San Joaquin, and North and South Lahontan Basins were sent letters explaining that hydrological data indicated reduced runoff (likely 35 to 40 percent of average).[55] A week later, the Board sent "water conservation notices to 2,849 riparian landowners in Sonoma County possibly diverting surface flow and/or underflow of the Russian River" with water conservation guidelines.[56] In late March, the Board sent notices cautioning 52 significant post-1914 diverters in the Colusa Basin Drain about potential inadequate supply.[57]

C.1.6.2 Notices of Water Unavailability (Curtailment Notices)

Beginning in late March, the Board sent notices of water unavailability to different groups of water rights holders and claimants in the Sacramento and San Joaquin River watersheds, including a large number of riparian diverters (Table C-1).

Table C-1: **Notices of Water Unavailability Sent to Diverters During the 1976–1977 Drought**[58]
Notices sent to pre-1914 appropriative or riparian diverters are highlighted in blue.

Notice Sent	Watershed	Applicability	Curtailment Start	Forecast	# Rights Affected
3/29/77	Sacramento River	Post-1914 appropriators in Basin Upstream of I Street Bridge in Sac. diverting > 3.0 cfs and having no contracts with DWR or USBR	5/1/77 (post-1927), 5/15/77 (pre-1927)	No supply available	259
3/29/77	Sacramento River	Diverters in Colusa Basin Drainage with no DWR or USBR contracts	–	Cautioned regarding inadequate supply	52
4/18/77	San Joaquin	36 post-1914 appropriators in San	4/18/77	No supply available	36

	River	Joaquin Basin on Merced, Tuolumne, San Joaquin, and Calaveras Rivers		throughout the season	
4/18/77	San Joaquin River	27 post-1914 appropriators in San Joaquin Basin on Mokelumne and Cosumnes Rivers	5/20/77	No supply available	27
4/18/77	San Joaquin River	7 post-1914 appropriators in San Joaquin Basin on Calaveras River	6/7/77	No supply available	7
4/18/77	San Joaquin River	1 post-1914 appropriator in San Joaquin Basin on Mokelumne River	6/15/77	No supply available	1
4/18/77	San Joaquin River	14 post-1914 appropriator in San Joaquin Basin on San Joaquin, Merced, and Mokelumne Rivers	7/1/77	No supply available	14
4/18/77	San Joaquin River	18 post-1914 appropriators in San Joaquin Basin on Stanislaus River	8/1/77	No supply available	18
4/22/77	Sacramento River	Riparian diversions from Sacramento River above I Street Bridge and lower reaches of main tributaries not having contracts with USBR or agreements with DWR *(Sacramento River = 895, Yuba River = 83, Feather River = 15)*	6/1/77	Shortage *("commencing about June 1, only about 50 % of a full supply of water would be available for irrigation through August")*	993
5/18/77	Sacramento-San Joaquin Delta	Post-1914 appropriators in the Sacramento-San Joaquin Delta	5/1/77	No supply available	235
5/18/77	Sacramento-San Joaquin Delta	Pre-1914 appropriators *("Diverters of water under different levels of water rights (riparian, pre-1914, and post-1914 appropriators)"*)	6/1/77	No natural supply available	4
5/18/77	Sacramento-San Joaquin Delta channels	Riparian diverters from Sacramento-San Joaquin Delta channels	6/1/77	Shortage *("natural flow would only supply about 50 % of the riparian requirements for June through August")*	2,146
5/27/77	San Joaquin River	Diverters from San Joaquin River and its tributaries under riparian and pre-1914 appropriative water rights *(Merced = 3, Tuolumne = 1, Stanislaus = 3, San Joaquin = 6, Mokelumne = 17, Calaveras = 4, Cosumnes = 3)*	6/1/77	No natural supply available; have claim to return flow, if available	37
5/27/77	San Joaquin River	Riparian diverters from middle & lower San Joaquin River and its tributaries *(Merced = 163, Tuolumne = 172, Stanislaus = 187, San Joaquin = 107, Calaveras = 143, Mokelumne = 166, and Cosumnes = 122)*	6/1/77	Shortage *(natural flow supplying 0% of riparian demand in Calaveras and Cosumnes June through August and ~50% or less in others)*	1,029

C.1.6.3 Term 91 Curtailments

Because this drought occurred before the Board adopted Term 91 and applied it to permits and licenses, there were no Term 91 curtailments.[59]

C.1.7 Allowing Limited Health and Safety Exceptions to Curtailments

We found no information about health and safety exceptions to curtailments during this drought. However, the Board did use emergency regulations to prohibit "export of water from the Delta unless needed to meet emergency municipal, domestic or other essential uses."[60]

C.1.8 Considering Curtailment Alternatives

We found no information about the use of curtailment alternatives during this drought.

C.1.9 Encouraging or Mandating Conservation

The Board engaged in several conservation-related activities during the 1976–1977 drought.

Issued Irrigation Conservation Guidelines — With assistance from UC Davis, Board staff prepared a set of "guidelines for water conservation in irrigation," which "emphasized planting low water use crops; preventing water waste by controlling leaks, conveyance losses[,] and tail water runoff; and promoting . . . efficient on-farm water use."[61] The guidelines were included with water shortage notices sent to agricultural diverters during February 1977.[62] In its 1978 retrospective report, the Board reported that the guidelines "were very well received," leading many farmers to "either reduce[] their cropped area or change[] their cropping scheme . . . to low water use crops."[63]

Emergency Regulation for the Conservation and Protection of Water Within the Sacramento-San Joaquin Delta and Its Tributary Streams — In June 1977, the Board adopted a regulation that relaxed Delta water quality requirements and limited Delta exports with the goal of allowing more water to be held back in reservoir storage in the near term in case dry conditions continued in the 1978 water year. Appendix B.3.3 describes the regulation in more detail. The Board identified this regulation as conserving water for later use.

Proposed Regulations for the Prevention of Waste and Unreasonable Use — The Board considered, but did not end up adopting, regulations that included "guidelines for prevention of waste and unreasonable use of diverted water for urban beneficial uses and irrigation purposes."[64]

Adopted Reclaimed Water Policy — In early 1977, the Board adopted a resolution setting a policy of "encourag[ing], and consider[ing] or recommend[ing] for funding, water reclamation projects which . . . do not adversely impact vested water rights or unreasonably impair instream beneficial uses or place an unreasonable burden on present water supply systems" and meet certain other conditions.[65] These potentially included projects that would make beneficial use "of wastewaters that would otherwise be discharged to marine or brackish receiving waters or evaporation ponds," projects for which reclaimed water would "replace or supplement the use of fresh water or better quality water," or projects that would use reclaimed water "to preserve, restore, or enhance instream beneficial uses."[66]

C.1.10 Prohibiting Specific Wasteful Uses of Water

In March 1977, the Board found that filling an artificial lake, Lake Mission Viejo in Orange County, for private recreational purposes would constitute "a waste and an unreasonable use of water" that would violate Article X, § 2, of the California constitution.[67] After the Mission Viejo Company proposed to fill the lake with degraded groundwater, to provide water to two well owners expected to be affected by the pumping, and to compensate others potentially affected, the Board concluded that filling the lake would not be wasteful or unreasonable.[68]

C.1.11 Adopting Emergency Regulations Targeted to Address Urgent Needs

In 1977, the Board adopted two drought-related emergency regulations. The first, initially adopted in late January, expedited hearings on drought-related issues. The second, initially adopted in June, relaxed Delta water quality requirements and limited Delta exports with the goal of allowing more water to be held back in reservoir storage in the near term in case dry conditions continued in the 1978 water year. These emergency regulations are discussed in more detail in other parts of this report, identified in Table 3.

C.1.12 Improving Decision-Related Information

The Board took actions aimed at improving information during the 1976–1977 drought.

Information Collection — According to the Board's 1978 drought retrospective, with support from DWR, it produced and collected "voluminous data" during the 1976–1977 drought, including aerial survey data and crop maps, information from field inspections and complaint investigations, hydrologic routing study results, and water availability analyses.[69]

Recommendations for Improving Decision-Related Information — During the drought, the Board's Water Rights Division recognized that incomplete availability of Statements of Diversion and Use from riparians and pre-1914 appropriators was a problem for demand estimates, as was the fact that the information was in hardcopy form. In its 1978 drought retrospective report (see Section C.1.1.4), the Division made a series of recommendations for improving information for future drought decision making. For example, it urged that "water rights data must be converted to computer storage and retrieval techniques so that information . . . can be displayed in such a way as to have meaning to an effective monitoring and enforcement plan."[70] Other recommendations included "undertak[ing] special studies for water use trends, disposition of return flows, conservation methods, . . . [and] specific trouble areas."[71]

C.1.13 Tracking Water Right Compliance and Taking Enforcement Actions

According to its 1978 retrospective report, during the 1976–1977 drought, the Board used most of the compliance tracking techniques identified in Section 4.4.3 in some way.[72] Field investigations and aerial surveys were conducted to confirm compliance with curtailments and to identify potential waste and unreasonable use. The Board assigned additional staff to respond to an "unprecedented increase in water rights complaints" and investigated over 200, finding 30 that it deemed required enforcement action. In 24 of these cases, the violator subsequently complied with the Board's directives. The Board referred the remaining 6 cases to the Attorney General.

C.2 The 1987–1992 Drought

C.2.1 Overview

Although individual years during the 1987–1992 drought did not experience as significant a precipitation shortfall as the 1976–1977 and 2012–2016 droughts, its 6-year duration strained the state's storage systems, with carryover reaching dangerously low levels in many reservoirs. The population had grown significantly since the prior drought (Table 1).

C.2.1.1 Direction from Political Leadership

The 1987–1992 drought overlapped with the terms of two different governors: George Deukmejian, followed by Pete Wilson (beginning January 7, 1991). Shortly after Pete Wilson took office, he created a Drought Action Team and instructed DWR to establish a state drought water bank.[73]

In September 1988, SB 32 was signed into law. It directed DWR to develop recommendations for state drought response by January 1989 in case the drought continued.[74] Other legislation clarified provisions of the Water Code dealing with water transfers, exempted certain water leases of 5 years or less from requiring Board approval, declared that using potable water for certain purposes was a waste or unreasonable use of water when reclaimed water could be used cost effectively instead, and required metering of new connections, among other things.[75]

Amendments to the Urban Water Management Planning Act required the development of water shortage contingency plans.[76]

Toward the end of the drought, Congress passed the Central Valley Project Improvement Act (CVPIA), which reallocated 800,000 acre-feet per year of CVP water to fish and wildlife, required habitat and species restoration and enhancement efforts, and made other changes.[77] However, its requirements did not kick in until after the drought.

C.2.1.2 Drought Impacts

DWR built temporary rock barriers in several parts of the Delta. Barriers in Old River (near Tracy) and Middle River were meant to improve local conditions for irrigation, and a barrier at the head of Old River (near the San Joaquin River) was meant to aid salmon migration.[78]

Project deliveries varied over the course of the drought. From 1987–1989, SWP delivered full allocations to its contractors, but allocations were reduced for some contractors in 1990 (when agricultural contractors received 50%), and for all contractors in 1991 (when urban, agricultural, and agricultural water rights settlement contractors received 30%, 0%, and 50%, respectively) and 1992 (when urban, agricultural, and agricultural water rights contractors received 45%, 45%, and 50%, respectively).[79] CVP delivered full allocations in 1987 and 1988 and reduced allocations in 1989 (50–70% for municipal and industrial contractors, 50% for agricultural contractors, and 75% for water rights settlement contractors), 1990 (50–75% for municipal and industrial contractors, 50% for agricultural contractors, and 75% for water rights contractors), 1991 (25–50% for municipal and industrial contractors, 25% for agricultural contractors, and 75% for water rights contractors), and 1992 (75% for municipal and industrial contractors, 25% for agricultural contractors, and 75% for water rights contractors and wildlife refuges).[80]

Through the 1991 Drought Water Bank, 12 agencies bought water DWR had acquired through hundreds of purchase contracts.[81] DWR also ran a 1992 Drought Water Bank, in which 16 agencies (including CDFW) bought water acquired through 19 purchase contracts.[82]

As they had during the previous drought, many urban water suppliers introduced mandatory or voluntary conservation programs, primarily aimed at residential customers.[83] Urban areas with limited groundwater that relied on local surface water supply were hardest hit, like the Santa Barbara area which instituted mandatory conservation measures including a ban on watering lawns that lasted 14 months.[84]

Groundwater was used heavily during the drought, accounting for about 60% of water use and causing subsidence and degradation of groundwater quality in some areas, including via saltwater intrusion in some coastal zones.[85] Many private domestic wells, and some small rural community wells went dry.[86]

As mentioned above, SWP agricultural contractors received no allocation and CVP contractors received a 25% allocation in 1991. About 500,000 acres of agricultural land was idled.[87]

A number of environmental constraints applied to state and federal water project operations during this drought. They included Water Right Decision 1485, adopted just after the 1976–1977 drought to implement provisions of the 1978 Bay-Delta Plan (see Appendix B.3.3), and Water Righter Orders 90-5 and 91-01, which established temperature requirements for parts of the Sacramento River and the Trinity River.

Fish populations suffered during the drought. In response, as mentioned above, Congress passed the CVPIA. NOAA Fisheries issued biological opinions related to CVP operations for winter-run Chinook salmon in 1992 and 1993 and upgraded the fish to endangered in 1994.[88] The USFWS listed Delta smelt as threatened in 1993.

California forests experienced widespread bark beetle infestations, and in October 1991, a major wildfire occurred in the Oakland Hills at the urban /wildland interface, causing significant damage and loss of life.[89] This event spurred the 1993 Emergency Services Act, requiring the establishment a standardized emergency management system (SEMS) around the state.[90]

C.2.1.3 Summary of the Board's Drought Response Actions

Addressing Urgent Water Rights Requests — The Board addressed at least 19 petitions for temporary water rights and at least 11 requests for temporary changes in water right terms and conditions (most involving the CVP). It also addressed at least 10 transfer proposals.

Providing Oversight of Existing Diversions — The Board issued notices of potential water shortage and notices of water availability to some (possibly thousands of) diverters in the Central Valley during at least two years of this 6-year drought. However, it is unclear to what extent the Board engaged in drought water availability analysis to support these efforts.

Providing Oversight of Water Use by End Users — The Board determined that at least two instances of using potable water for landscape irrigation when reclaimed water was available constituted a waste and unreasonable use of water.

Cross-Cutting Strategies — The Board conducted hundreds of compliance inspections and pursued at least one ACL action, in addition to making waste and unreasonable use determinations in several cases (as described above) in response to complaints.

C.2.1.4 Drought Retrospective by the Board

We did not identify a public drought retrospective by the Board for this drought. However, others, including DWR, published drought updates and retrospectives.[91]

C.2.2 New Water Rights

During the 1987–1992 drought, the Board approved at least 18 drought-related temporary permits and denied at least one, again, on the basis that there was no unappropriated water available.[92]

C.2.3 Temporary Water Right Changes

During this drought, the Board approved at least 10 TUCPs, including 8 associated with the CVP.[93] The CVP-related TUCPs came during a time of flux for the Bay-Delta Plan (see Appendix B.3.3). It denied one TUCP.[94]

C.2.4 Short-Term Water Transfers

Between 1987 and 1992, the Board evaluated and approved at least 10 water transfers. These included significant transfers on the Feather and Yuba rivers.[95] From 1988 to 1990, the Board approved a series of transfers from the Yuba County Water Agency to DWR aimed at maintaining Delta outflow, so that DWR could store an equivalent amount of SWP water for later use.[96] The Board also approved a transfer from the USBR to the Kern National Wildlife Refuge 1989,[97] two transfers from DWR to Westlands Water District in 1989 and 1990,[98] a

transfer from Yuba County Water Agency to Tudor Mutual Water Company & the Feather Water District,[99] and a transfer from Yuba County Water Agency to four member agencies of the Napa County Flood Control and Water Conservation District.[100]

While many more transfers occurred during this time period, most were not submitted to the Board for approval.

Under urgency legislation meant to reduce diverters' concerns about participating,[101] DWR created a Drought Water Bank in 1991. It bought water from willing sellers to create a "pool" of water available for purchase by willing buyers for a set price.[102] Most of the water was freed up under contracts transferors made with DWR to fallow their land (328 contracts accounting for 51% of bank water) or to use groundwater instead of surface water (19 contracts accounting for 32% of bank water), but a few transferors (4 contracts accounting for 17% of bank water) sold previously stored water.[103] DWR purchased more than 820,000 acre-feet of water through the contracts, and eventually sold almost 390,000 acre-feet to 12 purchasers.[104]

There were several reasons for the Board's minimal involvement in Drought Water Bank Transfers. First, most transfers involved rights for which the Board lacks transfer approval powers: riparian and pre-1914 rights.[105] Although riparian rights cannot generally be transferred apart from the riparian land, riparian users signed contracts agreeing not to exercise their riparian rights so that more water stayed instream, reducing DWR's need to release stored water to meet Delta water quality requirements.[106] Second, DWR characterized most other transfers in a way that avoided the Board's jurisdiction over post-1914 rights.[107] Many transferors were Sacramento River settlement contractors who assert riparian or pre-1914 appropriative water right claims but now receive water deliveries under contracts with the USBR.[108] Transfers of CVP water that would change the point of diversion, place of use, or purpose of use identified in the USBR's permits would normally require Board approval.[109] However, DWR argued that transfers of settlement contract water were legally the same as transfers of pre-1914 appropriative rights, and therefore outside the Board's purview.[110] Additionally, DWR characterized transfers of surface water by permittees or licensees in Yolo and Solano counties that were based on groundwater substitution as groundwater transfers, concluding that they were consequently not subject to Board review.[111] Ultimately, the Board asserted jurisdiction over and reviewed transfers related to 2 of the 351 Drought Water Bank contracts.[112]

DWR also operated a Drought Water Bank in 1992, this time acting as a "true broker, matching supply to real demands," in order to avoid acquiring excess water.[113] DWR made a number of changes based on its experience with the 1991 bank.[114] The 1992 Drought Water Bank involved fewer participants (most of whom were agricultural entities) and less water: There were only 11 sellers, and the 16 buyers purchased just over 193,000 acre-feet.[115]

C.2.5 Analyzing Water Supply, Demand, and Availability in Particular Watersheds

Although we did not find specific information about the Board analyzing water availability, the fact that it apparently issued some curtailment-related notices (see next section) suggests some such analysis probably occurred.

C.2.6 Providing Curtailment-Related Information and Curtailing Water Diversions

C.2.6.1 Notices of Potential Water Shortage

April 1988 — According to a 1989 DWR report, in April 1988 the Board sent notices to more than 5,000 riparian diverters and more than 1,350 post-1914 diverters in the Sacramento and San Joaquin River watersheds, warning them that water shortages were likely.[116]

March and/or April 1990 — In a 1990 order dismissing an ACL complaint, the Board stated that, in April 1990, it had "notified water users within the Sacramento and San Joaquin watersheds that the estimated runoff for the current water year is less than 50% of normal and water shortages are expected to occur."[117] A 1991 DWR report stated that the Board sent notices of a similar description to about 11,000 water rights holders throughout the state in March 1990.[118]

Notices of potential water shortage may also have been sent in 1987, 1991, and/or 1992.[119]

C.2.6.2 Notices of Water Unavailability (Curtailment Notices)

1988 — According to a 1989 DWR report, the Board sent notices of curtailment to approximately 55 post-1914 diverters on the San Joaquin River prior to April 1988.[120] What these notices said, or to whom they were specifically addressed, is not clear.

1990 — Based on the Board's 1990 order (mentioned above) and a 1991 DWR report, in late June and/or early July 1990, the Board sent notices of water unavailability to some of those who received April 1990 notices of potential water shortage.[121] DWR's report suggests these notices were extensive, stating that "[a]pproximately 3,600 letters were sent to all appropriative water right holders in the Sacramento-San Joaquin watershed and Delta Channels with notification of curtailment of water use from July 1 through August 31"[122]

Notices of water unavailability may also have been sent in 1987, 1991, and/or 1992.[123]

C.2.6.3 Term 91 Curtailments

Term 91 curtailments were issued during the 1987–1992 drought.[124]

C.2.7 Allowing Limited Health and Safety Exceptions to Curtailments

We found no information about health and safety exceptions to curtailments during this drought.

C.2.8 Considering Curtailment Alternatives

We found no information about the use of curtailment alternatives during this drought.

C.2.9 Encouraging or Mandating Conservation

Although we found no information about the Board taking specific actions to encourage conservation and reuse or mandate conservation during this drought, we suspect it may have taken some.

C.2.10 Prohibiting Specific Wasteful Uses of Water

The Board made some waste and unreasonable use determinations during the 1987–1992 drought. Several hinged on the conclusion that using potable water for landscape irrigation when reclaimed water is available constitutes a waste and unreasonable use of water. For example, in a decision initially made in 1989 and amended in 1990, the Board decided that if the San Gabriel Valley Water Company "were to provide potable water for greenbelt irrigation

where suitable reclaimed water is determined to be available, as provided in [Water Code] Section 13550, that would constitute waste and unreasonable use."[125] The Board defined availability as "where the user's total cost for reclaimed water . . . is less than, or comparable to, the cost of potable water from the Company."[126] The Board made a similar determination regarding irrigation of the Montecito Country Club in the City of Santa Barbara.[127]

C.2.11 Adopting Emergency Regulations Targeted to Address Urgent Needs

We found no information about the adoption of drought-related emergency regulations during this drought.

C.2.12 Improving Decision-Related Information

Although we did not identify particular efforts associated with improving decision-related information during this drought, it is likely the Board did undertake some.

C.2.13 Tracking Water Right Compliance and Taking Enforcement Actions

According to DWR reports, the Board added enforcement staff during the 1987–1992 drought and conducted compliance inspections, including approximately 220 inspections from July through September 1990.[128]

It responded to complaints, determining that some water uses were wasteful and unreasonable (as described above in Section C.2.10).

It also pursued at least one ACL action when a diverter did not cease diversions upon receiving a notice of water unavailability.[129] The notice was mailed on July 2, 1990, and held with other mail at the post office until after the diverter returned from a trip, picking up the accumulated mail on July 9. The diverter testified that he shut down his pump the following morning, hours before Board staff visited the site while conducting a field investigation. The Board decided to dismiss its ACL complaint due to the minimal extent of the violation and the fact that the diverter stopped the violation before Board staff discovered it.

