Sustainability Outlook Indicator Descriptions and Methodology

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About this Document

The Sustainability Outlook describes how, through the lens of four societal values — public health and safety, healthy economy, ecosystem vitality, and opportunities for enriching experiences — it will help identify desired water management outcomes and indicators. Those outcomes and indicators can be used to gauge the status of, and progress toward, sustainability. Because sustainability is not something achieved once and forever, the Sustainability Outlook and the representative indicators are intended to be adaptive and help water resource managers address changing circumstances and incorporate lessons learned.

This document details the process to date for developing the sustainability indicators and includes descriptions of the initial indicators. Indicators are presented according to societal value, corresponding intended outcome, and classification ("Basic" with potential statewide application or "Watershed" level application, "Advanced" for future development, or "Archived" with no additional development identified at this time). Each intended outcome has several indicators, and in some cases, indicators may apply to multiple outcomes.

The document is organized as follows:

- **Section 1, Introduction to Sustainability Outlook and Indicators** — Provides background information and describes the four societal values, intended outcomes, and their relationship to the indicators.

- **Section 2, Methodology** — Describes development of the initial set of indicators