C.3 The 2007–2009 Drought

C.3.1 Overview

By many measures, the 2007–2009 drought was the least severe of the four we examined (Section 2.2.3). It was the 3-year period with the fourth least precipitation during the period of record. On the other hand, it was the second warmest of the four droughts we analyzed. The state's population had grown considerably since the 1987–1992 drought. Again, many water users shifted to groundwater to make up all or part of the surface water shortfall. Between April 2006 and March 2010, Central Valley groundwater storage is estimated to have decreased by about 19 million acre-feet.[130]

C.3.1.1 Direction from Political Leadership

Arnold Schwarzenegger was governor during the 2007–2009 drought. In June 2008, he issued an executive order directing DWR to take certain drought-related actions and to coordinate other actions with the Department of Public Health, the California Public Utilities Commission, and the Department of Food and Agriculture.[131] The Board was not named. He also proclaimed a drought-based state of emergency for the Central Valley Region, tasking DWR and the Board with expediting processing of transfer requests, directing DWR to change SWP operations to

enable increased deliveries to the San Joaquin Valley and to file TUCPs to facilitate transfers, and directed the Board to expedite processing and consideration of TUCPs to facilitate such transfers.[132] In February of 2009, Governor Schwarzenegger issued the first ever proclamation of statewide emergency due to water shortage.[133] Among other things, the proclamation directed DWR and the Board to expedite processing of transfer requests "and related efforts" by those unable to participate in the 2009 Drought Water Bank. Other directives for the Board included expediting processing and consideration of (1) DWR's request to consolidate the place of use and points of diversion for the SWP and CVP and (2) TUCPs by DWR to relax Delta water quality standards to preserve cold water in storage for later use for salmon and water supply. For the purposes of actions taken to respond to the drought emergency consistent with the proclamation, the governor suspended California Water Code § 13247 and directed the use of emergency exemptions to environmental review requirements under the CEQA.[134] Water Code § 13247 generally requires state entities to comply with approved/adopted water quality control plans when they carry out activities that could affect water quality. Subsequently, the governor mobilized emergency response related to social services programs, namely, food banks and unemployment assistance.[135]

C.3.1.2 Drought Impacts

Project deliveries varied over the course of the drought. SWP allocations were 60% in 2007, 35% in 2008, and 40% in 2009 (different allocations for urban and agricultural contractors were eliminated following the 1994 Monterey Agreement).[136] CVP allocations in 2007 were 100% for North of Delta contractors, wildlife refuges, and water right settlement and exchange contractors; 50% for South of Delta agricultural contractors, and 75% for South of Delta municipal and industrial contractors.[137] In 2008, wildlife refuges and water right settlement and exchange contractors received full allocations, while municipal and industrial contractors received 75% and agricultural contractors received 40%.[138] Finally, in 2009, wildlife refuges, water right settlement and exchange contractors, and some North of Delta municipal and industrial contractors received full allocations while other North of Delta municipal and industrial contractors received 75%, South of Delta municipal and industrial contractors received 60%, North of Delta agricultural contractors received 40%, and South of Delta agricultural contractors received 10%.[139]

Environmental protections affected water availability during the 2007–2009 drought. Between the 1987–1992 drought and this drought many fish species—Delta smelt, central coast Coho salmon, Central coast and Central Valley steelhead, Central Valley spring run Chinook salmon, green sturgeon, and longfin smelt—were listed for protection under the state or federal ESAs.[140] Biological Opinions for Delta Smelt (in 2008) and for spring run Chinook salmon, steelhead, and green sturgeon (in 2009), as well as court decisions in related litigation, limited Delta exports.[141] However, only about one quarter of the restrictions on Delta exports are estimated to have been due to these and other protections for species and water quality under state and federal law.[142] In fact, many environmental requirements were not met during the 2007–2009 drought, resulting in "increased salinity, reductions in flows for waterfowl and wildlife refuges, and catastrophic declines in many fisheries."[143]

C.3.1.3 Summary of the Board's Drought Response Actions

Addressing Urgent Water Rights Requests — The Board approved and renewed at least one petition for a temporary water right and addressed at least 15 requests for temporary changes in water right terms and conditions, including two regarding the state and federal water projects'

obligations to meet water Delta water quality standards. It also addressed at least 35 transfer proposals.

Providing Oversight of Existing Diversions — The Board issued notices of potential water shortage to diverters statewide in the final year of the drought. However, it is unclear to what extent the Board engaged in drought water availability analysis to support the notices.

Providing Oversight of Water Use by End Users — We found no information about the Board exercising oversight over water use by end users separate from its diversion oversight activities, although it may have done so.

Cross-Cutting Strategies — We found no information about the Board using cross-cutting strategies during this drought, although it may have done so.

C.3.1.4 Drought Retrospective by the Board

We did not identify a public drought retrospective by the Board for this drought. However, others, including DWR, published drought updates and retrospectives.[144]

C.3.2 New Water Rights

In 2009, the Board approved and renewed a drought-related temporary permit for San Bernardino Valley Municipal Water District and Western Municipal Water District of Riverside County.[145]

C.3.3 Temporary Water Right Changes

During this drought, the Board approved 14 TUCPs and denied 1.[146] One of the petitions the Board approved, with conditions, came from the Sonoma County Water Agency, which requested a reduction in instream flows in the Russian River downstream of Lake Mendocino.[147] Among the conditions for the change were that the Agency reduce its diversions from the Russian River by 25% over 2004 levels, prohibit its customers from watering commercial lawns unless certain requirements were met, and submit a plan for achieving 25% (in Sonoma County) or 50% (in Mendocino County) water conservation by agricultural and municipal users of Russian River water.[148]

Some of the TUCPs were associated with the CVP and/or SWP. The Board approved a temporary change that allowed the Yuba County Water Agency to conditionally carry out a long-term transfer of water using project facilities "when certain southern Delta Water quality objectives for agricultural beneficial uses are not being met."[149] It also temporarily expanded the place of use for certain permits and licenses held by DWR and the USBR to include to allow transfers and exchanges between the projects.[150] The Board denied the third, which would have relaxed Delta outflow objectives, based in part on changed hydrologic conditions which no longer supported an urgent need for the change.[151]

C.3.4 Short-Term Water Transfers

The Board was involved in more transfers during the 2007–2009 drought. It approved at least 35 transfers, including 13 from various parties to DWR's 2009 Drought Water Bank.[152] In May 2009, the Board approved a petition to consolidate the places of use for the SWP and the CVP to support inter-project exchanges and transfers.[153]

C.3.5 Analyzing Water Supply, Demand, and Availability in Particular Watersheds

Although we did not find specific information about the Board analyzing water availability, the fact that it issued some notices of potential curtailment (see next section) suggests some analysis may have occurred.

C.3.6 Providing Curtailment-Related Information and Curtailing Water Diversions

C.3.6.1 Notices of Potential Water Shortage

In February 2009, the Board sent a "Notice of Surface Water Supply" to diverters statewide.[154] The notice reminded diverters that "[w]hen there is insufficient water for all, water diversions must be curtailed in order of water right priority."

C.3.6.2 Notices of Water Unavailability (Curtailment Notices)

We found no information about the Board sending curtailment notices during this drought.

C.3.6.3 Term 91 Curtailments

Term 91 curtailments were issued during the 2007–2009 drought.[155]

C.3.7 Allowing Limited Health and Safety Exceptions to Curtailments

We found no information about health and safety exceptions to curtailments during this drought.

C.3.8 Considering Curtailment Alternatives

We found no information about the use of curtailment alternatives during this drought.

C.3.9 Encouraging or Mandating Conservation

Except for conditions in TUCP approvals (see above), we found no information about the Board taking specific actions to encourage conservation and reuse or mandate conservation during this drought, but we suspect it may have taken some.

C.3.10 Prohibiting Specific Wasteful Uses of Water

We found no information about the Board prohibiting specific wasteful uses of water during this drought, although it may have done so.

C.3.11 Adopting Emergency Regulations Targeted to Address Urgent Needs

We found no information about the adoption of drought-related emergency regulations during this drought.

C.3.12 Improving Decision-Related Information

Although we did not identify particular efforts on the part of the Board to improve decision-related information during this drought, it is likely the Board did undertake some.

As Section 4.4.2 explained, in 2009, the Legislature imposed a penalty for failure to file statements of diversion and use for riparian or pre-1914 rights, for the first time addressing a long-standing problem with lack of compliance.[156] However, new information was not received until the drought was over.

C.3.13 Tracking Water Right Compliance and Taking Enforcement Actions

Although we found no information regarding drought-related water right compliance tracking or formal enforcement[157] during this drought, it is likely the Board did undertake some.

C.4 The 2012–2016 Drought

C.4.1 Overview

By a number of measures, the 2012–2016 drought was the most severe of the four we analyzed. It combined record heat with record low precipitation for any three- or four-year period since 1896 at a time when the state's population was almost double that during the severe 1976–1977 drought (Table 1).

C.4.1.1 Direction from Political Leadership

Just as he was during the 1976–1977 drought, Jerry Brown was the governor during the 2012–2016 drought. In December 2013, he convened an interagency Drought Task Force.[158] On January 17, 2014, Governor Brown proclaimed a statewide state of emergency due to drought conditions.[159] In it, he suspended California Water Code § 13247 and CEQA for (1) DWR and Board actions taken to "immediately consider petitions requesting consolidation of the places of use of the [SWP and CVP]" to "streamline water transfers and exchanges between water users within the areas of these two major water projects" and (2) for Board actions taken to "consider modifying requirements for reservoir releases or diversion limitations, where existing requirements were established to implement a water quality control plan," to "enable water to be conserved upstream later in the year to protect cold water pools for salmon and steelhead, maintain water supply, and improve water quality."[160] "Absent suspension of section 13247, the State Water Board could not approve a change petition that modifies permits and licenses in a way that does not provide for full attainment of the water quality objectives in the Bay-Delta Plan, even during a drought emergency."[161]

Governor Brown followed the drought proclamation with an April 25, 2014, Executive Order that expanded the range of agency activities that could be taken under CEQA suspension and put a sunset date of December 31, 2014, on its own and the January proclamation's suspensions.[162] Among his directives to the Board were the following:

- ***Water transfers*** — "[I]mmediately and expeditiously process requests to move water to areas of need, including requests involving voluntary water transfers, forbearance agreements, water exchanges, or other means" with a 15-day comment period and "consider changes to water right permits to enable such voluntary movements of water."
- ***Urban Water Conservation*** — "[D]irect urban water suppliers that are not already implementing drought response plans to limit outdoor irrigation and other wasteful water practices such as those identified in this Executive Order" and "request by June 15 an update from urban water agencies on their actions to reduce water usage and the effectiveness of these efforts," "adopt[ing] emergency regulations as it deems necessary, pursuant to Water Code section 1058.5, to implement this directive."
- ***Recycled Water*** — "[A]dopt statewide general waste discharge requirements to facilitate the use of treated wastewater that meets standards set by the Department of Public Health, in order to reduce demand on potable water supplies."

- ***Waste and Unreasonable Use Prevention*** — "[A]dopt and implement emergency regulations pursuant to Water Code section 1058.5, as it deems necessary to prevent the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water, to promote water recycling or water conservation, and to require curtailment of diversions when water is not available under the diverter's priority of right."

A December 2014 executive order extended and expanded applicability of the CEQA and Water Code § 13247 suspensions.[163]

On April 1, 2015, Governor Brown extended his prior directives and, among other things, tasked the Board with the following[164]:

- ***Mandatory urban water conservation regulations*** — imposing restrictions to achieve a 25% statewide reduction in potable urban water use over 2013, considering "the relative per capita water usage of each water suppliers' service area" and requiring proportionally larger reductions from areas higher per capita use and "requir[ing] urban water suppliers to provide monthly information on water usage, conservation, and enforcement on a permanent basis";

- ***Water use by commercial, industrial, and institutional properties*** — imposing restrictions on "commercial, industrial, and institutional properties," consistent with the urban water use reductions. and to prohibit irrigation of turf in public street medians with potable water;

- ***Wasteful water uses*** — prohibiting certain wasteful uses of water, including irrigating turf on public street medians with potable water and "irrigation with potable water outside of newly constructed homes and buildings that is not delivered by drip or microspray systems";

- ***Pricing mechanisms*** — directing "urban water suppliers to develop rate structures and other pricing mechanisms, including but not limited to surcharges, fees, and penalties, to maximize water conservation consistent with statewide water restrictions" via emergency regulations;

- ***Reporting of diversion and use*** — requiring water right holders to report water diversion and use more frequently, "conduct[ing] inspections to determine whether illegal diversions or wasteful and unreasonable use of water are occurring, and bring[ing] enforcement actions against illegal diverters and those engaging in the wasteful and unreasonable use of water"; and

- ***Drought salinity barriers*** — "immediately consider[ing] any necessary regulatory approvals for the purpose of installation of the Emergency Drought Salinity Barriers."

In November 2015, the governor gave the Board more assignments, including "prioritiz[ing] temporary water right permits, water quality certifications," and other permits "to accelerate approvals for projects that enhance the ability of a local or state agency to capture high precipitation events this winter and spring for local storage or recharge, consistent with water right priorities and protections for fish and wildlife."[165]

In May 2016, the governor tasked the Board and other state agencies with helping California "transition to permanent, long-term improvements in water use" by developing "new water use targets as part of a permanent framework for urban water agencies," permanently requiring urban water suppliers to issue monthly reports on water usage, conservation, and enforcement, permanently prohibiting "practices that waste potable water," directing actions to minimize leaks in water systems, and directing "urban and agricultural water suppliers to accelerate their data collection, improve water system management, and prioritize capital projects to reduce water waste."[166]

Finally, in April 2017, Governor Brown lifted the drought emergency for all counties except Fresno, Kings, Tulare, and Tuolumne Counties, while directing the Board to, among other things, maintain the prohibitions on wasteful practices until it could adopt permanent restrictions and rescind the portions of the urban water conservation regulations that required water suppliers to meet mandatory conservation standards or a water supply stress test.[167]

Actions by the Legislature are described below and in Section 5 of the main report.

C.4.1.2 Drought Impacts

Project deliveries varied over the course of the drought, but included the lowest allocations ever given. SWP allocations were 65% in 2012, 35% in 2013, 5% in 2014, ~20% in 2015, and ~60% in 2016.[168] CVP allocations in 2012 were 100% for North of Delta contractors, wildlife refuges, and water right settlement and exchange contractors; 40% for South of Delta agricultural contractors, and 75% for South of Delta municipal and industrial contractors.[169] In 2013, wildlife refuges, water right settlement and exchange contractors, and North of Delta urban contractors received full allocations, while North of Delta agricultural contractors, American River municipal and industrial contractors, and Contra Costa received 75%, South of Delta urban contractors received 70%, and South of Delta agricultural contractors received 20%.[170] In 2014 and 2015, conditions were dire, with urban contractors receiving 50% (in 2014) and 25% (in 2015) allocations, wildlife refuges and water right settlement and exchange contractors receiving between 65 and 75% allocations, and agricultural contractors received no allocation at all (0%).[171] Finally, in 2016, North of Delta contractors received full allocations, while South of Delta allocations for agricultural contractors (5%) and urban contractors (55%) remained restricted.[172]

Other drought impacts are described below and in Section 5.

C.4.1.3 Summary of the Board's Drought Response Actions

Addressing Urgent Water Rights Requests — The Board addressed at least 17 petitions for temporary water rights and established programs to facilitate temporary permits for diverting water for groundwater recharge and to expedite the process for certain riparian water users to receive approval for installing an emergency storage tank for domestic use. It addressed at least 45 requests for temporary changes in water right terms and conditions, including an extensive series of TUCPs regarding the state and federal water projects' obligations to meet water Delta and Sacramento River water quality standards. It also addressed at least 51 transfer proposals.

Providing Oversight of Existing Diversions — The Board undertook extensive diversion oversight activities, including drought water availability analyses for a number of priority watersheds, issuing notices of potential water shortage statewide, and implementing curtailments to protect senior users of water by issuing notices of water unavailability to

thousands of diverters 2014, 2015, and 2016. It also issued curtailment orders under emergency regulations adopted to protect fish flows in three Sacramento River tributaries, allowing exceptions for diversions needed to support minimum health and safety uses and developing or approving voluntary agreements in lieu of curtailments in some cases.

Providing Oversight of Water Use by End Users — The Board adopted emergency regulations prohibiting certain wasteful uses of water, imposing mandatory conservation standards for urban water suppliers, and imposing enhanced conservation requirement in lieu of curtailments in the Russian River. It also helped prepare a plan for *Making Water Conservation a California Way of Life*, and adopted general waste discharge requirements to facilitate recycled water use.

Cross-Cutting Strategies — The Board adopted six sets of emergency regulations during the drought. These included regulations for informational orders the Board then used to improve information about diversions and relative water right priority. It also improved information about urban water use by requiring reporting as part of its mandatory conservation standards for urban water suppliers. While it did not benefit from the results during the 2012–2016 drought, the Board adopted emergency regulations for enhanced measurement and reporting of diversions under Senate Bill 88 that will greatly improve the timeliness and accuracy of future diversion data. Finally, the Board tracked compliance with its regulations, notices of water unavailability, and orders and undertook various enforcement actions.

C.4.1.4 Drought Retrospective by the Board

During fall 2014, to inform a report to the Board, water rights division staff solicited public feedback on how the Board might improve implementation and enforcement of the water rights system during the ongoing drought.[173] The Board received 38 comment letters (including one from some of the authors of this report).[174] The resulting 13-page report, released in early 2015 while the drought was still ongoing, examined the recommendations of the 1978 retrospective report, summarized the 2014 curtailment and complaint process, addressed data quality in the water rights database, and suggested near-term ways to expand and improve data and database capabilities.[175] This report contained some specifics about what the Board did during 2014, but it was much less extensive than the 1978 report and its accompanying appendix.

The report identified a number of unaddressed recommendations from the 1978 report as "still relevant," including the following:

1. To enable more timely enforcement actions, the Legislature could grant the Board "authority to issue cease and desist orders against illegal diverters while the public hearing process is underway."
2. To reduce under- and over-curtailments, the Legislature could require "more frequent reporting of water diversion and use by pre-1914 and riparian water right diverters."
3. The Board could improve the "methodology for determining water availability relative to water rights priority," developed for the 1976–1977 drought, and used as the basis for 2014 water availability analyses.
4. The Board could increase communication with diverters, especially about water shortage forecasting.

5. The Board/state could pursue new technologies, including satellite imagery and more telemetered data, to more effectively quantify consumptive use and prioritize resources for investigations and enforcement.[176]

The legislature has since acted on the second recommendation, and to some extent the fifth (see Section C.4.12). The Board also made significant gains in communication during the 2012–2016 drought, using its website and email to convey information and analysis to diverters and to the public more generally.

In the 2015 report, the Board noted that "[d]rought conditions stress the water right prioritization system and expose issues or problems that may otherwise have gone unnoticed or untested for years," and expressed that current water rights administration is less than ideal.[177] It suggested that an ideal, modernized system would include the following elements:

1. Adjudications or other actions which account for all rights, including riparian and pre-1914, and extinguishes prior unexercised rights for all streams,
2. Minimum in-stream flow requirements for all streams, and
3. Real-time management of flows and diversions that accurately tracks water availability and the need for curtailment based on the accounting of water rights, hydrology, and by ensuring that minimum in-stream flow levels are met.[178]

The Board is currently working on a post-drought retrospective that expands on this 2015 in-drought analysis.

C.4.2 New Water Rights

C.4.2.1 Temporary Permits

During the 2012–2016 drought, the Board approved a number of drought-related temporary water rights. In water years 2012 through 2016, the Board received 17 applications for temporary water right permits from 12 entities and individuals; 7 applications were cancelled and 10 were approved.[179] It denied at least two: one, in 2014, on the basis of water unavailability, reflected by curtailments in the Sacramento River watershed, and one, in 2016, on the basis that there was no urgent need.[180] Four of the applications were related to the Board's program to facilitate temporary permits for groundwater recharge, described below.

C.4.2.2 Drought Programs Related to New Water Rights

The Board established two drought programs related to new water rights.

Program: Temporary Permits for Groundwater Recharge — In 2016, the Board created a program to facilitate temporary permits for diverting water for groundwater recharge/storage and subsequent beneficial use.[181] The program significantly reduced filing fees and suspended CEQA requirements for temporary permits for groundwater recharge.[182] Through the end of water year 2016, the Board received four applications under the program. One was cancelled, while the Board approved three others, issuing temporary permits for groundwater recharge to Scott Valley Irrigation District in Siskiyou County (for up to 5,400 acre-feet, for infiltration into the existing unlined canal system and up to 3,475 acres of agricultural fields), Yolo County Flood Control and Water Conservation District (for up to 40,000 acre-feet, for infiltration into the existing system of largely unlined canals and up to 50,000 acres of agricultural fields), and

Eastside Water District in Stanislaus and Merced Counties (for up to 570 acre-feet, for infiltration in an existing flood control basin).[183]

Program: Emergency Tank Storage Registration — In March 2014, the Board announced an Emergency Tank Storage Registration Program in conjunction with the CDFW in the Department's Northern and Bay Delta Regions.[184] The program expedited the process (including by eliminating the requirement for CDFW to perform a site visit) for riparian water users on small coastal streams in these regions to get approval to install a storage tank for small domestic use to capture water during high flows during and after rain events.[185] The goal was to reduce diversions during drier parts of the year, when reduced flows mean the impacts of diversions on fish and wildlife would be most severe. The program was suspended on April 7, 2017, the date that Governor Brown terminated the Drought State of Emergency for the counties involved with the program.[186] Although new registrations can no longer receive the expedited process, those initiated under the program remain valid for five years (like other registrations) as long as registrants comply with standard conditions.[187]

C.4.3 Temporary Water Right Changes

Although TUCPs would generally be subject to CEQA, during the recent drought, the Board evaluated TUCPs that did not involve transfers[188] for at least 15 local agencies plus DWR and the USBR (for the SWP and CVP) under CEQA suspension or exemption[189]:

- Cambria Community Services District *(approved petition)*
- Camp Meeker Recreation and Park District *(approved petition)*
- City of Santa Cruz *(approved petition + 3 renewal petitions)*
- City of Thousand Oaks *(approved petition; renewal petition submitted)*
- El Dorado Irrigation District *(approved wastewater change petition + renewal petition (later revoked))*[190]
- Hidden Valley Lake Community Services District *(2 petitions submitted; outcome unclear)*
- June Lake Public Utility District *(approved petition + 2 renewal petitions)*
- Los Angeles Department of Water and Power *(approved 2 petitions)*
- Malacha Hydro Limited Partnership *(approved petition)*
- Mendocino County Russian River Flood Control and Water Conservation Improvement District *(approved petition)*
- Merced Irrigation District *(approved petition)*
- Montague Water Conservation District *(approved petition)*
- Sonoma County Water Agency *(approved 8 petitions)*
- SWP and CVP petitions *(approved 11 petitions)*
- Woodland-Davis Clean Water Agency *(approved 3 petitions)*
- Yuba County Water Agency *(approved 2 petitions)*

The SWP and CVP TUCPs, described in Table C-2 and Appendix D, were extensive. The Board received two types of change petitions from DWR and the USBR regarding the state and federal water projects (SWP and CVP, respectively). First, the agencies sought to consolidate the projects' place of use to streamline transfers between SWP and CVP contractors. Second, they requested relaxations of water quality standards within the Delta and the greater Sacramento-San Joaquin River Watershed. We focus on the latter here.

Since 1999, the Bay-Delta Plan (Appendix B.3.3) has been implemented through Decision 1641, which assigns DWR and the USBR "interim responsibility" for meeting Delta flow and salinity objectives to support in-Delta consumptive and environmental uses and to enable exports.[191] Starting in 1995, it was implemented through the Bay-Delta Accord, in which DWR, USBR, and other state and federal agencies implemented the agreed upon standards voluntarily. In addition to Delta flow and water quality requirements, the projects must operate their reservoirs, including the USBR's New Melones Dam on the Stanislaus River and Shasta Dam on the Sacramento River, to comply with water quality requirements—namely temperature and flow—to support protected fish and wildlife, especially migratory salmonids, in tributary rivers.[192]

Beginning in early 2014, DWR and the USBR sought, and the Board approved, at least 11 modifications of these requirements.[193] After the Board approved the initial TUCP, it was modified 8 times in 2014. A similar process played out in 2015, when there were 6 TUCP approvals or modifications.

The primary driver for the TUCPs was to reduce outflow requirements in the winter and spring to increase storage for later use. In 2014, the focus was on maintaining water in storage for salinity control in the Delta and to provide sufficient cold water for salmon in the rivers, in case the drought continued.[194] In 2015, the focus shifted towards more consumptive water supply benefits.[195] As the Board explained in its April 2015 order, different human and environmental needs informed its TUCP decision making, including the differing needs of in-Delta fish and wildlife and fisheries in tributary rivers:

> The impacts of the proposed changes on fish and wildlife in the Bay-Delta must be weighed against the impacts to all beneficial uses of water if the changes are not approved. California is in the midst of a significant, multi-year drought driven by the lack of rain and snowfall around the state. The January through March time period in particular is the driest on record. The drought is having devastating effects on communities, farmers, farm workers, the fishing industry, and the environment, and has caused substantial human suffering.
>
> In the face of this drought, the California Department of Fish and Wildlife (CDFW), NMFS, United States Fish and Wildlife Service (USFWS) (collectively fisheries agencies), and the State Water Board have coordinated with DWR and Reclamation to allow a number of adjustments to Endangered Species Act (ESA) and water right requirements in order to increase diversions from the Delta and conserve water in storage so that more water can be delivered to farms and communities. These adjustments have temporarily set aside a number of scientifically based, environmental protections developed as part of rigorous evidentiary proceedings and established in decisions that were ultimately upheld by the courts.
>
> Most of what was requested by the Petitioners in the January 23 Petition was approved in the February 3 and March 5 Orders, including a reduction of all fish and wildlife outflow requirements to the Bay-Delta in February and March, to allow more water to be exported and more water to be held in storage for future water deliveries. Similarly, this Order approves most of what was requested by the Petitioners for the April through June period. Assuming continued dry conditions, the changes approved in this order will significantly reduce flows in favor of improved water supplies and reservoir storage levels. The potential water supply and storage

> improvements from the changes approved by this Order and the February 3 and March 5 Orders total more than 1.2 million acre-feet (MAF) of water. In granting similar requests last year, more than 400 TAF of water was made available for other uses during the course of the water year.[196]

While the TUCPs allowed the projects to store substantial amounts of water for later use—including cold water critical for salmon smolt survival—there was, nonetheless, a significant failure to protect salmon. For example, in 2014, "95 percent of the winter-run Chinook salmon run [in the Sacramento River] experienced mortality due to elevated water temperatures, despite modeling that indicated that adequate flow and storage conditions would be provided to avoid such temperature impacts."[197] In 2015, as a condition of TUCP approval, the Board required the USBR to develop and implement a temperature management plan "to ensure . . . reasonable protection for winter-run Chinook salmon and other salmonids."[198] However, the temperature management plan "failed to achieve the intended results, and the 2015 winter-run Chinook salmon cohort experienced nearly complete mortality due in part to elevated temperatures for the second year in a row"—which the Board found particularly concerning "given that most winter-run Chinook salmon have a three-year lifecycle, leading to an increased risk of extinction if drought conditions continue."[199] The Board held public workshops that touched on or focused on this issue in 2014, 2015, and 2016 and required the USBR to update its plan multiple times, but these measures were not sufficient to avoid severe impacts to fisheries.

Table C-2: Summary of Drought-Related TUCP Decisions for the SWP and CVP, 2014–2016[200]

Date	Action
1/31/2014	Approved Jan. 29 TUCP to: • Allow reduced Delta outflow during February; • Require saved water storage for health and safety, ecosystem needs; • Require updates on flows, storage, deliveries; • Allow flexible operation of DCC Gates through May 20; • Limit Delta exports to health and safety needs.
2/7/2014	Revised Jan. 31 TUCP order to provide that D-1641 outflow and gate closure requirements are operative if precipitation events enable compliance, except that Project exports > 1,500 cfs would be limited to natural or abandoned flow that exceeded Decision 1641 minimum requirements.
2/28/2014	Revised Feb. 7 TUCP order to reduce Delta outflow requirements for Mar.
3/18/2014	Revised Feb. 28 TUCP order to allow increased exports while there are higher Delta inflows, including exports for other purposes if health and safety and other critical needs are met.
4/9/2014	Revised Mar. 18 TUCP order to extend outflow and export modifications into April.
4/11/2014	Revised Apr. 9 TUCP order to allow USBR to meet modified San Joaquin River flow requirements through June, as proposed in the Apr. 8 Drought Operations Plan.
4/18/2014	Revised Apr. 11 TUCP order to allow increased exports (the greater of 100% of 3-day average flow at Vernalis or 1,500 cfs) during the San Joaquin River pulse-flow period.
5/2/2014	Revised Apr. 18 TUCP order to: • Renew Jan. TUCP order through Jan. 27, 2015; • Extend modified Delta outflow requirement to May and July; • Reduce Sept. to Nov. 15 Sacramento River flow requirements; • Move Western Delta salinity compliance point until Aug. 15; • Add reporting deadlines; • Modify export limits.
9/24/2014	Modified May 2 TUCP order to: • Require earlier reporting of actual operations; • Ensure access to info. on real-time impacts to fish, etc.; • Require preparation of a drought contingency plan; • Require advanced planning for specific fishery needs.
10/7/2014	Revised Sept. 24 TUCP order to allow 31-day pulse flow period (800 cfs minimum average monthly flow) for San Joaquin River.

2/3/2015	Issued order largely approving the 1/23/2015 TUCP, but added export constraints to allow exports of 1,500 cfs when Delta outflows are below 7,100 cfs regardless of DCC Gate status and allows exports up to D-1641 limits when Delta outflows are above 7,100 cfs and the DCC gates are closed.
3/5/2015	Revised Feb. 3 TUCP order to provide more flexibility to store and move water in Feb. and Mar. It: • Reduced minimum daily delta outflow requirement to 4,000 cfs • Allowed exports of 1,500 cfs when outflow is 4,000 to 7,100 cfs • Allowed D-1641-level exports when outflow is > 7,100 if all flow is natural or abandoned + DCC Gates are closed • Allowed DCC Gates to be open in some circumstances • Reduced minimum San Joaquin River flow requirement at Vernalis to 500 cfs.
4/6/2015	Revised Mar. 5 TUCP order through June to: • Extend changes to Delta outflow and export requirements through June • Extend change to DCC Gate requirements through May 20. • Reduce San Joaquin River at Vernalis pulse-flow volume requirement to 710 cfs (period shifted earlier, to Mar. 25 through Apr. 25, by executive order) and require USBR to comply with pulse-flow requirement in Biological Opinion and Conference Opinion for Long-Term Operations. • Reduce the minimum San Joaquin River flow requirement at Vernalis following the pulse flow period to 300 cfs until May 31. • Move the compliance point (on the Sacramento River) for the Western Delta agricultural salinity requirement from Emmaton to Three Mile Slough from April through June. • Require USBR to develop and implement a plan for New Melones Reservoir operations that reasonably protects fish and wildlife in the Stanislaus River. • Require USBR to prepare and implement a Temperature Management Plan for the Sacramento River to prevent the high mortality that occurred in 2014.
5/29/2015	Suspended USBR's Sacramento River temperature management plan until further notice based on new information indicating that warmer than expected temperatures in Shasta Reservoir will likely make it impossible to meet the required temperature at Clear Creek throughout the temperature control season.
7/3/2015	Modified and renewed the Apr.6 TUCP order, approving May 21 TUCP request and requiring • USBR to reevaluate the Stanislaus River plan given the changed conditions. • Propose adjusted Folsom Reservoir operations "to ensure that critical water supplies are available for municipal and industrial use" upon request • USBR to coordinate with CVP refuge managers to assist with planning • DWR and USBR to perform monitoring "to understand and evaluate the effects of reduced Delta outflows in combination with" the drought barrier.[201]
12/15/2015	Adopted order granting in part and denying in part petitions for reconsideration of the Feb. 5 order. It • Found "decisions were appropriate when . . . made based on the information available at the time." • Extended July 3 TUCP order "to address actions needed for next year, if conditions continue to be dry" • Required "additional temperature management planning and related measures to respond to the issues raised in . . . petitions" for reconsideration of approval of the Sacramento River Temperature Management Plan for 2015.[202]

C.4.4 Short-Term Water Transfers

In his January 17, 2014, proclamation of a statewide drought emergency, the governor suspended Water Code § 13247 and CEQA for Board actions taken to "immediately consider petitions requesting consolidation of the places of use of the State Water Project and Federal Central Valley Project" to "streamline water transfers and exchanges between water users within the areas of these two major water projects."[203] On April 25, 2014, a subsequent Executive Order halved the comment period for transfer proposals to 15 days.[204] On April 29, 2014, the Board and DWR held a joint public listening session to solicit suggestions on temporary water transfer streamlining.[205]

Table C-3 shows the Board's decisions on short-term water transfer petitions during the recent drought. Curtailments limited the circumstances under which transfers were possible. The Board denied a number of petitions on the basis of curtailments, and several more were approved before the sellers' rights were then curtailed, rendering the transfer unavailable.

Table C-3: Board decisions on short-term water transfer petitions, 2012 to 2016[206]
Transfers that involved DWR and/or the USBR are shaded blue.
Requests that were denied outright or later curtailed are highlighted pink.

Date of Request	Description	Petitioners (watershed of origin)	Parties receiving transfer water	Decision
1/5/2012	100,000 ac-ft (expanding USBR's place of use to include part of SWP)	**USBR on behalf of Arvin-Edison Water Storage District** (San Joaquin River, American River, Old River, Sacramento River, Trinity River, Clear Creek, Rock Slough)	Metropolitan Water District of Southern California	Approved 4/2/2012
5/18/2012	52,320 ac-ft (consolidating place of use for SWP + CVP)	**DWR and USBR** (Trinity/Delta/San Joaquin River Watersheds)	**5 state and federal contractors:** Santa Clara Valley Water District, Oak Flat Water District, Del Puerto Water District, Kern County Water Agency, Kern Tulare Water District	Approved 7/6/2012
7/2/2012	10,000 ac-ft	**Merced Irrigation District** (Merced River Watershed)	Westlands Water District	Approved 10/24/2012
4/23/2013	20,000 ac-ft	**Placer County Water Agency** (Sacramento River Watershed)	Westlands Water District	Approved 6/27/2013
4/30/2013	1,730 ac-ft	**Pelger Mutual Water Company** (Sacramento River Watershed)	San Luis & Delta Mendota Water Authority	Approved 7/1/2013
5/1/2013	196,000 ac-ft (consolidating place of use for SWP + CVP)	**DWR and USBR** (Trinity/Delta/San Joaquin River Watersheds)	**10 state and federal contractors:** Santa Clara Valley Water District, Oak Flat Water District, Del Puerto Water District, Kern County Water Agency, Kern Tulare Water District, Westlands Water District, Castaic Lake Water Agency, San Luis Water District, Arvin Edison, Water Storage District, Metropolitan Water District of Southern California	Approved 7/1/2013
5/1/2013	3,520 ac-ft	**Tule Basin Farms (**Sutter Bypass)	**3 State Water Contractor Agencies**: Kern County Water Agency, Dudley Ridge Water District, Empire-West Side Irrigation District	Approved 7/1/2013
5/1/2013	5,000 ac-ft	**Garden Highway Mutual Water Company (**Feather River Watershed)	**3 State Water Contractor Agencies**: Kern County Water Agency, Dudley Ridge Water District, Empire-West Side Irrigation District	Approved 7/1/2013
5/3/2013	1,100 ac-ft	**Eastside Mutual Water Company** (Sacramento River Watershed)	San Luis & Delta Mendota Water Authority	Approved 7/1/2013
5/3/2013	7,175 ac-ft	**Reclamation District No. 1004** (Sacramento River Watershed)	San Luis & Delta Mendota Water Authority	Approved 7/1/2013
5/6/2013	8,100 ac-ft	**Pleasant Grove-Verona Mutual Water Company** (Sacramento River Watershed)	San Luis & Delta Mendota Water Authority	Approved 7/1/2013
5/6/2013	8,000 ac-ft	**Conaway Preservation Group** (Sacramento River Watershed)	San Luis & Delta Mendota Water Authority	Approved 7/1/2013

5/8/2013	4,000 ac-ft	**David & Alice Te Velde Revocable Family Trust** (Sacramento River Watershed)	San Luis & Delta Mendota Water Authority	Approved 7/2/2013
5/10/2013	3,658 ac-ft	**City of Sacramento and Sacramento Suburban Water District** (Sacramento River Watershed)	**3 State Water Contractor Agencies**: Kern County Water Agency, Dudley Ridge Water District, Empire-West Side Irrigation District	Approved 7/3/2013
6/7/2013	2,500 ac-ft	**Thermalito Water and Sewer District** (Feather River Watershed)	Westlands Water District	Approved 8/14/2013
7/12/2013	15,000 ac-ft	**Merced Irrigation District** (Merced River)	San Luis Water District & Westlands Water District	Approved 9/13/2013
7/17/2013	1,500 ac-ft	**Merced Irrigation District** (Merced River)	San Luis National Wildlife Refuge	Approved 9/13/2013
2/12/2014 4/22/2014 10/20/2014	277,863 ac-ft (TUCPs consolidating place of use for SWP + CVP)	**DWR and USBR**	**10 state and federal contractors:** Santa Clara Valley Water District, Oak Flat Water District, Del Puerto Water District, Kern County Water Agency, Kern Tulare Water District, Arvin Edison Water Storage District, Metropolitan Water District of Southern California, Westlands Water District, Department of Veterans Affairs - San Joaquin Valley National Cemetery, Musco Olive Products, Inc.	Approved 3/28/2014 5/2/2014 10/24/2014
2/14/2014	20,000 ac-ft Stored water release	**Placer County Water Agency** (American River Watershed)	East Bay Municipal Utility District	Approved 4/2/2014
3/20/2014 4/8/2014	5,000 ac-ft Stored water release (TUCP including transfer and instream flow dedication)	**Merced Irrigation District** (Merced River Watershed)	San Luis Water District and/or Santa Clara Valley Water District	Approved 4/22/2014 Revised 5/22/2014
2/21/2014	11,603 ac-ft Cropland idling	**Reclamation District No. 756** (San Joaquin River Watershed, in-Delta transfer)	**Semitropic Water Storage District** for distribution to Alameda County Water District, Alameda County Flood Control and Water Conservation District (Zone 7), the City of Tracy, and Santa Clara Valley Water District	Approved 5/12/2014 **later curtailed**
2/21/2014	9,131.31 ac-ft Cropland idling	**Delta Farms Reclamation District No. 2026** (San Joaquin River Watershed, in-Delta transfer)	**Semitropic Water Storage District** for distribution to Alameda County Water District, Alameda County Flood Control and Water Conservation District (Zone 7), the City of Tracy, and Santa Clara Valley Water District	Approved 5/12/2014 **later curtailed**
5/8/2014	15,225 ac-ft Stored water release	**DWR** (Feather River Watershed)	Westlands Water District	Approved 6/9/2014
5/2/2014	5,000 ac-ft Groundwater substitution	**Plumas Mutual Water Company** (Feather River Watershed)	**5 State Water Contractor Agencies**: County of Kings, Dudley Ridge Water District, Kern County Water Agency, Oak Flat Water District, Napa County Flood Control & Water Conservation Dist.	**Denied** 6/10/2014 due to curtailment
5/2/2014	7,500 ac-ft Groundwater substitution	**Garden Highway Mutual Water Company** (Feather River Watershed)	San Luis & Delta-Mendota Water Authority	**Denied** 6/10/2014 due to curtailment
5/23/2014	10,000 ac-ft Stored water release	**South Sutter Water District** (Bear River Watershed)	**5 State Water Contractor Agencies**: County of Kings, Dudley Ridge Water District, Kern County Water Agency, Oak Flat Water District, Napa County Flood Control & Water Conservation Dist.	Approved 7/7/2014
5/23/2014	35,000 ac-ft Stored water release	**Placer County Water Agency** (American River Watershed)	Westlands Water District	Approved 7/8/2014

5/27/2014	6,600 ac-ft Groundwater substitution	**DWR** (Feather River Watershed)	San Luis & Delta-Mendota Water Authority	Approved 7/11/2014
5/27/2014	5,000 ac-ft Stored water release	**Contra Costa Water District and USBR** (Old River / Middle River)	Alameda County Water District	Approved 7/11/2014
7/17/2014	4,000 ac-ft Stored water release	**Contra Costa Water District and USBR** (Old/ Middle River)	Byron-Bethany Irrigation District	Approved 8/27/2014
11/26/2014	5,000 af (consolidated place of use for SWP + CVP)	**DWR** (Feather River, Italian Slough, Sacramento-San Joaquin Delta Channels)	Alameda County Water District and Alameda County Flood Control and Water Conservation District (Zone 7) **via exchange** with Contra Costa Water District	Approved 1/20/2015
3/12/2015	2,000 ac-ft Stored water release	**Foresthill Public Utility District** (American River Watershed)	Santa Clara Valley Water District	Approved 4/13/2015
3/25/2015 5/11/2015 5/18/2015 7/27/2015	335,560 ac-ft (consolidated place of use for SWP + CVP)	**DWR and USBR**	**State and federal contractors:** Santa Clara Valley Water District, Oak Flat Water District/Del Puerto Water District, Kern County Water Agency/Kern-Tulare Water District, San Joaquin River Exchange Contractors, Arvin-Edison Water Storage District/Metropolitan Water District, Kern County Water Agency/Westlands Water District, Department of Veterans Affairs - San Joaquin Valley National Cemetery, Musco Olive Products Inc, Tulare Lake Basin Water Storage District-Westlands Water District/San Luis Water District	Approved 4/27/2015 5/22/2015 5/22/2015 7/30/2015
3/27/2015	7,500 ac-ft Groundwater substitution	**Garden Highway Mutual Water Company** (Feather River Watershed)	**10 State Water Contractor Agencies:** Central Coast Water Authority, County of Kings, Dudley Ridge Water District, Kern County Water Agency, Metropolitan Water District of Southern California, Napa County Flood Control and Water Conservation District, Oak Flat Water District, Palmdale Water District, Santa Clara Valley Water District, Tulare Lake Basin Water Storage District	**Denied** 5/7/2015 due to curtailment
3/27/2015	4,828 ac-ft Groundwater substitution	**Plumas Mutual Water Company** (Feather River Watershed)	**10 State Water Contractor Agencies:** Central Coast Water Authority, County of Kings, Dudley Ridge Water District, Kern County Water Agency, Metropolitan Water District of Southern California, Napa County Flood Control and Water Conservation District, Oak Flat Water District, Palmdale Water District, Santa Clara Valley Water District, Tulare Lake Basin Water Storage District	**Denied** 5/7/2015 due to curtailment
5/22/2015	500 ac-ft Stored water release	**Contra Costa Water District and USBR** (Old/ Middle River)	Byron Bethany Irrigation District	Approved 6/22/2015
5/22/2015	6,000 ac-ft Stored water release	**South Sutter Water District** (Bear River Watershed)	**9 State Water Contractor Agencies:** Central Coast Water Authority, County of Kings, Dudley Ridge Water District, Kern County Water Agency, Metropolitan Water District of Southern California, Napa County Flood Control and Water Conservation District, Oak Flat Water District, Palmdale Water District, Santa Clara Valley Water District	Approved 7/3/2015
6/25/2015	12,000 ac-ft Stored water release	**Placer County Water Agency** (American River Watershed)	East Bay Municipal Utility District	Approved 7/24/2015
6/29/2015	700 ac-ft Stored water release	**El Dorado Irrigation District** (American River Watershed)	Westlands Water District	Approved 8/18/2015

8/28/2015	5,000 ac-ft (consolidated place of use for SWP + CVP)	**USBR** (Sacramento River, San Joaquin River Delta, and Trinity River)	Alameda County Water District and Alameda County Flood Control and Water Conservation District (Zone 7) **via exchange** with Contra Costa Water District	Approved 9/28/2015
8/19/2015	10,000 ac-ft Stored water release	**South Feather Water and Power Agency** (Feather River Watershed)	**5 State Water Contractor Agencies**: County of Kings, Dudley Ridge Water District, Kern County Water Agency, Oak Flat Water District, Metropolitan Water District of Southern California	Approved 10/2/2015
12/15/2015	76,069 ac-ft Stored water release (for San Joaquin River Restoration Program)	**USBR** (San Joaquin River Watershed)	Friant Water Contractors	Approved 3/23/2016
3/9/2016	17,433 ac-ft Cropland idling and groundwater substitution	**Sutter Extension Water District** (Feather River)	**6 State Water Contractor Agencies:** Dudley Ridge Water District, Kern County Water Agency, Metropolitan Water District of Southern California, Palmdale Water District, Santa Clara Valley Water District, San Bernardino Valley Municipal Water District	Approved 4/25/2017
3/28/2016	257,900 ac-ft (of 305,820 requested) (consolidated place of use for SWP + CVP)	**DWR and USBR**	**State and federal contractors:** Santa Clara Valley Water District, Oak Flat Water District/Del Puerto Water District, Kern County Water Agency/Kern-Tulare Water District, San Joaquin River Exchange Contractors, Arvin-Edison Water Storage District/Metropolitan Water District, Kern County Water Agency/Westlands Water District, Department of Veterans Affairs - San Joaquin Valley National Cemetery, Musco Olive Products Inc, Tulare Lake Basin Water Storage District-Westlands Water District/San Luis Water District	Approved in part 5/17/2016 7/8/2016 7/21/2016
6/17/2016	20,000 ac-ft Stored water release	**Merced Irrigation District** (Merced River Watershed)	Le Grand-Athlone Water District, Lone Tree Mutual Water Company, San Luis Canal Company, Chowchilla Water District, and Sphere of Influence Lands	Approved 8/23/2016

C.4.5 Analyzing Water Supply, Demand, and Availability in Particular Watersheds

Although the Board's curtailment analyses during the 2012–2016 drought were in some ways improvements over their 1970s counterparts, they relied on the same general methodology: (1) comparing estimates of total watershed-wide supply to total watershed-wide demand and (2) assigning any shortfall beginning with the most junior users in the watershed to arrive at a priority date for which demand no longer exceeds supply.

Triggers — In 2014, the governor's drought declaration was a key trigger for the Board's initial drought water availability analyses. Other triggers may include below average projected snowpack and other water supply, or a large number of complaints about water availability in a particular region; or other indications of a localized water shortage.

Supply — The Board calculated projected water supply based on data maintained by DWR, the National Weather Service, the U.S. Geological Survey, the USBR, and the U.S. Army Corps of Engineers.[207] It updated its analyses periodically to incorporate new information.

The supply information the Board used in its drought water availability analyses for the Sacramento and San Joaquin River basins (and for major watersheds within each) came from forecasts of monthly runoff DWR produces for specific locations as part of its February through May Bulletin 120 update process,[208] supplemented by daily "full natural flow" and monthly

"full natural flow" data from the California Data Exchange Center (CDEC) website.[209] These flow estimates rest on calculations at a limited number of locations with adjustments to monthly forecasts made for "minor streams" based on estimates for water year 1977 (which had low snowpack, like water year 2015) and assumed return flows.[210]

Demand — Demand analyses were based on reports filed by water rights holders documenting past amounts of water diverted and used each month.[211] These data were of variable quantity and quality for different groups of water right holders in different watersheds. Although at the time the drought began, post-1914 appropriators (permittees and licensees) were already required to submit this information annually, riparian and pre-1914 appropriative users were only required to submit reports every three years. For its 2014 drought water availability analyses, the Board used the most recent complete reported demand information (for the 2010 water year).[212] That information did not necessarily reflect what was actually happening during the drought in a particular watershed. Demand information improved for 2015, when the Board issued informational orders (see Section C.4.12) to some water users. For example, in February 2015, the Board issued informational orders to diverters estimated to account for 90% of watershed demand in the Sacramento-San Joaquin River Watershed, requesting that they provide information about projected 2015 demand and actual 2014 use, and that they report their actual 2015 use on a monthly basis.[213] For 2015, the Board used reported 2014 use to represent demand. For those not subject to informational orders, the Board averaged reported use over the four-year period from 2010–2013 (or whichever of those years' data were available).

The Board made adjustments for estimated return flows, for example, reducing demand for Delta water users by 40%, as suggested by stakeholders.

Demand data quality control involved automatic and manual screening to identify and address apparent reporting problems.

Availability — To assess water availability, the Board compared estimates of projected or actual total watershed-wide supply and total watershed-wide demand. If demand appeared to exceed supply, the Board assigned any shortfall beginning with the most junior users in the watershed to arrive at a priority date for which demand no longer exceeded supply.[214]

The Board made its drought water availability analyses available to the public on its website.[215]

C.4.6 Providing Curtailment-Related Information and Curtailing Water Diversions

During the 2012–2016 drought, the Board took various actions related to curtailments. Some of these actions were controversial and are being litigated (Box C-1).

C.4.6.1 Notices of Potential Water Shortage

In 2014, the Board sent a statewide notice of potential curtailment on January 17[216] and a notice of potential curtailment to adjudicated rights in the Scott River Watershed a few days later.[217] The Delta Watermaster issued a notice of probable Term 91 curtailments on February 3.[218]

In 2015, the Board issued a statewide notice of potential curtailment on January 23[219] and a notice of probable curtailment to permittees and licensees subject to Term 91 on February 13.[220] On April 2, 2015, the Board sent a second statewide letter announcing "Curtailment of Water Right Diversions Expected Soon," warning of probable curtailments of pre- and post-1914 water rights and possible curtailments of riparian rights and directing people to its curtailment

analysis webpage, which, as of this date, contained only Term 91 and Scott River Watershed analyses (other analyses were listed as "pending").[221]

In 2016, the Board issued a notice of probable Term 91 curtailment on May 10, 2016.[222]

C.4.6.2 Notices of Water Unavailability (Curtailment Notices) and Orders

Between 2014 and 2016, the Board sent notices of water unavailability to many diverters in the Sacramento and San-Joaquin River Watersheds (including those with appropriative rights with a 1903 or later priority date), junior adjudicated rights in the Scott River Watershed, post-1914 appropriative rights in the Eel River Watershed, and rights with priority dates of February 19, 1954, or later upstream of the confluence with Dry Creek in the Russian River Watershed (Figures C-1 and C-2).

In general, notices were sent earlier in 2015 than in 2014, at least in part because the work the Board put in in 2014 made its job in 2015 easier and enabled a more timely response.

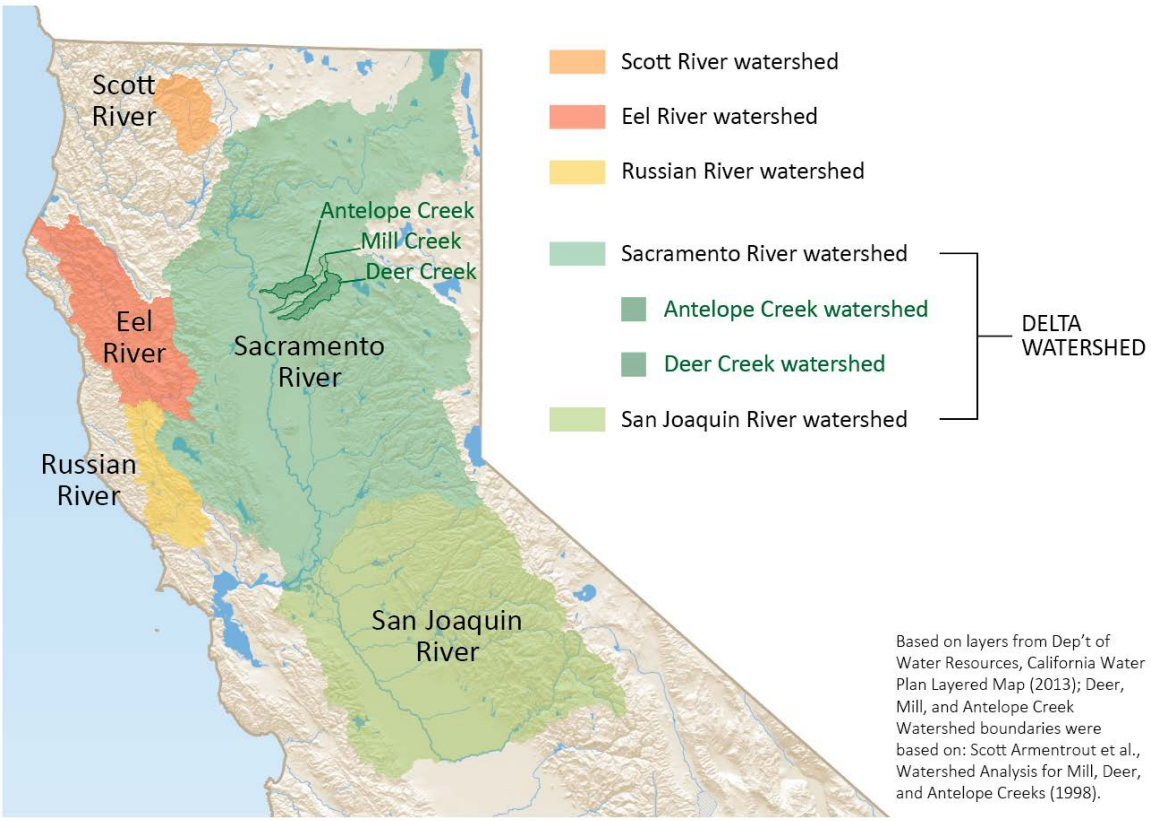

Figure C-1: Watersheds in Which Diverters Received Curtailment Notices or Orders During the 2012–2016 Drought[223]

Curtailments to protect fish flows

During the recent drought, the Board took the unprecedented step of implementing curtailments to maintain minimum instream flows to support adult and juvenile migration in streams considered critical for the survival of ESA-listed Central Valley spring-run Chinook salmon and Central Valley steelhead.[224] At the request of state and federal wildlife agencies,[225] in May 2014, the Board adopted a set of Emergency Regulations for Curtailment of Diversions

Due to Insufficient Flow in three Sacramento River tributaries: Deer, Mill, and Antelope Creeks.[226] The regulations, which were in effect through December 2015, set minimum emergency instream flows for each creek, laying the groundwork for drought-related curtailments. The regulations defined diversions that threatened required flows as a waste and unreasonable use of water. They explained on what basis and how the Board might issue curtailment orders to protect required flows or approve local cooperative solutions in lieu of curtailment orders. The regulations included exceptions for non-consumptive uses and for diversions necessary to meet minimum human health and safety needs (see Section C.4.7). Finally, they required recipients of curtailment orders to certify and describe their compliance.

The Board issued curtailment orders under the emergency regulations to all diverters in the Deer Creek watershed for parts of the 2014, 2015, and 2016 water years and to all diverters in Antelope Creek watershed for parts of the 2015 and 2016 water years (Figures C-1 and C-2). Although the curtailments were generally successful in maintaining flows that enable fish passage in these three creeks, poor conditions in the mainstem Sacramento River due to problems with temperature management left local diverters feeling as if their sacrifice had been for naught.[227] An important lesson is that taking a more "comprehensive approach to fish protection that better addresses the full suite of threats to species' survival" would lead to better outcomes for at-risk species and greater cooperation from stakeholders who would find such an approach more fair.[228]

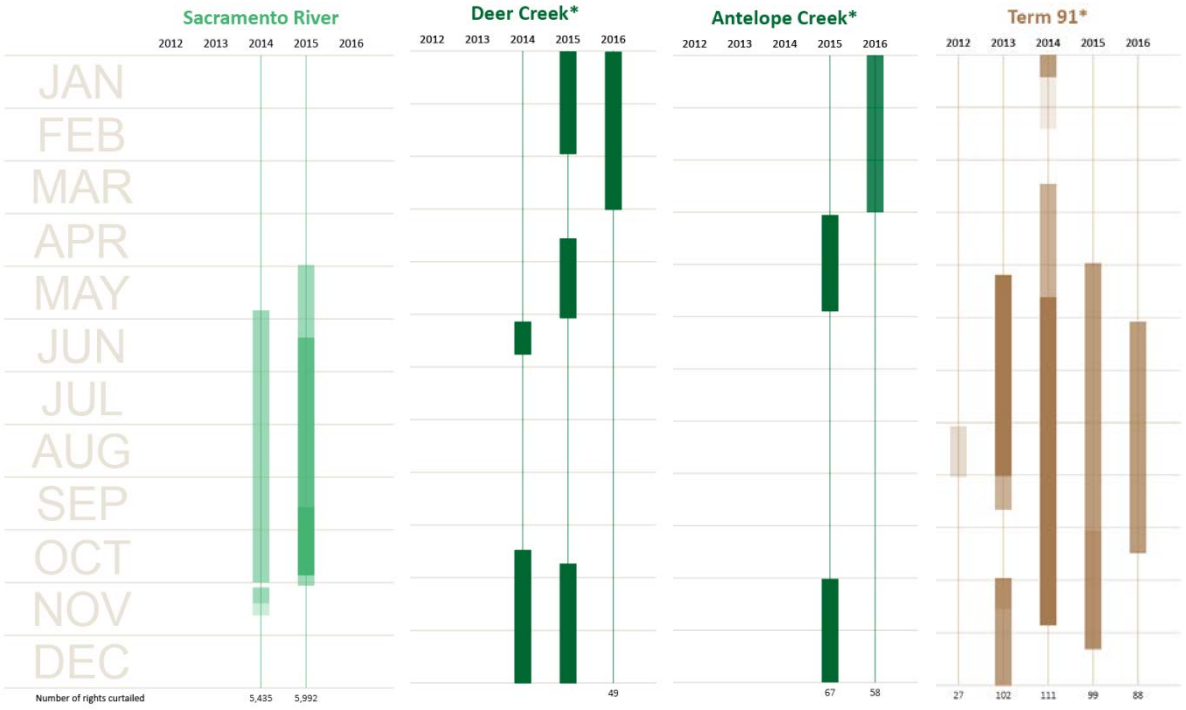

Figure C-2: Periods of Curtailment in California Watersheds During the 2012–2016 Drought
As Figure C-1 shows, Deer and Antelope Creeks are sub-watersheds of the Sacramento River basin. Term 91 curtailments apply to certain permits within the Delta watershed.

Box C-1: Controversy Surrounding Curtailments During the 2012–2016 Drought

In 2015, some of the entities that received curtailment notices sued the Board, bringing multiple cases challenging its authority to issue the notices and addressing other curtailment-related issues. In September 2015, the cases were moved to Santa Clara County Superior Court (a neutral location) and coordinated under a single trial judge.[229]

One of the plaintiffs' basic arguments was that, before a particular party receives an enforceable curtailment order it is has the right to a hearing to see and defend itself against the evidence of unlawful diversion. They argued that the language of the water unavailability notices made it look as if the Board thought compliance, and providing confirmation of compliance, was mandatory and could be enforced without the opportunity for a hearing. Essentially, the plaintiffs argued, the notices appeared to be held out as enforceable curtailment orders. They sought a stay of the notices during the trial. The court agreed with the plaintiffs, concluding that the curtailment notices violated recipients' due process right to a hearing.

In response, on July 15, 2015, the Board issued a partial rescission and clarification of water unavailability notices sent to particular diverters in the Sacramento River and Delta, the San Joaquin River, and the Scott River, but it did not recall the original notices.[230] In particular, the letter rescinded the notices to the extent that they "contain language that may be construed as an order requiring you to stop diversion," rescinded the requirement "to complete and file the Curtailment Certification Form . . . attached to the prior notices," and eliminated usage of the term "curtailment." It simultaneously emphasized that the point of the notices was "to ensure that diverters: (a) are

aware of the severity of the situation; (b) have reliable information regarding the amount of water available for their diversion; and (c) have information on whether water that may appear to be available instead is only available to serve senior rights."

The litigation addresses an array of issues, including appropriate considerations for water availability analyses, the language in curtailment notices, the use of curtailment notices, whether the notices were consistent with water right priority, whether the Board's Executive Director had the authority to send the notices, the interaction between curtailments and temporary urgency change orders, the scope of the Board's jurisdiction over pre-1914 and riparian water users, whether and what types of oversight and enforcement are appropriate for them, and related due process and takings allegations. Because it touches on many issues that have not been directly addressed before, the outcome is uncertain, yet certain to affect the way the Board approaches curtailments in the future.

In February 2018, the Superior Court issued a Statement of Decision in Phase I of the coordinated curtailment cases. It concluded that Water Code Section 1052 "does not authorize the Board to 'curtail' or take enforcement action against pre-1914 appropriators based on their use of water in excess of that available under their priority of right," reasoning that the section includes language which explicitly limits its application to post-1914 rights.[231] Additionally, the court held that the Board's 2015 water unavailability notices violated the plaintiffs' due process rights and its partial rescission and clarification did not cure the violation.[232] However, the court noted that it had expressed "no opinion" regarding alternative sources of the Board's authority, such as alternative provisions of the Water Code or the possible "future delegation of power by the Legislature."[233]

This litigation is ongoing.

Curtailments to protect senior water rights

The Board adopted a second set of curtailment-related emergency regulations, effective from July 2014 to April 2015, regarding potential curtailments to protect senior water rights.[234] These emergency regulations, adopted July 2, 2014, explained on what basis and how the Board might issue curtailment orders to post-1914 appropriators to protect senior water rights. They clarified that exceptions for diversions necessary to meet minimum health and safety needs (described above) would not apply, and allowed approved alternative water sharing agreements to be implemented in lieu of curtailment orders. The Board did not end up issuing curtailment orders under this set of emergency regulations, which was highly controversial. Instead, it issued notices of water unavailability (described above) to protect senior water rights. This move was also controversial (see Box C-1). Notably, the 2014 notices were all issued before the Board adopted the curtailment regulations, and the regulations expired before the Board issued most of its 2015 curtailment notices (Figure C-2).

A provision of these emergency regulations authorized the issuance of informational orders in response to a complaint of water right interference or information indicating "unlawful diversions of stored water." An informational order would require riparian or pre-1914 appropriative users to provide "the property patent date, the date of initial appropriation, and diversions made or anticipated during the current drought year" within 5 days. The provision regarding informational orders was subsequently expanded and remained in effect after the curtailment-related provisions of this set of emergency regulations expired (see Section C.4.12).

C.4.6.3 Term 91 Curtailments

Enforceable curtailment notices were issued to many Term 91 permittees for much of the irrigations seasons in 2013, 2014, 2015, and 2016 (Figure C-2).

C.4.7 Allowing Limited Health and Safety Exceptions to Curtailments

When the Board adopted emergency curtailment regulations to protect fish in Mill, Deer, and Antelope Creeks[235] in May 2014, it included an exception for diversions "necessary for minimum health and safety needs."[236] Section 878.1 defined "minimum health and safety needs" as "the amount of water necessary for prevention of adverse impacts to human health and safety, for which there is no reasonable alternate supply."[237] It set out different requirements for three categories of needs:

- First, "[d]iversions for domestic and municipal use under any valid basis of right, of less than 50 gallons per person, per day" could be continued "without further approval" if the diverter certified satisfaction of seven conditions.[238]
- Second, a petition for specific Board approval was needed for larger domestic or municipal diversions or for domestic or municipal diversions "requiring more than 50 gallons per person, per day to meet minimum health and safety needs."[239]
- Third, diverters could petition the Board regarding "[a]ll other diversions for minimum health and safety needs," including water supplies that are:
    - "necessary for energy sources that are critical to basic grid reliability,"
    - "regionally necessary for fire preparedness,"
    - "regionally necessary to address critical air quality impacts in order to protect public health,"
    - "necessary to address immediate public health or safety threats," or
    - "critical to public health and safety, or to the basic infrastructure of the state . . . ."[240]

The Board could approve petitions for diversions in the second and third categories "upon a finding that the diversion is in furtherance of the constitutional policy that the water resources of the state be put to beneficial use to the full extent they are capable, and that waste and unreasonable use be prevented, notwithstanding the effect of the diversion on senior water rights or instream beneficial uses . . . ."[241] Approval was potentially subject to conditions "appropriate to ensure that the diversion and use are reasonable and in the public interest."[242]

Box C-2: Controversy Surrounding Curtailment Exceptions for Minimum Health and Safety Needs

Although the Board acknowledged that minimum health and safety needs are "important throughout the state, not just in the [Mill, Deer, and Antelope Creek] watershed[s]," the Board was worried that giving Section 878.1 statewide effect could "undermine the cooperation necessary" to meet these needs.[243] Because the Board received almost exclusively negative feedback about the health and safety exception during its May 2014 curtailment workshop, it theorized that "applying section 878.1 statewide could generate such concern that the energy and resources spent addressing the legal framework . . . would detract from efforts to ensure that all minimum health and safety needs are met."[244]

To help it decide what to do, the Board requested written comments ahead of its July 2014 Board meeting regarding whether it should extend the health and safety exception to statewide curtailments, or take some other action regarding minimum health and safety needs.[245] Some commenters argued that any health

and safety exception that would give some more junior diverters precedence over more senior diverters would violate priority. Others argued that the Section 878.1 exception should be preserved in statewide curtailment regulations, but that some additional provision should be made to ensure that larger (less than 50 gal/day/person, but more than 4,500 gal/day total) municipal diversions were not viewed as illegal (with the potential to accumulate large fines) during the 878.1 petition process (or the petition for reconsideration process, should 878.1 remain inapplicable).

At the Board's July 2014 meeting, most of the public commenters who mentioned the health and safety exception argued that section 878.1 should be extended statewide. However, the Board decided against doing so. The Board stated that, even though it would be logical to constrain the exception's use by narrowly defining it (as Section 878.1 arguably attempted to do), senior water users "don't want it" and "say there's no need." The Executive Director, recommended that the Board instead use its enforcement discretion, telling staff not to undertake enforcement actions against diverters with apparently valid minimum health and safety claims, but to instead encourage those diverters to work on procuring emergency replacement supplies. The Board directed its staff to try to get a handle on the extent of the problem (including domestic drinking and sanitation needs, fire protection needs, schools, hospitals, etc.), reasoning that it could quickly pass a health and safety exception regulation later if needed.

In October 2014, the Board's Division of Drinking Water issued compliance orders to 22 curtailed water systems for violating their duty to maintain a reliable water supply (SWRCB 2014).[246] These orders prohibited new service connections, required metering, and directed the systems to develop and implement plans to establish alternative water sources to meet projected system demand, including during future severe droughts.

Diverters who wanted to claim a health and safety exception were asked to fill out and return a "Human Health and Safety Claims Form."[247] This form asked claimants to explain why bottled water, hauled water, groundwater wells, and purchases from local water purveyors were infeasible, and requested the names and phone numbers of alternate suppliers the diverter had contacted.

The emergency regulation identified minimum health and safety diversions as "necessary to further the constitutional policy that the water resources of the state be put to beneficial use to the full extent they are capable, and that waste and unreasonable use be prevented, notwithstanding the effect of the diversions on more senior water rights or instream beneficial uses."[248] It reasoned that, "[g]iven the essential nature of water in sustaining human life, use even under a more senior right for any other purpose when domestic and municipal supplies required for minimum health and safety needs cannot be met is a waste and unreasonable use under the California Constitution, Article X, § 2."[249]

This regulation was not without controversy (Box B-2). When the Board proposed statewide emergency curtailment regulations in June 2014, it did not include an explicit health and safety exception. Instead, the Board opted to rely on petitions for reconsideration of curtailment orders and enforcement discretion.[250]

C.4.8 Considering Curtailment Alternatives

C.4.8.1 Voluntary Agreements in Lieu of Curtailments to Protect Fish Flows

The Emergency Regulations for Curtailment of Diversions Due to Insufficient Flow for Specific Fisheries left open the possibility of local cooperative solutions in lieu of curtailment orders. Voluntary agreements with state and federal wildlife agencies that represented most of the water diverted in a watershed and achieved comparable results could potentially stave off curtailments for fish flows. Post-drought analyses suggest that voluntary agreements and

curtailment orders seemed to be similarly effective in maintaining flows and enabling fish passage in Deer, Mill, and Antelope Creeks.[251]

Deer Creek — In June 2014 and April 2015, the Board determined that voluntary agreements with the Deer Creek Irrigation District would not provide comparable protection to curtailments.[252]

Mill Creek — Diverters in Mill Creek were able to avoid any fisheries-related curtailment orders during the drought. In June 2014 and April 2015, the Board determined that voluntary agreements between several diverters and state and federal wildlife agencies accounted for at least 85% of the water diverted in the lower Mill Creek watershed, providing protections comparable to curtailments.[253]

Antelope Creek — Initially, diverters in Antelope Creek were able to avoid fisheries-related curtailment orders. In June 2014, the Board determined that voluntary agreements between two large diverters and state and federal wildlife agencies accounted for about 95% of riparian and pre-1914 water use in the Antelope Creek watershed, providing protections comparable to curtailments.[254] However, after only one of the large diverters entered into a voluntary agreement with CDFW in April 2015, the Board decided the agreement was an insufficient alternative to curtailments, since it did not cover "substantially all of the water diverted" in the watershed.[255]

C.4.8.2 Voluntary Diversion Reduction Program Among In-Delta Riparian Water Right Claimants

In May 2015, the Board approved a proposal from Delta farmers who claimed riparian rights for a program to voluntarily reduce their diversions by 25% relative to the 2013 water year in exchange for the Board agreeing not to enforce subsequent curtailments against participants.[256] They submitted more than 200 diversion reduction plans, covering about two-thirds of the farmable land in the central and southern Delta, that were based on strategies like fallowing land, crop shifting, irrigating less frequently, and increasing irrigation efficiency.[257] The Delta Watermaster estimated that the program reduced 2015 diversions "by more than 25% versus 2013, and by a smaller percentage versus the amount of water that would have been diverted without the program."[258]

C.4.8.3 Enhanced Water Conservation Requirements in Lieu of Curtailments

In an attempt to avoid curtailments in 2015, the Board adopted an Emergency Regulation for Enhanced Water Conservation and Additional Water User Information for the Protection of Specific Fisheries in Tributaries to the Russian River in June 2015 (described in Section C.4.10).

C.4.9 Encouraging or Mandating Conservation

During the 2012–2016 drought, the Board took a number of conservation-oriented steps it had never taken before.

C.4.9.1 Statewide Urban Water Conservation Requirements

Beginning in July 2014, the Board adopted emergency regulations for statewide urban water conservation that included mandatory urban water conservation requirements which applied to end users of water. Portions of these regulations focused on prohibiting certain uses of water the Board deemed wasteful (described in Section C.4.10.1). In 2015, the Board amended

portions of the regulations that applied to urban water suppliers, introducing mandatory conservation standards (described in Section C.4.9.3).

C.4.9.2 Imposing Enhanced Water Conservation Requirements in Lieu of Curtailments

The Board adopted an Emergency Regulation for Enhanced Water Conservation and Additional Water User Information for the Protection of Specific Fisheries in Tributaries to the Russian River in June 2015. Again, because these regulations focused on prohibiting certain uses of water the Board deemed wasteful, they are described in Section C.4.10, below.

C.4.9.3 Mandatory Conservation Standards for Urban Water Suppliers

When Governor Brown proclaimed a state of emergency due to drought in January 2014, he called on DWR and other state agencies to "execute a statewide water conservation campaign to make all Californians aware of the drought and encourage personal actions to reduce water usage . . . by 20 percent" over 2013.[259] These voluntary efforts achieved a 9 percent reduction.[260]

In an April 25, 2014, Executive Order, the governor called on the Board to oversee and improve the conservation efforts of urban water providers. First, the Board had to "direct urban water suppliers that are not already implementing drought response plans to limit outdoor irrigation and other wasteful water practices such as those identified in this Executive Order."[261] Second, the Order required the Board to request "an update from urban water agencies on their actions to reduce water usage and the effectiveness of these efforts," by June 15. Finally, it tasked the Board with adopting emergency regulations "it deems necessary, pursuant to Water Code section 1058.5, to implement this directive."

Over the next few months, the Board took actions consistent with the governor's directive. In May, it issued a survey to over 400 urban water suppliers to learn about the substance and effectiveness of their conservation actions.[262] In July, it adopted emergency regulations that required urban water suppliers and other distributors of public water supplies to take certain steps to promote water conservation.[263] The regulations required large water suppliers with water shortage contingency plans to implement them to require mandatory restrictions on "outdoor irrigation of ornamental landscapes or turf with potable water." Large water suppliers without plans and smaller suppliers had to restrict outdoor watering to 2 days per week or take other measures that achieve comparable levels of conservation. The regulations also introduced requirements for large water suppliers to submit monthly reports of the amount of potable water produced and an estimate of the number of gallons of water used per person per day by their residential customers.

In April 2015, the governor directed the Board to "impose restrictions to achieve a statewide 25% reduction in potable urban water usage."[264] Therefore, the following month, the Board amended the Urban Water Conservation emergency regulations, assigning each urban water supplier with 3,000 or more connections a conservation standard between 4% and 36% of its 2013 monthly use, depending on residential per capita water use, with the goal of achieving a statewide 25% reduction over 2013 usage.[265] In February 2016, the Board adjusted these supplier conservation standards based on local climate, population growth, and local water investments.[266]

A few months later, in May 2016, the Board amended the emergency regulations to allow urban water suppliers either to keep using the assigned standard or to develop and self-certify their own conservation standards designed to ensure a 3-year supply (assuming 3 more dry years

like 2012–2015).[267] Similarly, each urban water wholesaler was required to submit a calculation, and underlying analysis, of the volume of water it expects to be able to deliver to each urban water supplier during each of the next 3 years.[268]

In April 2017, after the governor ended the statewide drought emergency, the Board repealed the mandatory water conservation standards for suppliers but maintained the data collection and reporting requirements which, together with "[c]ontinued prohibition of wasteful and/or unreasonable water use practices . . . provide a bridge to permanent rules for making water conservation a California way of life."[269]

The Board reported that, statewide, urban water suppliers reduced their potable water use 22.5% over 2013 levels between June 2015 and February 2017, saving approximately "2.6 million acre-feet of water"—"enough water to supply approximately 13 million Californians for one year."[270]

A 2017 PPIC report has argued that the statewide conservation mandate "generated significant discord between the state and local water suppliers—entities that need to work well together to protect the state's residents and economy from the worst effects of drought" and "muddied the waters in terms of state and local roles and responsibilities going forward, which if left unaddressed could undermine effective planning and response to future droughts."[271]

C.4.9.4 Helping Prepare Plan for Making Water Conservation a California Way of Life

On May 9, 2016, the governor tasked the Board and other state agencies with helping California "transition to permanent, long-term improvements in water use" by developing "new water use targets as part of a permanent framework for urban water agencies," permanently requiring urban water suppliers to issue monthly reports on water usage, conservation, and enforcement, permanently prohibiting "practices that waste potable water," directing actions to minimize leaks in water systems, and directing "urban and agricultural water suppliers to accelerate their data collection, improve water system management, and prioritize capital projects to reduce water waste."[272] In April 2017, the Board and four other state agencies issued a plan for implementing the Executive Order.[273]

C.4.9.5 Adopting General Waste Discharge Requirements to Facilitate Recycled Water Use

In his April 25, 2014, Executive Order, the governor called on the Board to "adopt statewide general waste discharge requirements to facilitate the use of treated wastewater that meets standards set by the Department of Public Health, in order to reduce demand on potable water supplies."[274] In September 2014, the Board adopted General Waste Discharge Requirements (WDRs) for Small Domestic Wastewater Treatment Systems to help streamline permitting by the Regional Boards.[275] The WDRs are essentially a water quality permit that allows "the production and use of recycled water" for non-potable uses when certain conditions are met.[276]

C.4.10 Prohibiting Specific Wasteful Uses of Water

C.4.10.1 Imposing Statewide Urban Water Conservation Requirements

Governor Brown's April 25, 2014, Executive Order called for redoubling efforts to conserve water.[277] Among other things, the Order recommended that all Californians conserve water by not applying water to sidewalks or other hardscapes, by using "recycled or grey water" in decorative water features, by minimizing the use of potable water to wash their cars, and by limiting outdoor watering to twice a week.[278] It tailored additional recommendations to

recreational facilities and large institutional complexes, commercial establishments, and professional sports facilities.[279]

Beginning in July 2014, the Board adopted mandatory urban water conservation requirements that applied to end users of water via emergency regulations. Many of the requirements mirrored the governor's recommendations. The regulations prohibited the following, "except where necessary to address an immediate health and safety need or to comply with a term or condition in a permit issued by a state or federal agency":

(1) The application of potable water to outdoor landscapes in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots, or structures;
(2) The use of a hose that dispenses potable water to wash a motor vehicle, except where the hose is fitted with a shut-off nozzle or device attached to it that causes it to cease dispensing water immediately when not in use;
(3) The application of potable water to driveways and sidewalks;
(4) The use of potable water in a fountain or other decorative water feature, except where the water is part of a recirculating system;
(5) The application of potable water to outdoor landscapes during and within 48 hours after measurable rainfall;
(6) The serving of drinking water other than upon request in eating or drinking establishments, including but not limited to restaurants, hotels, cafes, cafeterias, bars, or other public places where food or drink are served and/or purchased;
(7) The irrigation with potable water of ornamental turf on public street medians; and
(8) The irrigation with potable water of landscapes outside of newly constructed homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission and the Department of Housing and Community Development.[280]

It also required hotel and motel operators to give guests "the option of choosing not to have towels and linens laundered daily" and instituted outdoor irrigation restrictions for commercial, industrial, and institutional properties using at least some water from a source other than an urban water supplier.[281] Violations of any of these requirements could be met with fines of up to $500 per day.[282]

These emergency regulations expired in November 2017.

C.4.10.2 Imposing Enhanced Water Conservation Requirements In Lieu Of Curtailments

The Board adopted an Emergency Regulation for Enhanced Water Conservation and Additional Water User Information for the Protection of Specific Fisheries in Tributaries to the Russian River in June 2015.[283] This regulation built on the statewide urban water conservation requirements, increasing conservation requirements for water users in tributaries to the Russian River to protect instream flows for fish. The regulation defined diversions inconsistent with the enhanced measures as a waste and unreasonable use of water.[284] It required all water users in identified watersheds to comply with listed prohibitions and requirements, including a ban on watering ornamental turf (except with untreated rainwater or gray water).[285] The regulation included an exception for those in compliance with a voluntary drought initiative program that

a wildlife agency determines is "at least equivalent to the conservation measures."[286] Additionally, it explained that the Board might issue informational orders requiring landowners and water suppliers to provide information on the sources, amounts, and uses of both surface and groundwater they diverted from the listed watersheds within 30 days of the order date.[287] The Board amended the emergency regulation in March 2016 to remove the enhanced conservation measures.[288] The emergency regulation expired on December 28, 2016.

C.4.10.3 Defining Diversions That Threaten Minimum Emergency Fish Flows as Waste And Unreasonable Use

The regulations that established minimum emergency flows to support migratory fish passage in Deer, Mill, and Antelope Creeks (see Section C.4.6) defined diversions that threaten these flows as a waste and unreasonable use of water.[289]

C.4.11 Adopting Emergency Regulations Targeted to Address Urgent Needs

The Board's most extensive drought-related regulatory efforts occurred during the 2012–2016 drought, when it adopted six sets of emergency regulations (see Table 3). The first, initially adopted in early June 2014, addressed curtailment of water diversions to maintain sufficient flows to support passage of protected fish in three tributaries to the Sacramento River (see Section C.4.6). The second, adopted in mid-July 2014, addressed curtailment of water diversions to protect senior water rights (see Section C.4.6). Next the Board tackled urban water conservation, initially adopting mandatory conservation requirements in late July 2014 (see Sections C.4.9 and C.4.10). In March 2015, the Board decided to expand the scope and reach of a provision on informational orders that was initially included in the second set of curtailment-related emergency regulations (see Section C.4.12). In mid-June 2015, the Board took a different tack to addressing the protection of fish flows by imposing heightened water conservation requirements on water users in the watersheds of several tributaries to the Russian River (see Sections C.4.9 and C.4.10). The California Legislature directed the Board to develop the final set of emergency regulations, adopted in January 2016, to implement the enhanced diversion measurement and reporting requirements introduced by Senate Bill 88 in mid-2015 (see Section C.4.12).

C.4.12 Improving Decision-Related Information

During the 2012–2016 drought, the Board adopted and implemented several emergency regulations aimed at improving the information available for analyzing water availability during the recent drought, described below (see also Table 3).

C.4.12.1 Emergency Regulations for Statewide Urban Water Conservation

One of the most important contributions of these regulations, discussed above in Section C.4.9.3, was a requirement for large water suppliers to submit monthly reports of the amount of potable water produced and an estimate of the number of gallons of water used per person per day by their residential customers.[290] The resulting data suggest declining usage during the summer months from 2013 to 2014 and 2015, and a slight uptick during the summer of 2016 (though use was still less than 2014 levels).[291]

C.4.12.2 Emergency Regulation Regarding Informational Orders

In March 2015, the Board amended a provision regarding informational orders it had initially adopted as part of emergency regulations for Statewide Drought-Related Curtailment of Water Diversions to Protect Senior Water Rights in July 2014 (see Table 3).[292] The amendment

expanded the circumstances under which an informational order could be issued, including in response to "information that indicates actual or threatened waste, unreasonable use, unreasonable method of diversion, or unlawful diversions." It allowed informational orders to be issued to any "water right holder, diverter or user," including post-1914 appropriators and those diverting without apparent rights. it also expanded the information that could be requested to include "claim of right," "basis of right and amount of a water transfer not subject to approval of the Board or the Department of Water Resources," or "any other information relevant to authenticating the right or forecasting use and supplies in the current drought year." It gave recipients of informational orders more time (30 days instead of just 5) to report required information. The emergency regulation was subsequently readopted twice, with minor amendments.

The Board issued the following information orders during the 2012–2016 drought:

- In late 2014, after receiving a complaint from the USBR alleging potential unlawful diversions, it requested information from 24 alleged diverters "between Friant Dam and Gravelly Ford along the San Joaquin River."[293]
- In May 2015, it requested information regarding a particular diversion on the Tuolumne River.[294]
- In February 2015, it requested information from 1,061 diverters, including riparians and pre-1914 appropriators in the Delta representing 90% of reported demand, as well as "the remaining top 90% of riparian and pre-1914 demand in the Sacramento and San Joaquin watersheds."[295]
- In July 2015, it requested "supporting documentation for . . . [West Side Irrigation District's] existing diversions from Old River, a San Joaquin River tributary.[296]
- In August 2015, it requested information on past and projected water diversion and use from landowners in the watersheds of four tributaries to the Russian River "in order to accurately estimate demand."[297]
- In October 2015, it requested information on past and projected water diversion and use from 25 landowners in the watershed of the north fork of China Creek in Humboldt County[298]
- In October 2015, it requested information from two "property owners on San Mateo Creek in San Mateo County."[299]

Information required generally included (1) information about past diversions (usually from the beginning of 2014 to the date of the notice), (2) information about the basis of right for their diversions, and (3) monthly diversion data until the drought ended and/or projections of future water use.

C.4.12.3 Emergency Regulations for Measuring and Reporting Water Diversions

The final set of emergency regulations the Board adopted during the recent drought (in January 2016) implemented Senate Bill 88's enhanced diversion measurement and reporting requirements.[300] Whereas previously those diverting under claims of riparian or pre-1914 appropriative rights were required to report their diversions only every 3 years, these emergency regulations required annual reporting of diversion and use for *all* surface water

diverters.[301] They also required more accurate and higher frequency monitoring for devices, or alternative compliance approaches, used to measure larger diversions. Those diverting more than 10 acre-feet of water per year must now measure their diversions on a weekly, daily, or hourly basis, depending on the size and type (direct vs. storage) of diversion.[302] During times of shortage, the Board can require monthly or more frequent electronic reporting (up to the required measurement frequency) of these measurements in a watershed projected to have insufficient flows to support all diversions.[303]

Because the Legislature required the Board to develop Senate Bill 88's implementing regulations as emergency regulations and provided that they would remain in place until the Board revised them, they do not sunset as emergency regulations generally do. Measurement requirements were phased in between January 2017 and January 2018, with requirements for larger diversions kicking in sooner.[304]

C.4.13 Tracking Water Right Compliance and Taking Enforcement Actions

During the recent drought, the Board used most of the tracking techniques listed in Section 4.4.3, to varying degrees.

Originally, the notices of water unavailability the Board sent asked recipients to complete and return a Curtailment Certification form to confirm their compliance (Box C-1). The Board looked at these to identify which, and how many, diverters had not returned them.

The Board also checked compliance through field inspections, carrying out 947 inspections with the help of staff from DWR and the Central Valley Regional Water Quality Control Board in 2014.[305] The Board had some difficulty getting access and appropriate tools to perform inspections.[306] Through inspections, it identified "previously-unreported claims of water rights, potential unauthorized diversions, and unapproved changes such as changes in the point of diversion or place of use that require additional follow-up activities."[307]

Additionally, the Board received and followed up on various complaints. It received 53 water rights complaints in 2012, 59 in 2013, 189 in 2014, 171 in 2015, and 100 in 2016.[308]

The Board took an array of drought-related enforcement actions, including issuing ACL complaints, ACL orders, draft CDOs, and final CDOs for unauthorized diversion and use and for failure to file annual use reports.[309]

Examples of the Board's tracking and enforcement activities during the recent drought include the following:

San Joaquin River Watershed — In May 2014, the Board received a complaint against the USBR alleging that was not maintaining contractually required flows of at least 5 cubic feet per second at Gravelly Ford below Friant Dam on the San Joaquin River.[310] The following month, the USBR surveyed the stretch of river between the dam and Gravelly Ford, identifying "20 potentially unauthorized diversions."[311] To acquire the information necessary to determine whether unauthorized diversions had taken place, in November 2014 the Board issued an Information Order to "existing and potential pre-1914 and riparian water right claimants" on that reach.[312] Those that did not respond were subject to ACL complaints, ACL orders, draft CDOs, and/or final CDOs.[313]

Deer Creek Watershed (Tributary to Sacramento River) — In June 2014, the Board issued a draft CDO to Stanford Vina Ranch Irrigation Company for failing to cease or reduce diversions in the Deer Creek watershed to maintain minimum fish flows, as required by the curtailment order the Board had adopted earlier that month.[314] The draft CDO was finalized in November 2014, when the Company agreed to "fully comply with" the Emergency Regulations for Curtailment of Diversions Due to Insufficient Flow for Specific Fisheries and to "maintain a daily record of all its diversions from Deer Creek and of the flows registered at the Department of Water Resources gaging stating below the . . . Company's points of diversion."[315]

Delta Watershed — In July 2014, the Board received a joint letter from DWR and the USBR suggesting that south and central Delta diverters claiming riparian or pre-1914 appropriative rights were likely diverting stored water and water acquired in transfers. The agencies requested the Board to order these diverters to provide information to support the basis of their asserted rights as well as their actual and expected diversions.[316] In August 2014, the California Sportfishing Protection Alliance submitted a letter refuting the USBR's accusations and urged the Board to instead investigate what it described as "the continuing illegal diversion of water from the San Joaquin, Mokelumne, Cosumnes and Calaveras Rivers and Delta agricultural return flow by DWR and USBR at their Delta pumping facilities and the illegal diversion of San Joaquin River riparian flow by the USBR at its Friant Project."[317] In response to both complaints, in February 2015 the Board issued an informational order to the 1,061 water users representing more than 90% of the riparian and pre-1914 demand in the Delta and greater Sacramento and San Joaquin River watersheds.[318]

Delta Watershed — In July 2015, the Board issued a draft CDO to West Side Irrigation District (WSID) under Water Code § 1831 and an ACL complaint to Byron-Bethany Irrigation District (BBID) under Water Code § 1052 alleging unauthorized diversions. Both Districts had continued to divert water after receiving notices of water unavailability.[319] BBID is a pre-1914 appropriator, while WSID holds a senior post-1914 license. The Board eventually dismissed the actions because it concluded that the prosecution team was unable to carry its burden of proving that water was truly unavailable under the Districts' rights with the information and analyses presented.[320] This result drove home the Board's need for more precise, accurate, and timely information about water supply and demand and a better process for analyzing water availability.

Russian River Watershed — Board staff conducted field inspections to confirm that water conservation requirements were being followed by those subject to the Enhanced Water Conservation and Additional Water User Information for the Protection of Specific Fisheries in Tributaries to the Russian River (Section C.4.10).[321] In May 2016, the Board pursued an ACL action against a landowner in the Russian River watershed who continued irrigating ornamental turf with water from the watershed after emergency regulations prohibited the practice.[322] The action ended in a conditional settlement, with the landowner paying a $1,900 fine.[323]

Russian River Watershed — In December 2015, the Board issued ACL complaints to 1,881 landowners and water suppliers in the Russian River watershed who did not respond to an August 24, 2015, informational order,[324] a violation of emergency regulations.[325] Those who failed to respond by the original deadline received reminder letters with new, later, due dates. In most cases, complaint recipients eventually submitted required water use and supply information, and the Board declined to fine them.[326]

C.5 Endnotes

[1] *See* CAL. DEP'T OF WATER RES., THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW 1–12 (1978), *available at* http://www.water.ca.gov/waterconditions/docs/9_drought-1976-77.pdf.; CAL. DEP'T OF WATER RES., CALIFORNIA'S MOST SIGNIFICANT DROUGHTS: COMPARING HISTORICAL AND RECENT CONDITIONS 51 (2015) [hereinafter CALIFORNIA'S MOST SIGNIFICANT DROUGHTS], *available at* http://www.water.ca.gov/waterconditions/docs/a9237_CalSignficantDroughts_v10_int.pdf.; *see also* Section 2.2.3.

[2] *See* THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 12–26.

[3] *See* GOVERNOR'S COMMISSION TO REVIEW CALIFORNIA WATER RIGHTS LAW, FINAL REPORT (1978), *available at* https://digitalcommons.law.ggu.edu/caldocs_agencies/426/.

[4] See CAL. DEP'T OF WATER RES., THE CALIFORNIA DROUGHT – 1977: AN UPDATE 84, 93–103, 140–45 (Feb. 1977); STATE WATER RES. CONTROL BD., DROUGHT 77: DRY YEAR PROGRAM 1 (1978) [hereinafter 1978 DRY YEAR PROGRAM REPORT].

[5] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 97–100; Edmund G. Brown, Jr., Executive Order No. B-27-77, Mar. 4, 1977.

[6] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 101–04.

[7] *See* THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 91–94.

[8] *See id.* at 95–97.

[9] CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 1, at 48.

[10] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 26.

[11] *Id.* at 26–27.

[12] *See id.*

[13] *Id.* at 28–36.

[14] *Id.* at 39.

[15] U.S. Bureau Reclamation, Mid-Pacific Region, Central Valley Project - Water Contracts (May 2017), *available at* https://www.usbr.gov/mp/mpr-news/docs/factsheets/cvp-water-contracts.pdf.

[16] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 41.

[17] CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 1, at 50.

[18] *Id.* at 50; THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 49.

[19] CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 1, at 50.

[20] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 42–50, 106.

[21] *Id.* at 51, 54.

[22] *Id.* at 83–85.

[23] 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at 1–2.

[24] *Id.* at 2.

[25] *Id.*

[26] *Id.* at 25.

[27] *Id.* at 25–26.

[28] *See* State Water Res. Control Bd., In the Matter of Application 25132 of Mammoth Water District to Appropriate Water from Lake Mary in Mono County, Decision 1461, Oct. 21, 1976, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1461.pdf.

[29] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 121.

[30] The Board approved the renewal in Decision 1465, approved two new applications (in Orders WR 77-07 and WR 77-10) and denied one (in Order WR 77-04). *See* State Water Res. Control Bd., Decision 1465, In the Matter of Renewal of Temporary Urgency Permit 16843, Application 25132 of Mammoth Water District to Appropriate Water from Lake Mary in Mono County, Mar. 17, 1977; State Water Res. Control Bd., Order WR 77-04, In the Matter of Application 25262 of Dexter D. and Valerie E. Ahlgren: San Lorenzo River in Santa Cruz County, May 12, 1977. State Water Res. Control Bd., Order WR 77-07, In the Matter of Application 25339 of North Marin County Water District for a Temporary Permit to Appropriate Water: Bear Valley Creek in Marin County, June 24, 1977; State Water Res. Control Bd., Order WR 77-10, In the Matter of Temporary Urgency for Permit 16934 (Application 25494) of Joe W. Trowbridge: Mule Spring from Mule Springs in Nevada County, Sept. 22, 1977. These orders can be accessed at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[31] State Water Res. Control Bd., Decision 1464, In the Matter of Request for Modification of Terms of Permits 16123 and 16601 by City of Santa Cruz, Mar. 17, 1977, *available at* http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1464.pdf; *Drought Related Actions*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/droughtorders.shtml (last updated Feb. 7, 2014).

[32] *See* State Water Res. Control Bd., Decision 1466, In the Matter of Request for Modification of Term of License 9847, Issued on Application 17913, City of Santa Cruz, Apr. 21, 1977, *available at* http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1466.pdf; *Drought Related Actions*, *supra* note 31.

[33] *See* State Water Res. Control Bd., Decision 1468, In the Matter of Permit 16479 Issued on Application 14442, California Department of Water Res., Apr. 21, 1977, *available at* http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1468.pdf.

[34] *See* State Water Res. Control Bd., Order WR 77-13, In the Matter of Permits 11714 and 11715 (Applications 16454 and 17291) of Humboldt Bay Municipal Water District: Mad River in Trinity County, October 20, 1977, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1977/wro77_13.pdf.

[35] State Water Res. Control Bd., Water Quality Control Plan: Sacramento-San Joaquin Delta and Suisun Marsh IV-I (1978) [1978 Bay-Delta Plan], *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/docs/1978wqcp.pdf.

[36] *See id.* at I-2, IV-6.

[37] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 26.

[38] 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at 19.

[39] 1977 Cal. Regulatory Notice Reg. 54.2–54.2.1 (Revision Record No. 24, June 11, 1977); *see also* 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at iv, 19.

[40] THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 26.

[41] *See id.* at 95–97, 115; *see also* CLIFFORD T. LEE, GOVERNOR'S COMMISSION TO REVIEW CALIFORNIA WATER RIGHTS LAW, STAFF PAPER NO. 5: THE TRANSFER OF WATER RIGHTS IN CALIFORNIA: BACKGROUND AND ISSUES 57–70 (Dec. 1977).

[42] *See* RICHARD W. WAHL, MARKETS FOR FEDERAL WATER: SUBSIDIES, PROPERTY RIGHTS, AND THE BUREAU OF RECLAMATION 137–38 (1989); X Fed. Reg. (Apr. 16, 1977).

[43] *See* THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 115.

[44] *See id*.

[45] *See id*.

[46] *See* State Water Res. Control Bd., Decision 1474, In the Matter of Review of Proposed Groundwater Transfer Plan, Anderson Farms Company, Berrenda Mesa Water District v. County of Yolo, et al., Sept. 22, 1977, http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1474.pdf

[47] *See* THE 1976–1977 CALIFORNIA DROUGHT: A REVIEW, *supra* note 1, at 116; Decision 1474, *supra* note 46, at 3.

[48] Decision 1474, *supra* note 46, at 2, 10–13.

[49] *Id.* at 6–15.

[50] 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at iii.

[51] *Id.* at 5.

[52] *Id.* at 8.

[53] *Id.*

[54] *Id.* at 8–9.

[55] *Id.* at 5.

[56] *Id.*

[57] STATE WATER RES. CONTROL BD., DROUGHT 77: DRY YEAR PROGRAM, APPENDIX 161 tbl.45 (1978) [hereinafter 1978 DRY YEAR PROGRAM REPORT APPENDIX].

[58] 1978 DRY YEAR PROGRAM REPORT APPENDIX, *supra* note 57, at 63 tbl.17, 98 tbl.34, 161 tbl.45; 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at 11.

[59] *See* Andrew M. Schwarz, *California Central Valley Water Rights in a Changing Climate*, S.F. ESTUARY & WATERSHED SCI., June 2015, at 1, 3, doi: http://dx.doi.org/10.15447/sfews.2015v13iss2art2.

[60] Decision 1474, *supra* note 46, at 3.

[61] 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at 18.

[62] *Id.*

[63] *Id.* at 23.

[64] *Id.* at 18–19.

[65] State Water Res. Control Bd., Resolution No. 77-1: Policy with Respect to Water Reclamation in California, at 2, Jan. 6, 1977, *available at* http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/1977/rs77_001.pdf.

[66] *Id.*

[67] S*ee* State Water Res. Control Bd., Decision 1463, In the Matter of Alleged Waste, Unreasonable Use, Method of Use, or Method of Diversion of Water by Mission Viejo Company, Mar. 2, 1977, *available at* http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1463.pdf.

[68] S*ee* Decision 1469, In the matter of alleged waste, unreasonable use of water by Mission Viejo Company, June 16, 1977, https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1469.pdf (modifying Decision 1463).

[69] 1978 DRY YEAR PROGRAM REPORT, *supra* note 4, at iv–v, 25.

[70] *Id.* at 24.

[71] *Id.* at 27.

[72] *Id.* at v.

[73] *See* Pete Wilson, Executive Order W-3-91, Feb. 1, 1991.

[74] CAL. DEP'T OF WATER RES., DROUGHT CONTINGENCY PLANNING GUIDELINES FOR 1989, at iii (Jan. 1989), *available at* http://www.water.ca.gov/watertransfers/docs/5_planning_guidelines-1989.pdf.

[75] CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 1, at 57–58; *see also* CAL. WATER CODE §§ 1020(c)(2), 1025.5, 1030.

[76] *See* DEP'T OF WATER RES., 2015 URBAN WATER MANAGEMENT PLANS GUIDEBOOK FOR URBAN WATER SUPPLIERS, at 8-3 to 8-19 (2016), available at https://www.water.ca.gov/LegacyFiles/urbanwatermanagement/docs/2015/UWMP_Guidebook_Mar_2016_FINAL.pdf.

[77] *Central Valley Project Improvement Act (CVPIA)*, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/mp/cvpia/ (last updated Dec. 19, 2017).

[78] *See* CAL. DEP'T OF WATER RES., CALIFORNIA'S 1987–1992 DROUGHT: A SUMMARY OF SIX YEARS OF DROUGHT 33 (July 1993), *available at* http://www.water.ca.gov/watertransfers//docs/2_drought-1987-92.pdf.

[79] *See id.* at 31.

[80] *See id.* at 33–35.

[81] *See id.* at 27.

[82] *See id.* at 28.

[83] CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 1, at 56.

[84] *Id.* at 55–56.

[85] CALIFORNIA'S 1987–1992 DROUGHT, *supra* note 78, at 20, 25.

[86] CAL. DEP'T OF WATER RES., PREPARING FOR CALIFORNIA'S NEXT DROUGHT: CHANGES SINCE 1987–1992, at 17–18 (July 2000), *available at* http://www.water.ca.gov/waterconditions/docs/Drought_Report_87-92.pdf.

[87] CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 1, at 56.

[88] PREPARING FOR CALIFORNIA'S NEXT DROUGHT, *supra* note 86, at 33.

[89] CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 1, at 57.

[90] PREPARING FOR CALIFORNIA'S NEXT DROUGHT, *supra* note 86, at 34–35.

[91] *See, e.g.*, CALIFORNIA'S 1987–1992 DROUGHT, *supra* note 78, and other publications listed at *Publications*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/waterconditions/publications.cfm (last modified Oct. 3, 2017); KENNETH W. UMBACH, CAL. RESEARCH BUREAU, ISSUE SUMMARY: AGRICULTURE, WATER, AND CALIFORNIA'S DROUGHT OF 1987–92: BACKGROUND, RESPONSES, LESSONS (1994); BENEDYKT DZIEGIELEWSKI, HARI P. GARBHARRAN & JOHN F. LANGOWSKI, JR., LESSONS LEARNED FROM THE CALIFORNIA DROUGHT (1987–1992), U.S. Army Corps of Engineers, Inst. for Water Res. Report 93-NDS-5 (1993).

[92] The Board approved Orders WR 87-05, WR 87-09, WR 87-11, WR 88-13, WR 88-16, WR 88-21, WR 89-02, WR 89-05, WR 89-06, WR 89-09, WR 89-12,WR 89-13, WR 89-22, WR 89-26, WR 90-07, WR 90-19, WR 91-09, WR 92-06. It denied Order WR 88-09. These orders can be accessed at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[93] CVP-associated orders included Orders WR 87-10, WR 87-12, WR 88-05, WR 88-18, WR 88-23, WR 88-24, WR 89-01, WR 89-10. Other orders included Orders WR 87-13 and WR 89-03. These orders can be accessed at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[94] State Water Res. Control Bd., Order WR 88-15, In the Matter of Application 5626 et al. of U. S. Bureau of Reclamation: Indian Slough in Alameda, Amador, Calaveras, Contra Costa, and San Joaquin Counties, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1988/wro88-15.pdf.

[95] *See* CAL. DEP'T OF WATER RES., CALIFORNIA'S CONTINUING DROUGHT 37 (Jan. 1991), *available at* http://www.water.ca.watertransfers//docs/3_jan-1991.pdf.

[96] *See* State Water Res. Control Bd., Orders WR 88-12, WR 88-17, WR 89-17, WR 89-20, and WR 90-08. These orders can be accessed at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[97] *See* State Water Res. Control Bd., Order WR 89-21, In the Matter of Conditional Temporary Change Order for Permitted Application 5626 and 12 others, as listed in Table 1 of U.S. Bureau of Reclamation: Old River in Contra Costa County, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1989/wro89-21.pdf.

[98] *See* State Water Res. Control Bd., Order WR 89-24, In the Matter of Conditional Temporary Urgency Change Order on Permit 16482 (Application 17512) of State Department of Water Resources: Sacramento-San Joaquin Delta and San Luis Creek in Sacramento, Contra Costa and Merced Counties, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1989/wro89-24.pdf; State Water Res. Control Bd., Order WR 90-12, In the Matter of Conditional Order Allowing Temporary Urgency Change in Place of Use Involving the Interbasin Transfer of 1,500 acre-feet of Water from the Tulare Lake Basin Water Storage District to Westlands Water

District under Permit 16482, (Application 17512) of California Department of Water Resources: Italian Slough, Sacramento-San Joaquin Delta and San Luis Creek in Sacramento, Contra Costa and Merced Counties, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1990/wro90-12.pdf.

[99] *See* State Water Res. Control Bd., Order WR 90-14, In the Matter of Permit 15026 on Application 5632 of Yuba County Water Agency: North Yuba, Yuba, Middle Yuba Rivers, and Oregon Creek in Yuba, Nevada, Butte, Sutter Counties, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1990/wro90-14.pdf.

[100] *See* State Water Res. Control Bd., Order WR 91-05, In the Matter of Permit 15026 (Application 5632) of Yuba County Water Agency: North Yuba, Yuba Middle Yuba, and Oregon Creek in Yuba, Nevada, Butte and Sutter Counties., *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1991/wro91-05.pdf.

[101] *See* Cal. Stats. 1991, 1st Ex. Sess. 1991, ch. 1, 2.

[102] Ray Coppock, Brian E. Gray & Edward McBean, *California Water Transfers: The System and the 1991 Drought Water Bank*, *in* SHARING SCARCITY: GAINERS & LOSERS IN WATER MARKETING, at 21, 28, 31–33 (Harold O. Carter et al. eds., 1994).

[103] *Id.* at 34–36.

[104] *Id.* at 36–37 (stating that the difference resulted from two main factors: carriage water losses during transport through the Delta and "heavy and unexpected March rains [which] decreased demand, particularly for 'noncritical' uses"). *See also* Morris Israel & Jay R. Lund, *Recent California Water Transfers: Implications for Water Management*, 35 NAT. RES. J. 1, 11–, 16–17 (1995).

[105] *See* CAL. WATER CODE §§ 1201, 1706.

[106] *See* Brian Gray, *The Role of Laws and Institutions in California's 1991 Water Bank*, *in* SHARING SCARCITY: GAINERS & LOSERS IN WATER MARKETING, at 133, 149 (Harold O. Carter et al. eds., 1994).

[107] *See id*. at 133, 144.

[108] *Id*.

[109] CAL. WATER CODE § 1701.

[110] Gray, *supra* note 106, at 145 (citing interview with the Board's Executive Director).

[111] *See id.* at 133, 145; CAL. DEP'T OF WATER RES., THE 1991 DROUGHT WATER BANK 8, 12, *available at* http://www.water.ca.gov/waterconditions/docs/10_1991-water_bank.pdf.

[112] *See* Gray, *supra* note 106, at 143–44 (citing interviews with the Manager of the Drought Water Bank and the Board's Executive Director).

[113] *See* Israel & Lund, *supra* note 104, at 17.

[114] *Id.* at 14–19.

[115] *Id.* at 16–17.

[116] DROUGHT CONTINGENCY PLANNING GUIDELINES FOR 1989, *supra* note 74, at 75.

[117] State Water Res. Control Bd., Order WR 90-17, In the Matter of Administrative Civil Liability Issued to Harold and Anna Belle Brown (Complaint No. 262.10.03): Wadsworth Canal in Sutter County, at 2, Nov. 27, 1990, *available at* http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1990/wro90-17.pdf.

[118] *See* CALIFORNIA'S CONTINUING DROUGHT, *supra* note 95, at 37; DROUGHT CONTINGENCY PLANNING GUIDELINES FOR 1989, *supra* note 74, at 75.

[119] *See* Kevin O'Brien, Comment Letter to Felicia Marcus, Chair, State Water Res. Control Bd., at 2, May 19, 2014, available at https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/comments052014/docs/kevin_obrien.pdf (stating that the Board "issued notices of curtailment for all post-1914 appropriative water rights . . . in 1977, 1988, 1991, 1992, and 1994"); *see also Drought and Water Rights Frequently Asked Questions*, State Water Reources Control Bd., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/faq.shtml#curtailment (last updated May 22, 2015) (stating that the Board "curtailed water rights in 1987-88").

[120] DROUGHT CONTINGENCY PLANNING GUIDELINES FOR 1989, *supra* note 74, at 75.

[121] Order WR 90-17, *supra* note 117, at 2 (stating that the target of the ACL complaint had received a notice of water unavailability on June 29, 1990, and that "Board staff conducted a field investigation on July 10, 1990); CALIFORNIA'S CONTINUING DROUGHT, *supra* note 95, at 37.

[122] CALIFORNIA'S CONTINUING DROUGHT, *supra* note 95, at 37.

[123] *See* sources cited *supra* note 119.

[124] *See* Schwarz, *supra* note 59, at 1, 3–4.

[125] State Water Res. Control Bd., Decision 1623, In the Matter of Availability of Reclaimed Water for Greenbelt Irrigation in the San Gabriel Valley Water Company Service Area in the Vicinity of the San Jose Creek Reclamation Plant of the Los Angeles County Sanitation Districts in Los Angeles County, at 16–17, Feb. 16, 1989 (amended on Jan. 18, 1990), *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1623.pdf.

[126] *Id*. at 16.

[127] State Water Res. Control Bd., Decision 1625, In the Matter of the Complaint by City of Santa Barbara Against the Use of Potable Water by the Tsukamoto Sogyo Co. for the Irrigation of Montecito Country Club when Reclaimed Water Meeting the Requirements of Water Code Section 13550 is available in Santa Barbara County, Feb. 15, 1990, *available at* https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1625.pdf.

[128] DROUGHT CONTINGENCY PLANNING GUIDELINES FOR 1989, *supra* note 74, at 76; CALIFORNIA'S CONTINUING DROUGHT, *supra* note 95, at 37.

[129] *See* Order WR 90-17, *supra* note 117.

[130] *See* J.S. Famiglietti et al., *Satellites Measure Recent Rates of Groundwater Depletion in California's Central Valley*, 38 GEOPHYSICAL RESEARCH LETTERS L03403, at 3 tbl. 1 (2011), doi:10.1029/2010GL046442.

[131] *See* Arnold Schwarzenegger, Executive Order S-06-08, June 4, 2008.

[132] *See* Arnold Schwarzenegger, Emergency Proclamation: Central Valley, June 12, 2008.

[133] *See* Arnold Schwarzenegger, State of Emergency — Water Shortage, Feb. 27, 2009 [hereinafter 2009 Drought Proclamation], *available at* https://www.gov.ca.gov/news.php?id=11557.

[134] *See id*.

[135] *See* Arnold Schwarzenegger, Executive Order S-11-08, June 19, 2009; Arnold Schwarzenegger, State of Emergency: Fresno County, July 21, 2009.

[136] CAL. DEP'T OF WATER RES., CALIFORNIA'S DROUGHT OF 2007–2009: AN OVERVIEW 31 tbl.7 (2010) [hereinafter CALIFORNIA'S DROUGHT OF 2007–2009: AN OVERVIEW], *available at* http://www.water.ca.gov/waterconditions/docs/DroughtReport2010.pdf.

[137] U.S. Bureau of Reclamation, Summary of Water Supply Allocations (2017), *available at* https://www.usbr.gov/mp/cvo/vungvari/water_allocations_historical.pdf.

[138] *Id.*

[139] *Id.*

[140] *See* Cal. Dep't of Fish & Wildlife, State & Federally Listed Endangered & Threatened Animals of California, at 4–6 (Oct. 2017), *available at* https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109405.

[141] *See* CALIFORNIA'S MOST SIGNIFICANT DROUGHTS, *supra* note 1, at 59; *see also* JULIET CHRISTIAN-SMITH, MORGAN C. LEVY & PETER H. GLEICK, IMPACTS OF THE CALIFORNIA DROUGHTS FROM 2007 TO 2009, at 24 (2011), *available at* https://pacinst.org/publication/impacts-of-the-drought-2007-2009/.

[142] *See* CHRISTIAN-SMITH et al., *supra* note 141, at 6, 23.

[143] *Id.* at 8, 64–76.

[144] *See, e.g.*, CALIFORNIA'S DROUGHT OF 2007–2009: AN OVERVIEW, *supra* note 136, and other publications listed at *Publications*, CAL. DEP'T OF WATER RES., http://www.water.ca.gov/waterconditions/publications.cfm (last modified Oct. 3, 2017); CHRISTIAN-SMITH et al., *supra* note 141.

[145] *See* Orders WR 2009-0002-DWR, WR 2009-0049-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[146] Approved: Orders WR 2007-0002-DWR; WR 2007-0015-DWR; WR 2007-0021-DWR; WR 2007-0022-DWR; WR 2007-0028-DWR. WR 2007-0038-DWR; WR 2008-0029-EXEC; WR 2008-0036-DWR; WR 2009-0024-DWR; WR 2009-0027-DWR; WR 2009-0033; WR 2009-0034-EXEC; WR 2009-0056-EXEC; WR 2009-0059-EXEC. Denied: Order WR 2007-0032-DWR. These orders can be accessed at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[147] Order WR 2009-0027-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[148] Order WR 2009-0034-EXEC, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[149] Order WR 2008-0029-EXEC, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[150] Order WR 2009-0033, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[151] Order WR 2009-0013-EXEC, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[152] *See* Orders WR 2007-0012-DWR, WR 2007-0014-DWR, WR 2007-0019-DWR, WR 2007-0023-DWR, WR 2007-0024-DWR, WR 2007-0026-DWR, WR 2007-0033-DWR, WR 2007-0036-DWR, WR 2007-0040-DWR, WR 2008-0022-DWR, WR 2008-0030-DWR, WR 2008-0031-DWR, WR 2008-0034-DWR, WR 2008-0035-DWR, WR 2008-0040-DWR, WR 2008-0046-DWR, WR 2008-0047-DWR, WR 2009-0003-DWR, WR 2009-0026-DWR, WR 2009-0037-DWR, WR 2009-0038-DWR, WR 2009-0040-DWR, WR 2009-0041-DWR, WR 2009-0042-DWR, WR 2009-0043-DWR, WR 2009-0044-DWR, WR 2009-0045-DWR, WR 2009-0046-DWR, WR 2009-0047-DWR, WR 2009-0048-DWR, WR 2009-0051-DWR, WR 2009-0053-DWR, WR 2009-0054-DWR, WR 2009-0055-DWR, WR 2009-0058-DWR. These orders can be accessed at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[153] Order WR 2009-0033, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[154] *State Water Board Drought Related Actions*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/droughtorders.shtml (last updated Feb. 15, 2018).

[155] *See* MBK Engineers, Memorandum Report: Water Availability Analysis for River Garden Farms Company Application to Appropriate Water, at 6, Jan. 20, 2012, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/appropriations/2012/a031919_attach2.pdf.

[156] *See* MICHAEL HANEMANN ET AL., CLIMATE VULNERABILITY AND ADAPTATION STUDY FOR CALIFORNIA: LEGAL ANALYSIS OF BARRIERS TO ADAPTATION FOR CALIFORNIA'S WATER SECTOr 9–13 (July 2012), *available at* http://www.energy.ca.gov/2012publications/CEC-500-2012-019/CEC-500-2012-019.pdf (noting that Board staff wrote a memo to the Delta Vision Blue Ribbon Task Force in September 2008 explaining its data deficiencies due to the lack of a penalty for not filing statements of diversion and use, among other things, and that the legislature subsequently introduced a penalty).

[157] The Board did, however, carry out a number of formal enforcement actions that overlapped with, but did not appear to be specifically related to the drought. *See Cease and Desist Actions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/cease_desist_actions/ (last updated July 19, 2018); *Administrative Civil Liability Complaint Actions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/acl_complaint_actions/ (last updated June 19, 2017); Revocations and Cancellations, STATE WATER RES. CONTROL BD., https://www.water

boards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/revocations/ (last updated July 5, 2018).

[158] *See* Letter from Edmund G. Brown, Jr., California Governor, to Karen Ross, Secretary, California Department of Food and Agriculture, Felicia Marcus, Chairwoman, State Water Resources Control Board, Mark Cowin, Director, Department of Water Resources, and Mark Ghilarducci, Director, Office of Emergency Services (Dec. 17, 2013), *available at* https://www.gov.ca.gov/docs/12.17.13_Drought_Task_Force.pdf.

[159] *See* Edmund G. Brown, Jr., A Proclamation of a State of Emergency, Jan. 17, 2014 [hereinafter 2014 Drought Proclamation], *available at* http://gov.ca.gov/news.php?id=18379.

[160] *Id.* at directives 5, 8, and 9. Directive 9 contains that suspensions. It states:

> The Department of Water Resources and the Water Board will take actions necessary to make water immediately available, and, for purposes of carrying out directives 5 and 8, Water Code section 13247 and Division 13 (commencing with section 21000) of the Public Resources Code and regulations adopted pursuant to that Division are suspended on the basis that strict compliance with them will prevent, hinder, or delay the mitigation of the effects of the emergency. Department of Water Resources and the Water Board shall maintain on their websites a list of the activities or approvals for which these provisions are suspended.

[161] *See* Order Approving a Temporary Urgency Change in License and Permit Terms and Conditions Requiring Compliance with Delta Water Quality Objectives in Response to Drought Conditions, at 7, Jan. 31, 2014, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/bd_change_order.pdf [hereinafter Jan. 31 Order]; *see also State Water Res. Control Bd. Cases*, 136 Cal. App. 4th 674, 729–732 (2006)

[162] *See* Edmund G. Brown, Jr., Executive Order to Redouble State Drought Actions/ A Proclamation of a Continued State of Emergency, April 25, 2014 [hereinafter April 2014 Executive Order], *available at* https://www.gov.ca.gov/news.php?id=18496.

[163] Edmund G. Brown, Jr., Executive Order B-28-14, Dec. 22, 2014, https://www.gov.ca.gov/news.php?id=18815.

[164] Edmund G. Brown, Jr., Executive Order B-29-15, Apr. 1, 2015, https://www.gov.ca.gov/docs/4.1.15_Executive_Order.pdf.

[165] Edmund G. Brown, Jr., Executive Order B-36-15, Nov. 13, 2015, https://www.gov.ca.gov/docs/11.13.15_EO_B-36-15.pdf.

[166] Edmund G. Brown, Jr., Executive Order B-37-16, May 9, 2016, https://www.gov.ca.gov/docs/5.9.16_Attested_Drought_Order.pdf.

[167] Edmund G. Brown, Jr., Executive Order B-40-17, Apr. 7, 2017, https://www.gov.ca.gov/docs/4.7.17_Attested_Exec_Order_B-40-17.pdf.

[168] *See* Notices 12-09, 13-09, 14-07, 15-03, and 16-06, accessible at *Water Deliveries*, CAL. DEP'T OF WATER RES., http://wdl.water.ca.gov/swpao/deliveries.cfm.

[169] U.S. Bureau of Reclamation, Summary of Water Supply Allocations (2017), *available at* https://www.usbr.gov/mp/cvo/vungvari/water_allocations_historical.pdf.

[170] *Id.*

[171] *Id.*

[172] *Id.*

[173] *See* State Water Res. Control Bd., Notice of Solicitation Regarding Improvements to the Implementation and Enforcement of Water Rights During Drought Conditions, Sept. 10, 2014, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/notice_dryyear091014.pdf.

[174] *See* Public Comments Regarding Improvements and Enforcement of Water Rights During Drought Conditions, State Water Res. Control Bd., https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/dryyear_report/comments2014oct/index.shtml (last updated Nov. 17, 2014); State Water Res. Control Bd., Public Comments regarding Report on Recommended Improvements to the Implementation and Enforcement of Water Rights during Drought Conditions, available at https://www.waterboards.ca.gov/board_info/agendas/2015/feb/021715_comments_4.pdf.

[175] *See* STATE WATER RES. CONTROL BD., RECOMMENDATIONS FOR IMPROVING THE ADMINISTRATION OF THE WATER RIGHTS PRIORITY SYSTEM IN DRY YEARS 3 (2015) [hereinafter 2015 DRY YEAR PROGRAM REPORT], *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/dryyear_report/docs/feb2015_dyr.pdf.

[176] *Id.* at 2–3.

[177] *Id.* at 13.

[178] *Id.*

[179] *See e-WRIMS Water Right Progress Report*, STATE WATER RES. CONTROL BD., http://ciwqs.waterboards.ca.gov/ciwqs/ewrims/EwMonthlyReportingServicesServlet?rptId=8&isPublic=true (last visited Jan. 29, 2018) (select a date range of October 2011 to September 2016, then select "Permitting (Temporary)," click "Generate Report," and click on "46" under "New" on the page that appears).

[180] *See Transfers and Temporary Urgency Actions – Orders*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/transfers_tu_orders/ (last updated Nov. 1, 2017); http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/transfers_tu_orders/docs/t032258_order_denial.pdf; https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/transfers_tu_orders/docs/2016/32649order.pdf

[181] *Water Rights for Groundwater Recharge*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/ (last updated Dec. 8, 2017).

[182] *See* Amanda Montgomery et al., Presentation: Workshop on Fees and Processing of Temporary Permits for Groundwater Recharge, Apr. 26, 2016, http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/docs/staffpresentation.pdf; Fiscal Year 2016-17 Fee Schedule Summary, http://www.waterboards.ca.gov/waterrights/water_issues/programs/fees/docs/fy1617_finalfeeschedulesummary.pdf.

[183] *See Water Rights for Groundwater Recharge*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/ (last updated Dec. 8, 2017).

[184] *Id*.

[185] *See* Cal. Dep't of Fish & Wildlife, State Streamlines Domestic Water Tank Storage Process in Response to Drought, Mar. 13, 2014, *available at* https://cdfgnews.wordpress.com/2014/03/13/state-streamlines-domestic-water-tank-storage-process-in-response-to-drought/; Salmonid Restoration Federation, Emergency Water Tank Storage Registration Program (2014), *available at* http://srf.accelerantdesign.net/sites/default/files/files/ETR_Brochure2014.pdf.

[186] *Water Rights Registrations Program*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/registrations/ (last updated Oct. 19, 2017).

[187] *See* Salmonid Restoration Federation, *supra* note 185.

[188] Note that other TUCPs involved temporary transfers. These are addressed in Section C.4.4.

[189] *See State Water Board Drought Year Water Actions Taken with California Environmental Quality Act Suspensions*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/wb_actions.shtml (last updated Aug. 29, 2016); Petitions and oders available at *Transfers and Temporary Urgency Actions – Notices*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/transfers_tu_notices/ (last updated July 18, 2018).

[190] During the recent drought, the Board approved temporary urgency wastewater change petitions for El Dorado Irrigation District in 2014 and again in 2015, but revoked the 2015 order a few months later after receiving more than 35 comments from people who lived near Deer Creek expressing concern that reducing the flows of treated wastewater had negatively impacted riparian habitat along creek. *See* State Water Res. Control Bd., Order Revoking Temporary Urgency Change In the Matter of Wastewater Change Petition 20 (WW0020), El Dorado Irrigation District, July 15, 2015, available at http://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/revocations/2015/ww0020_rev_ord.pdf.

[191] Sacramento-San Joaquin Bay-Delta Estuary Decision 1641 Compliance, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/compliance_monitoring/sacramento_sanjoaquin (last updated Dec. 6, 2017).

[192] *United States Bureau of Reclamation's New Melones Project Temporary Urgency Change Petitions*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/tucp/usbr_tucp.shtml (last updated Jan. 9, 2018); *Sacramento River Temperature and Order 90-5 Compliance*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/sacramento_river/ (last updated Jan. 10, 2018); Order WR 90-05.

[193] State Water Res. Control Bd., October 7, 2014 TUCP Order, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/10072014_tucp_order.pdf.

[194] *See* State Water Res. Control Bd., Jan. 31, 2014 TUCP Order, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/bd_change_order.pdf.

[195] *See* State Water Res. Control Bd., Mar. 5, 2015, TUCP Order, at 23, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/tucp_order030515.pdf ("Together, operations to meet unchanged Delta outflow, San Joaquin River flow and DCC Gate closure requirements approved in this Order and the February 3 Order could significantly reduce stored water supplies and opportunities to store additional supplies and reduce opportunities to export water as discussed above, making those supplies unavailable for the remainder of the season, primarily to water supply contractors and prior water right holders, and to some extent for fisheries protection, control of Delta salinity and refuge supplies.").

[196] *See* State Water Res. Control Bd., Apr. 6, 2015, TUCP Order, at 5, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/tucp_order040615.pdf.

[197] *See id*. at 3.

[198] See id. at 3.

[199] *See* State Water Res. Control Bd., Mar. 18, 2016, TUCP Order, at 3, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/tucp/docs/notice_temp_plan031816.pdf.

[200] SWP and CVP TUCP-related orders and other documents can be accessed from the following webpage: *State Water Project and Central Valley Project Temporary Urgency Change Petition*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/tucp.shtml (last updated Oct. 7, 2014).

[201] State Water Res. Control Bd., July 31, 2015, TUCP Order, at 3, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/tucp_order070315.pdf.

[202] Order WR 2015-0043, *available at* http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/2015/wro2015_0043.pdf.

[203] 2014 Drought Proclamation, *supra* note 159, at directives 5, 8, and 9. Directive 9 contains the suspensions.

[204] *Governor Brown Issues Executive Order to Redouble State Drought Actions*, OFFICE OF GOVERNOR EDMUND G. BROWN JR., Apr. 25, 2014, http://gov.ca.gov/news.php?id=18496.

[205] *Water Transfers Program: Transfer Process Streamlining*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/ (last updated May 2, 2014).

[206] Information from the following sources, unless otherwise noted: State Water Res. Control Bd., 2014 Water Transfers Under Water Code Section 1725, *available at* http://www.swrcb.ca.gov/waterrights/water_issues/programs/water_transfers/docs/2014transfertable.pdf; *Transfers and Temporary Urgency Actions – Orders*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/transfers_tu_orders/index.shtml (last updated Aug. 28, 2014).

[207] 2015 DRY YEAR PROGRAM REPORT, *supra* note 175, at 4.

[208] *See* Central Valley Project and State Water Project 2016 Drought Contingency Plan for Water Project Operations, February - November 2016, at 16 (submitted Jan. 15, 2016), available at http://www.water.ca.gov/waterconditions/docs/2016-DroughtContingencyPlan-CVP-SWPOperations-Feb-Nov_1.19.16-FINAL.pdf at 16 (describing the forecasts as "combin[ing] runoff associated with antecedent conditions with anticipated runoff resulting from precipitation predicted to occur for the remainder of the year under the 50%, 90%, and 99% hydrologic exceedence scenarios"; explaining that "the 90% exceedence hydrology assumes inflows from rainfall and snowmelt at levels that are likely to be exceeded with a 90% probability, or in other words, there is a 10% or less chance of actual conditions turning out to be this dry or drier from this point forward," while "[t]he 50% probability is the 50/50 assumption - it is just as likely to be drier or wetter").

[209] *See, e.g.*, State Water Res. Control Bd., 2015 Combined Sacramento river Basin Senior Supply/Demand Analysis with North Delta Demand (dated Sept. 10, 2015) [hereinafter 2015 Combined Demand], *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/analysis/docs/sacndelta.pdf; *see also Daily Full Natural Flows*, CAL. DATA EXCHANGE CTR., https://cdec.water.ca.gov/cgi-progs/stages/FNF (last visited Jan. 15, 2018); *Unimpaired Runoff Calculations*, CAL. DATA EXCHANGE CTR., http://cdec.water.ca.gov/snow/current/flow/fnfinfo.html (last visited Jan. 15, 2018) (""Unimpaired Runoff" or "Full Natural Flow" represents the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds. Gauged flows at the given measurement points are increased or decreased to account for these upstream operations.").

[210] *See, e.g.*, 2015 Combined Demand, *supra* note 209; *see also* CAL. DEP'T OF WATER RES., CALIFORNIA CENTRAL VALLEY UNIMPAIRED FLOW DATA FOURTH EDITION DRAFT (May 2007) [hereinafter UNIMPAIRED FLOW DATA], https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/sjrf_spprtinfo/dwr_2007a.pdf.

[211] 2015 DRY YEAR PROGRAM REPORT, *supra* note 175, at 5.

[212] *Id.*

[213] Order WR 2015-0002-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[214] *See* Andrew Tweet, Water Right Curtailment Analysis for California's Sacramento River: Effects of Return Flows 2 (2016) (Master's Thesis), *available at* https://watershed.ucdavis.edu/shed/lund/students/Andy_Tweet_MS.pdf ("Currently, the Board determines when curtailments are needed by comparing unimpaired flow estimates at the outlet of a major watershed to total reported recent demand upstream of those outlets. When the unimpaired flow estimate is less than the total demand, SWRCB determines the necessary number of water rights to curtail to bring allocated demand in balance with the estimated unimpaired flow supply.").

[215] *See Watershed Analysis*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/analysis/ (last updated July 26, 2017).

[216] State Water Res. Control Bd., Notice of Surface Water Shortage and Potential for Curtailment of Water Right Diversions, Jan. 17, 2014, *available at* http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/docs/notice_of_curtailment.pdf.

[217] State Water Res. Control Bd., Notice of Potential Curtailment of Diversion of Water Under Certain Water Rights Within the Scott River Watershed in Siskiyou County, Jan. 22, 2014, *available at* http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/docs/scottrivercurtailment.pdf.

[218] *Standard Term 91 (Stored Water Bypass Requirements)*, OFFICE OF DELTA WATERMASTER, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/water_issues/programs/delta_watermaster/term91.shtml.

[219] State Water Res. Control Bd., Notice of Surface Water Shortage and Potential for Curtailment of Water Right Diversions for 2015 (Jan. 23, 2015), available at http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/2015_notice.pdf.

[220] *See* State Water Res. Control Bd., Notice of Probable Curtailment of Water Diversion During 2015 (Term 91), Feb. 13, 2015, available at http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/docs/021315_term91_notice_ltr.pdf.

[221] State Water Res. Control Bd., Curtailment of Water Right Diversion Expected Soon, Apr. 2, 2015, available at http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/2015april_curt.pdf.

[222] See Notice of Probable Curtailment of Permits and Licenses Subject to Term 91, May 10, 2016, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/water_availability/term91probcurt2016.pdf.

[223] Map imagery is based on the following sources: Cal. Dep't of Water Res., California Water Plan Layered Map (2013), *available at* http://www.water.ca.gov/waterplan/docs/cwpu2013/Final/California_layered-online-map_10.pdf (base, hydrologic region, watershed, and water feature layers copied into Adobe Illustrator and edited); Scott Armentrout et al., Watershed Analysis for Mill, Deer, and Antelope Creeks 23 fig.8 (1998), http://www.krisweb.com/biblio/ccv_usdafs_armentroutetal_1998.pdf (Deer, Mill, and Antelope Creek Watershed boundaries traced in Adobe Illustrator).

[224] State Water Res. Control Bd. Resolution No. 2014-0023, To Adopt Emergency Regulations for Curtailment of Diversion Due to Insufficient Flow for Specific Fisheries 1-2 (May 21, 2014), http://www.waterboards.ca.gov/board_decisions//adopted_orders/resolutions/2014/rs2014_0023_corrected_with%20regs.pdf. For a fuller exploration of this issue, *see* Elizabeth Vissers, *Low Flows, High Stakes: Lessons from Fisheries Management on Mill, Deer, and Antelope Creeks During California's Historic Drought*, 23 WEST-NORTHWEST J. ENVTL. L. & POL'Y, 169 (2017).

[225] 2015 DRY YEAR PROGRAM REPORT, *supra* note 175, at 1.

[226] Resolutions 2014-0023 and 2015-0014, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[227] Vissers, *supra* note 224, at 190–91.

[228] *Id*. at 193–94.

[229] *See California Water Curtailment Cases*, No. 1-15-CV-285182 (Cal. Super. Ct., Santa Clara Cnty.). This proceeding coordinates the following cases: *Banta-Carbona Irrigation Dist. v. Cal. Water Resources Control Bd.*, No. 39-2015-00326421 (Cal. Super. Ct., San Joaquin Cnty., filed date); *Byron-Bethany Irrigation Dist. v. Cal. Water Resources Control Bd.*, No. NI50967 (Cal. Super. Ct., Contra Costa Cnty.); *Byron-Bethany Irrigation Dist. v. Cal. Water Resources Control Bd.*, No. 34-2016-80002388 (Cal. Super. Ct., Contra Costa Cnty.); *Patterson Irrigation Dist. v. Cal. Water Resources Control Bd.*, No. 2015307 (Cal. Super. Ct., Stanislaus Cnty.); *San Joaquin Tributaries Auth. v. Cal. Water Resources Control Bd.*, No. 2015366 (Cal. Super., Stanislaus Cnty. Ct.); *San Joaquin Tributaries Auth. v. California Water Resources Control Board*, No. 34-2016-80002389 (Calif. Super. Ct., Stanislaus Cnty.); *The West Side Irrigation Dist. v. Cal. Water Resources Control Bd.*, No. 34-2015-80002121 (Cal. Super. Ct., Sacramento Cnty.); *The West Side Irrigation Dist. v. Cal. Water Resources Control Bd.*, No. 34-2016-80002387 (Cal. Super. Ct., Sacramento Cnty.).

[230] State Water Res. Control Bd., Partial Rescission of April, May, and June 2015 Curtailment Notices and Clarification of State Water Resources Control Board Position Re: Notices of Unavailability of Water for Those Diverting Water in the Sacramento River Watershed, San Joaquin River Watershed and Delta, and Scott River (July 15, 2015), available at http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/water_availability/july15_clarif_ltr.pdf.

[231] *California Water Curtailment Cases*, No. 1-15-CV-285182, Cal. Super., Santa Clara Co., Statement of Decision, Phase I Trial, at 24–31, Feb. 20, 2018.

[232] *Id.* at 38–39.

[233] *Id*. at 30–31.

[234] Resolution 2014-0031 accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[235] CAL. CODE REGS. Tit 23, §§ 877–879.2; *see also Curtailment of Diversions Due to Insufficient Flow for Specific Fisheries*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/mill_deer_antelope_creeks.shtml.

[236] CAL. CODE REGS. Tit 23, § 878.1(a)(1).

[237] *See* CAL. CODE REGS. Tit 23, § 878.1(d).

[238] CAL. CODE REGS. Tit 23, § 878.1(b)(1) (for diversions "not exceeding 10 acre-feet per year of storage or 4,500 gallons per day of direct diversion"). The conditions are:

(A) Not more than 50 gallons per person per day will be diverted under all bases of right;

(B) The diversion is necessary to achieve the minimum amount of water necessary for health and safety, up to 50 gallons per person per day, after all other alternate sources of potable water have been used. To the extent other potable water is available, those sources will be used first and the total used will not exceed 50 gallons per person, per day;

(C) The diverter or all end users are operating under the strictest existing conservation regime for that place of use, if such a plan exists for the area or service provider, or shall be operating under such regime within 30 days. If additional approvals are required before implementation of the conservation regime, the diverter must certify that all possible steps will be taken immediately to ensure prompt approval;

(D) No potable water will be used for outdoor landscaping while this approval is in effect. Water service providers must implement this provision as rapidly as possible, up to a limit of 15 days. If additional approvals are

required before implementation of the conservation regime, the diverter must certify that all possible steps will be taken to ensure prompt approval;

(E) If the diverter has the authority to set rates, that such rates are set to encourage conservation, or that changing the rates to encourage conservation shall be considered at the next opportunity, but no later than 30 days from certification. If additional approvals are required before implementation of such a rate structure, the diverter must certify that all possible steps will be taken to ensure prompt approval. If the diverter does not implement rates to encourage conservation, it must submit to the Deputy Director with the next required reporting an explanation of why such rate setting is inappropriate despite the current drought;

(F) If the diverter is a public water supplier under Water Code section 350 et seq., that it has declared a water shortage emergency condition and adopted regulations and restrictions on the delivery of water or has noticed a meeting for adoption within the next 10 days, and shall adopt conservation and water delivery restrictions and regulations within the next 30 days. To the extent regulations and restrictions require additional approval, the diverter must certify that all possible steps will be taken to ensure prompt approval.

(G) The diverter has either pursued steps to acquire other sources of water, but has not yet been completely successful, as described in an attached report, or the diverter will pursue the steps in an attached plan to identify and secure additional water.

CAL. CODE REGS. Tit 23, § 878.1(b)(1).

[239] CAL. CODE REGS. Tit 23, § 878.1(b)(2) (for diversions "exceeding 10 acre-feet of storage or a total of 4,500 gallons per day" or "50 gallons per person, per day"). The petition must "[c]ertify compliance and provide documentation of the actions described in subdivision (b)(1)(C)-(b)(1)(G)" and "[d]escribe any other additional steps the diverter will take to reduce diversions and consumption." *Id.* § 878.1(b)(2)(B), (C). If the petition seeks > 50 gallons per person, per day, it must explain why "the requested diversion amount [is] necessary to meet minimum health and safety needs" and "[p]rovide the timeframe in which the diverter expects to reduce usage to no more than 50 gallons per person, per day, or why minimum health and safety needs will continue to require more water." *Id.* § 878.1(b)(2)(A), (D). The Board can condition "approval on implementation of additional conservation measures and reporting requirements." *Id.* § 878.1(b)(2)

[240] CAL. CODE REGS. Tit 23, § 878.1(c), (d)(2)–(6).

[241] CAL. CODE REGS. Tit 23, § 878.1(c).

[242] CAL. CODE REGS. Tit 23, § 878.1(c).

[243] State Water Res. Control Bd., Statewide Drought Related Curtailment of Water Diversions Emergency Regulations Digest, at 9 (June 20, 2014), *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/emergency_regulations/sw_eregs_digest_062014.pdf [hereinafter June 20 Digest].

[244] *Id.*

[245] *Id.* ("Mindful of this important policy issue, the Board is soliciting public and agency comment as to whether section 878.1 should apply to curtailment orders issued under proposed section 875, and may choose not to amend section 878.1. If the Board does not amend section 878.1, it would automatically apply to section 875."). The Board stated that section 878.1 is beneficial because it "defin[es] a narrow scope for minimum health and safety needs where no alternatives are available and offer[s] more certain protection for such needs . . . .").

[246] *Public Water Systems Curtailment Compliance Orders – October 2014*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/curtailment_compliance_orders.shtml (last updated Oct. 24, 2014).

[247] State Water Res. Control Bd., 2014 Curtailed Water Rights Human Health and Safety Claims Form, available at http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/docs/hhsclaim.pdf.

[248] CAL. CODE REGS. tit. 23, § 878.1(a)(2).

[249] CAL. CODE REGS. tit. 23, § 878.1(b).

[250] June 20 Digest, supra note 243, at 9.

[251] Vissers, *supra* note 224, at 190–91; JEFFREY MOUNT ET AL., MANAGING CALIFORNIA'S FRESHWATER ECOSYSTEMS LESSONS FROM THE 2012–16 DROUGHT, TECHNICAL APPENDIX: EIGHT CASE STUDIES OF ENVIRONMENTAL WATER MANAGEMENT DURING THE 2012–16 DROUGHT, at 32 (2017), *available at* http://www.ppic.org/wp-content/uploads/1117ccr_appendix.pdf.

[252] Thomas Howard, National Marine Fisheries Service and California Department of Fish and Game Voluntary Drought Agreement on Deer Creek, June 4, 2014, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/mill_deer_antelope_creeks/deer_agreement.pdf; Thomas Howard, California Department of Fish and Game and National Marine Fisheries Service Voluntary Drought Agreements on Deer Creek, Apr. 17, 2015, *available at* https://www.waterboards.ca.gov/waterrights//water_issues/programs/drought/docs/emergency_regulations/howard_deer_vol_agreement_april2015.pdf.

[253] Thomas Howard, National Marine Fisheries Service and California Department of Fish and Game Voluntary Drought Agreements on Mill Creek, June 4, 2014, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/mill_deer_antelope_creeks/mill_agreement.pdf; Thomas Howard, California Department of Fish and Wildlife and National Marine Fisheries Service Voluntary Drought Agreements on Mill Creek, Apr. 22, 2015, *available at* https://www.waterboards.ca.gov/waterrights//water_issues/programs/drought/docs/emergency_regulations/howard_mill_vol_agrmt_april2015.pdf; *see also* CAL. CODE REGS. Tit 23, §§ 877, 878.2.

[254] Thomas Howard, National Marine Fisheries Service and California Department of Fish and Game Voluntary Drought Agreements on Antelope Creek, June 4, 2014, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/mill_deer_antelope_creeks/antelope_agreement_updated.pdf; *see also* CAL. CODE REGS. Tit 23, §§ 877(c), 878.2.

[255] Thomas Howard, California Department of Fish and Wildlife Voluntary Drought Agreement on Antelope Creek, Oct. 30, 2015, *available at* https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/mill_deer_antelope_creeks/thoward_memo_103015.pdf.

[256] Michael Patrick George, Report on Voluntary Diversion Reduction Program among in-Delta Riparian Water Right Claimants 3 (2016), *available at* http://waterboards.ca.gov/water_issues/programs/delta_watermaster/docs/diversion_reduction15.pdf.

[257] *Id.*

[258] *Id.*

[259] Jan. 17, 2014, Drought Proclamation, https://www.gov.ca.gov/news.php?id=18379.

[260] CAL. DEP'T OF WATER RES. ET AL., MAKING WATER CONSERVATION A CALIFORNIA WAY OF LIFE: IMPLEMENTING EXECUTIVE ORDER B-37-16, at 1-4 (2017), *available at* http://www.water.ca.gov/wateruseefficiency/conservation/docs/20170407_EO_B-37-16_Final_Report.pdf.

[261] April 2014 Executive Order, *supra* note 162, Directive 3.

[262] *See* Max Gomberg et al., Emergency Regulations to Increase Urban Water Conservation: Description and Context, July 15, 2014, at 2 *available at* http://www.waterboards.ca.gov/board_info/agendas/2014/jul/071514_10_staff pres.pdf.

[263] *Compare* State Water Res. Control Bd., Resolution No. 2014-0038 to Adopt an Emergency Regulation for Statewide Urban Water Conservation, app. Sec. 864, *available at* http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2014/rs2014_0038_regs.pdf (containing the proposed text of the emergency regulations), *and* April 2014 Executive Order, *supra* note 162, Directive 3.

[264] Executive Order B-29-15, available at https://www.gov.ca.gov/docs/4.1.15_Executive_Order.pdf.

[265] Resolution 2015-0032, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018); CAL. CODE REGS. tit. 23, § 875(c).

[266] Resolution 2016-0007, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018); CAL. CODE REGS. tit. 23, § 875(c).

[267] *See* Resolution 2016-0029, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018); CAL. CODE REGS. tit. 23, § 864.5.

[268] Resolution 2016-0029, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018); CAL. CODE REGS. tit. 23, § 864.5.

[269] Resolution 2017-0024, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[270] *Id.* at 2.

[271] DAVID MITCHELL,ELLEN HANAK, KEN BAERENKLAU, ALVAR ESCRIVA-BOU, HENRY MCCANN, MARÍA PÉREZ-URDIALES & KURT SCHWABE, BUILDING DROUGHT RESILIENCE IN CALIFORNIA'S CITIES AND SUBURBS 41 (2017), *available at* http://www.ppic.org/publication/building-drought-resilience-californias-cities-suburbs/.

[272] Executive Order B-37-16 (May 9, 2016), https://www.gov.ca.gov/docs/5.9.16_Attested_Drought_Order.pdf.

[273] *See generally* MAKING WATER CONSERVATION A CALIFORNIA WAY OF LIFE, *supra* note 260.

[274] April 2014 Executive Order, *supra* note 162, Preamble.

[275] State Water Res. Control Bd., Notice of Public Hearing and Notice of Intent to Adopt a Negative Declaration and a General Order for Small Domestic Wastewater Treatment Systems, June 20, 2014, *available at* http://www.waterboards.ca.gov/water_issues/programs/land_disposal/docs/wd/notice_small%20domestic.pdf.

[276] State Water Res. Control Bd., Order WQ 2014-0153-DWQ, General Waste Discharge Requirements for Small Domestic Wastewater Treatment Systems, at 1–2, 4–5, 26– (Sept. 23, 2014), *available at* http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2014/wqo2014_0153_dwq.pdf.

[277] April 2014 Executive Order, *supra* note 162, Preamble.

[278] *Id.*

[279] *See id.*, Directive 3 ("Recreational facilities, such as city parks and golf courses, and large institutional complexes, such as schools, business parks and campuses, should immediately implement water reduction plans to reduce the use of potable water for outdoor irrigation. Commercial establishments such as hotel and restaurants should take steps to reduce water usage and increase public awareness of the drought through measures such as offering drinking water only upon request and providing customers with options to avoid daily washing of towels or sheets. Professional sports facilities, such as basketball arenas, football, soccer, and baseball stadiums, and hockey rinks should reduce water usage and increase public awareness of the drought by reducing the use of potable water for outdoor irrigation and encouraging conservation by spectators.").

[280] CAL. CODE REGS. tit. 23, § 864(a).

[281] CAL. CODE REGS. tit. 23, § 864(b), (c).

[282] CAL. CODE REGS. tit. 23, § 864(d).

[283] Resolution 2015-0045, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[284] CAL. CODE REGS. tit. 23, § 876.

[285] CAL. CODE REGS. tit. 23, § 876(d)(1).

[286] CAL. CODE REGS. tit. 23, § 876(d)(4).

[287] CAL. CODE REGS. tit. 23, § 876(e).

[288] Resolutions 2016-0012, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[289] Resolutions 2014-0023 and 2015-0014, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[290] Resolutions 2014-0038, 2015-0013, 2015-0032, 2016-0007, 2016-0029, 2017-0004, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[291] State Water Res. Control Bd., April 2017 Statewide Conservation Data (last updated June 6, 2017), *available at* http://www.waterboards.ca.gov/water_issues/programs/conservation_portal/docs/2017jun/fs060617_april_conservation.pdf.

[292] Resolutions 2015-0015, 2015-0075, 2016-0045, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018).

[293] Order WR 2014-0030-DWR, http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/order0030_dwr.pdf; *Drought Informational Orders*, STATE WATER RES. CONTROL BD., http://www.water

boards.ca.gov/waterrights/water_issues/programs/drought/informational_orders.shtml (last updated Feb. 2, 2016).

[294] Order WR 2015-0022-DWR, http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/infomational_order/order15_22.pdf.

[295] Order WR 2015-0002-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[296] Order WR 2015-0024-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[297] Order WR 2015-0026-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[298] Order WR2015-0035-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[299] Orders WR 2015-0037-DWR and WR 2015-0038-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[300] Resolution 2016-0005, accessible at *Resolutions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/ (last visited Jan. 15, 2018); *Measurement Regulation*, State Water Res. Control Bd., http://www.waterboards.ca.gov/waterrights/water_issues/programs/measurement_regulation/ (last updated Aug. 3, 2017).

[301] *See* CAL. WATER CODE § 1840(c); *see also* CAL. CODE REGS. tit. 23, §§ 920, 924, 925, 929.

[302] *See Water Use Reports and Measurement*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/diversion_use/water_use.html (last updated Oct. 17, 2017).

[303] CAL. CODE REGS. tit. 23, § 917.

[304] *Measurement Regulation*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/measurement_regulation/ (last updated Aug. 3, 2017).

[305] *See* 2015 DRY YEAR PROGRAM REPORT, *supra* note 175, at 7; *see also* State Water Res. Control Bd., Statewide Drought-Related Emergency Regulations to Curtail Diversions to Protect Senior Water Rights, slide 6, July 1, 2014, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/emergency_regulations/staff_pp_presentation070114.pdf.

[306] *See* 2015 DRY YEAR PROGRAM REPORT, *supra* note 175, at 7.

[307] *See id.*

[308] *Water Rights Enforcement Complaints*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/complaints/index.html (last updated Mar. 8, 2018).

[309] *See Cease and Desist Actions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/cease_desist_actions/ (last updated July 19, 2018); *Administrative Civil Liability Complaint Actions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/acl_complaint_actions/ (last updated June 19, 2017).

[310] Order WR 2015-00XX-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[311] *Id.*

[312] Order WR 2014-0030-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[313] *See* Order WR 2015-0018-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017); several notices of CDOs labeled WR 2015-00XX-DWR, accessible at *Cease and Desist Actions*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/cease_desist_actions/ (last updated July 19, 2018).

[314] Order WR 2014-0090-EXEC, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[315] *Id.*

[316] DWR & USBR Complaint Letter, July 23, 2014, http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/complaints/docs/072314_dwr_reclam_s_and_c_deltadiversions.pdf.

[317] Letter from California Sportfishing Protection Alliances to Barbara Evoy, Deputy Director, Division of Water Rights, State Water Resources Control Board, at 1 (Aug. 13, 2014), *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/complaints/docs/081314_cspa_evoy.pdf.

[318] *See Drought Informational Orders*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/informational_orders.shtml (last updated Feb. 22, 2018).

[319] *See* Order WR 2016-0015, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017).

[320] *Id.*

[321] *See* State Water Res. Control Bd., Administrative Civil Liability Complaint in the Matter of Violation of an Emergency Regulation for Failure to Comply with Enhanced Conservation Measures by SCP LLC, Khan Tran Trong, and/or Ken Tran, May 4, 2016, at 5, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/acl_complaint_actions/2016/scpllc_acl.pdf.

[322] *See generally id*.

[323] *See* Order WR 2016-0014-DWR, accessible at *Water Rights Orders*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/ (last updated Mar. 28, 2017) (approving conditional settlement).

[324] State Water Res. Control Bd., Fact Sheet: Russian River Tributaries Emergency Regulation Administrative Civil Liability (ACL) Complaints Issued for Failure to Provide Required Information Frequently Asked Questions, at 1, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/infomational_order/rrtribs_acl_factsheet.pdf (last updated Dec. 16, 2015).

[325] *See* CAL. WATER CODE § 1058.5

[326] *See* State Water Res. Control Bd., Orders WR 2016-0003-DWR Revised, WR 2016-0004-DWR, WR 2016-0005-DWR, WR 2016-0009-DWR, WR 2016-0010-DWR, WR 2016-0011-DWR, WR 2016-0020-DWR, WR 2016-0021-DWR, WR 2016-0022-DWR, WR 2016-0023-DWR, accessible from links at *Administrative Civil Liability Complaint Actions Related to the Russian River Tributaries Emergency Regulation Enhanced Water Conservation Measures and Informational Order*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/enforcement/compliance/acl_complaint_actions/russian_river_acls.shtml (last updated May 13, 2016).

APPENDIX D: Actions Related to State and Federal Water Project TUCPs (2014–2016)

Table D-1: Actions by the Board and Others Related to the State and Federal Water Project Temporary Urgency Change Petitions (TUCPs), 2014–2016[1]

The Board's decisions to consolidate the place of use for portions of the SWP and CVP are shaded green. Other Board actions are shaded blue. Actions by DWR and/or the USBR are shown in yellow. Deeper shading indicates decisions or requests, while paler shading indicates other actions. Other parties' actions are not shaded

Date	Action
1/29/2014	DWR and USBR filed TUCP requesting modification of Feb. Delta outflow requirements and Delta Cross Channel (DCC) gate operations for 180 days.
1/31/2014	Approved Jan. 29 TUCP to: • Allow reduced Delta outflow during February; • Require saved water storage for health and safety, ecosystem needs; • Require updates on flows, storage, deliveries; • Allow flexible operation of DCC Gates through May 20; • Limit Delta exports to health and safety needs.
1/31/2014	Announced Feb. 18 public workshop on TUCP.
2/7/2014	Revised Jan. 31 TUCP order to provide that D-1641 outflow and gate closure requirements are operative if precipitation events enable compliance, except that Project exports > 1,500 cfs would be limited to natural or abandoned flow.
2/14/2014	DWR and USBR submitted report on Export Amounts to Maintain Health and Safety During Drought.
2/18/2014	Held drought workshop addressing the TUCP.
2/27/2014	DWR and USBR requested extension of reduced Delta outflow requirements in Feb. 7 TUCP order.
2/28/2014	Petition for reconsideration of Jan. 31 and Feb. 7 TUCP orders by San Luis & Delta-Mendota Water Authority and its member agencies.
2/28/2014	Revised Feb. 7 TUCP order to reduce Delta outflow requirements for Mar.
3/2/2014	Petition for reconsideration of Jan. 31 and Feb. 7 TUCP orders by San Joaquin River Exchange Contractors Water Authority, Central California Irrigation District, San Luis Canal Company, Columbia Canal Company, and Firebaugh Canal Water District.
3/2/2014	Petition for reconsideration of Jan. 31, Feb. 7, and Feb. 28 TUCP orders by Friant Water Authority and its members.
3/3/2014	Petition for reconsideration of Jan. 31, Feb. 7, and Feb. 28 TUCP orders by Western Canal Water District, Plumas Mutual Water Company, and the Joint Water Districts Board.
3/18/2014	Revised Feb. 28 TUCP order to allow increased exports while there are higher Delta inflows, including exports for other purposes if health and safety and other critical needs are met.
3/18/2014	DWR and USBR requested modifications to Feb. 28 TUCP order to provide added flexibility to export water when inflows are high.
3/28/2014	Approved Feb. 12 requests for 1 year consolidation of place of use of portions of SWP and CVP to facilitate within-Project transfers and exchanges.
4/8/2014	DWR and USBR released a CVP/SWP Drought Operations Plan that included proposed operations for average and very dry hydrologic conditions.
4/9/2014	Revised Mar. 18 TUCP order to extend outflow and export modifications into April.
4/9/2014	USBR requested modifications to Mar. 18 TUCP order to allow increased storage in San Luis Reservoir during April and May.
4/11/2014	Revised Apr. 9 TUCP order to allow USBR to meet modified San Joaquin River flow requirements through June, as proposed in the Apr. 8 Drought Operations Plan.
4/16/2014	Issued "Save the Date" message for tentatively planned workshop on SWP/CVP TUCP.
4/18/2014	DWR and USBR requested modification of Apr. 11 TUCP order.
4/18/2014	Revised Apr. 11 TUCP order to allow increased exports (the greater of 100% of 3-day average flow at Vernalis or 1,500 cfs) during the San Joaquin River pulse-flow period.

4/25/2014	Announced May 6 public workshop on TUCP.
4/28/2014	Petition for reconsideration of April 11 TUCP order by Natural Resources Defense Council and The Bay Institute.
4/28/2014	Petition for reconsideration of Jan. 31, Feb. 7, Feb. 28, Mar. 18, Apr. 9, Apr. 11, and Apr. 18 TUCP orders by Friant Water Authority and its members.
4/29/2014	DWR and USBR requested modification and extension of Apr. 18 revised TUCP order.
5/2/2014	Revised Apr. 18 TUCP order to: • Renew Jan. TUCP order through Jan. 27, 2015; • Extend modified Delta outflow requirement to May and July; • Reduce Sept. to Nov. 15 Sacramento River flow requirements; • Move Western Delta salinity compliance point until Aug. 15; • Add reporting deadlines; • Modify export limits.
5/6/2014	Held drought workshop on TUCP.
5/13/2014	Petition for reconsideration of Jan. 31, Feb. 7, Feb. 28, Mar. 18, Apr. 9, Apr. 11, Apr. 18, and May 2 TUCP orders by Friant Water Authority and its members.
5/13/2014	Petition for reconsideration of May 2 TUCP order by California Sportfishing Protection Alliance, AquaAlliance, and California Water Impact Network.
6/19/2014	DWR responded to Board questions about Conserved Water Accounting.
7/23/2014	In joint letter, DWR & USBR alleged that So. & Central Delta diverters unlawfully took Project releases of stored water. They asked the Board to use CAL. CODE REGS. tit. 23 § 879(c) to get more information.
8/13/2014	California Sportfishing Protection Alliance responded to joint letter, made complaint against the Projects, and petitioned to adjudicate.
8/28/2014	DWR and USBR provided SWP/CVP Water Balance Estimates, as required by the TUCP order(s).
9/3/2014	Issued proposed order denying petitions for reconsideration of TUCP order (and revisions).
9/24/2014	Adopted order denying petitions for TUCP order reconsideration.
9/24/2014	Modified May 2 TUCP order to: • Require earlier reporting of actual operations; • Ensure access to info. on real-time impacts to fish, etc.; • Require preparation of a drought contingency plan; • Require advanced planning for specific fishery needs.
9/29/2014	DWR and USBR provided SWP/CVP Water Balance Estimates, as required by the TUCP order(s).
9/29/2014	USBR requested modification of Sept. 24 TUCP order to reduce Oct. San Joaquin River flow requirements.
10/7/2014	Revised Sept. 24 TUCP order to allow 31-day pulse flow period (800 cfs minimum average monthly flow) for San Joaquin River.
10/15/2014	DWR and USBR released Drought Contingency Plan for Oct. 15 to Jan. 15, 2015.
10/24/2014	Friant Water Agency sued the Board, seeking judicial review of its actions in response to the TUCPs, which Friant argues "contributed to Reclamation's failure to meet its obligation to provide . . . the Exchange Contractors, with an adequate substitute supply of north state water."
10/27/2014	DWR and USBR provided SWP/CVP Water Balance Estimates, as required by the TUCP order(s).
12/23/2014	DWR and USBR provided SWP/CVP Water Balance Estimates, as required by the TUCP order(s).
1/9/2015	USBR requested modification of the D-1641 San Joaquin River at Vernalis water quality objective in connection with 2014 TUCP.
1/15/2015	Deferred action on USBR's Jan. 9 request.
1/15/2015	DWR and USBR submitted CVP/SWP Drought Contingency Plan for Jan. 15 to Sept. 30, 2015.
1/23/2015	DWR and USBR submitted TUCP requesting modification of D-1641 requirements for Feb.–Mar. 2015 to: • Reduce minimum monthly average Delta outflow (NDOI) to 4,000 cfs • Reduce minimum San Joaquin River flows at Vernalis to 500 cfs. • Allow DCC gates to be opened in Feb. and March to reduce salinity intrusion into the Delta. • Modify the Combined Export Rate
1/27/2015	Announced Feb. 18 public workshop on SWP/CVP Drought Contingency Plan associated with TUCP.
1/27/2015	NRDC filed protest of Jan. 23 TUCP
2/3/2015	Issued order largely approving the 1/23/2015 TUCP, but added export constraints to allow exports of 1,500 cfs when Delta outflows are below 7,100 cfs regardless of DCC Gate status and allows exports up to D-1641 limits when Delta outflows are above 7,100 cfs and the DCC gates are closed.
2/13/2015	Protests and/or petitions for reconsideration of Feb. 3 TUCP order by: • The Bay Institute

	• California Sportfishing Protection Alliance, • AquaAlliance, & California Water Impact Network • Friant Water Authority • Restore the Delta • San Joaquin River Exchange Contractors et al.
2/18/2015	Held drought workshop on TUCP.
2/27/2015	Petition for reconsideration of Feb. 3 TUCP order by San Luis & Delta-Mendota Water Authority, Westlands Water District, and State Water Contractors.
3/5/2015	Revised Feb. 3 TUCP order to provide more flexibility to store and move water in Feb. and Mar. It: • Reduced minimum daily delta outflow requirement to 4,000 cfs • Allowed exports of 1,500 cfs when outflow is 4,000 to 7,100 cfs • Allowed D-1641-level exports when outflow is > 7,100 if all flow is natural or abandoned + DCC Gates are closed • Allowed DCC Gates to be open in some circumstances • Reduced minimum San Joaquin River flow requirement at Vernalis to 500 cfs. • Require USBR submit an updated Temperature Management Plan for the Sacramento River by June 1.
3/24/2015	DWR and USBR requested modification of Mar. 5 TUCP order to conserve stored water by modifying operations from April 1 to Sept. 30.
3/30/2015	Requested refined Sacramento River temperature modeling information and a plan for New Melones operations to reasonably protect fish and wildlife from USBR.
3/20/2015	The Bay Institute and NRDC file protest of Mar. 24 TUCP
3/31/2015	The Bay Institute files an additional protest
4/6/2015	Revised Mar. 5 TUCP order through June to: • Extend changes to Delta outflow and export requirements through June • Extend change to DCC Gate requirements through May 20. • Reduce San Joaquin River at Vernalis pulse-flow volume requirement to 710 cfs (period shifted earlier, to Mar. 25 through Apr. 25, by executive order) and require USBR to comply with pulse-flow requirement in Biological Opinion and Conference Opinion for Long-Term Operations. • Reduce the minimum San Joaquin River flow requirement at Vernalis following the pulse flow period to 300 cfs until May 31. • Move the compliance point (on the Sacramento River) for the Western Delta agricultural salinity requirement from Emmaton to Three Mile Slough from April through June. • Require USBR to develop and implement a plan for New Melones Reservoir operations that reasonably protects fish and wildlife in the Stanislaus River. • Strengthen requirement for USBR to prepare and implement an updated Temperature Management Plan for the Sacramento River to prevent the high mortality of salmonids that occurred in 2014 (included requirement for approval by the Board's Executive Director).
4/15/2015	DWR announced it "is moving to install an emergency, temporary rock [salinity] barrier across" West False River, "a Sacramento-San Joaquin Delta channel," in May.
4/20/2015	USBR announced that state (DWR, the Board, and DFW) and federal (USBR, NOAA FISHERIES, and USFWS) agencies and the Sacramento River Settlement Contractors have agreed on an integrated framework for CVP/SWP operations from mid-April through November.
4/27/2015	Approved Mar, 12 request for 1 year consolidation of place of use of portions of SWP and CVP to facilitate within-Project transfers and exchanges.
5/1/2015	Announced May 20 workshop on drought activities in the Bay-Delta.
5/4/2015	Issued a water quality certification for DWR's 2015 Emergency Drought Barrier Project.
5/4/2015	USBR submitted a Temperature Management Plan for the Sacramento River.
5/5/2015	Petition for reconsideration of Apr. 6 TUCP order by Restore the Delta.
5/6/2015	Petition for reconsideration of Apr. 6 TUCP order by California Sportfishing Protection Alliance, AquaAlliance, and California Water Impact Network.
5/14/2015	Provisionally approved the USBR's Temperature Management Plan for the Sacramento River.
5/15/2015	USBR submitted a 2015 Operations Plan for New Melones Reservoir.
5/20/2015	Held workshop on SWP and CVP Temporary Urgency Change Petition, Emergency Drought Barrier, and Water Right Curtailments.
5/21/2015	DWR and USBR submitted request to renew and modify the April 6 TUCP order for July–November to: • Reduce the minimum Delta outflow to reflect a monthly average 3,000 cfs for July with a 7-day running average not less than 2,000 cfs; • Reduce Sacramento River Flow requirements at Rio Vista for Sept. to Nov. to minimum monthly average of 2,500 cfs with a 7-day running average not less than 2,000 cfs;

	• Extend the change of compliance point for the Western Delta agricultural salinity requirement from Emmaton to Three-Mile Slough through Aug. 15.
5/29/2015	Suspended USBR's Sacramento River temperature management plan until further notice based on new information indicating that warmer than expected temperatures in Shasta Reservoir will likely make it impossible to meet the required temperature at Clear Creek throughout the temperature control season.
6/8/2015	Provided formal notice of request to modify and renew TUCP for July through Nov.
6/15/2015	Announced June 24 workshop on SWP/CVP operations.
6/16/2015	Announced outlines of revised Sacramento River temperature management plan.
6/16/2015	State Water Contractors (27 public agency contractors) filed a complaint requesting the Board take action to protect SWP releases from unlawful diversions in the Delta.
6/23/2015	USBR requested approval to change how NDOI is calculated.
6/24/2015	Approved USBR's request to change how NDOI is calculated for the month of June.
6/24/2015	Held Public Workshop regarding Summer and Fall Drought Related Sacramento River Temperature Operations and SWP and CVP Operations in the Sacramento-San Joaquin Delta Watershed.
6/26/2015	USBR submitted revised Temperature Management Plan for the Sacramento River
7/3/2015	Modified and renewed the Apr.6 TUCP order, approving May 21 TUCP request and requiring • USBR to reevaluate the Stanislaus River plan given the changed conditions. • Propose adjusted Folsom Reservoir operations "to ensure that critical water supplies are available for municipal and industrial use" upon request • USBR to coordinate with CVP refuge managers to assist with planning • DWR and USBR to perform monitoring "to understand and evaluate the effects of reduced Delta outflows in combination with" the drought barrier.
7/9/2015	DWR notified the Board of electrical conductivity exceedance at Three Mile Slough.
7/10/2015	Approved request for extension of time to submit Stanislaus River Temperature Management Plan.
7/13/2015	DWR notified the Board of electrical conductivity exceedance at Jersey Point.
7/20/2015	USBR notified the Board of electrical conductivity exceedance at Brandt Bridge.
7/22/2015	California Sportfishing Protection Alliance submitted a complaint against the Board, USBR, and DWR alleging that: • "sequential weakening of D-1641 requirements violates the federal [Clean Water Act] and represents a de facto change in the standards themselves" • the Board "has failed to enforce Bay-Delta water quality standards and has failed to enforce its 2010 Cease & Desist Order against USBR and DWR for violations of southern Delta salinity standards," • "USBR and DWR are presently violating water quality standards protecting fish & wildlife and agricultural beneficial uses," • "USBR and DWR have failed to comply with the . . . 2010 Cease & Desist Order," and • all three agencies "have failed to comply with their respective responsibilities and obligations under the [Endangered Species Act], Public Trust Doctrine and Article X of the California Constitution"
7/22/2015	Petition for reconsideration of July 3 TUCP order by Restore the Delta.
8/1/2015	Petition for reconsideration of July 3 TUCP order and July 7 approval of revised temperature management plan for the Sacramento River by The Bay Institute.
8/3/2015	Petition for reconsideration of July 3 TUCP order by California Sportfishing Protection Alliance, AquaAlliance, and California Water Impact Network.
8/6/2015	Petition for reconsideration of July 7 approval of revised temperature management plan for the Sacramento River by California Sportfishing Protection Alliance, AquaAlliance, and California Water Impact Network.
12/7/2015	Issued proposed order granting in part and denying in part petitions for reconsideration of the Feb. 5 order (and subsequent modifications).
12/15/2015	Adopted order granting in part and denying in part petitions for reconsideration of the Feb. 5 order. It • Found "decisions were appropriate when . . . made based on the information available at the time." • Extended July 3 TUCP order "to address actions needed for next year, if conditions continue to be dry" • Required "additional temperature management planning and related measures to respond to the issues raised in . . . petitions" for reconsideration of approval of the Sacramento River Temperature Management Plan for 2015.
12/28/2015	DWR and USBR notified the Board that they did not meet the Modified Rio Vista Flow Objective.
1/15/2016	DWR and USBR submitted CVP/SWP Drought Contingency Plan for Feb.–Nov. 2016 (updated Jan. 19)
2/19/2016	DWR and USBR updated the CVP/SWP Drought Contingency Plan for Feb.–Nov. 2016
3/7/2016	Announced Mar. 18 public workshop on 2016 Sacramento River temperature management
3/22/2016	DWR and USBR updated the CVP/SWP Drought Contingency Plan for Feb.–Nov. 2016
4/1/2016	USBR requests modification of REQ for San Joaquin inflow at Vernalis

4/11/2016	The Bay Institute et al. protest USBR TUCP
4/14/2016	USBR reported that monthly average flow fell short of the February Vernalis base flow objective
4/19/2016	Issued SJR TUCP
4/22/2016	DWR and USBR updated the CVP/SWP Drought Contingency Plan for Feb.–Nov. 2016
4/23/2016	The Bay Institute filed complaint after violations of Vernalis flow objective and other requirements
5/27/2016	DWR and USBR updated the CVP/SWP Drought Contingency Plan for Feb.–Nov. 2016
6/22/2016	DWR and USBR updated the CVP/SWP Drought Contingency Plan for Feb.–Nov. 2016
10/28/2016	DWR and USBR submitted a CVP/SWP Drought Preparedness Plan for Nov. 2016 through Jan. 2017

[1] SWP and CVP TUCP-related orders and other documents can be accessed from the following webpage: *State Water Project and Central Valley Project Temporary Urgency Change Petition*, STATE WATER RES. CONTROL BD., http://www.swrcb.ca.gov/waterrights/water_issues/programs/drought/tucp.shtml (last updated Oct. 7, 2014). *See also State Water Board Drought Workshops*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/workshops.shtml (last updated Sept. 19, 2014); *Bay-Delta Water Rights Complaints and Information Requests*, STATE WATER RES. CONTROL BD., http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/complaints/index.shtml (last updated Aug. 21, 2014); Friant Water Authority, Press Release: Friant Files Legal Challenge Over State Board's Drought Emergency Decision Process, Oct. 27, 2014, *available at* http://www.friantwater.org/docs/legislative_issues/Friant_Files_Legal_Challenge_Over_State_Board_Drought_Emergency_Decision_Process.pdf.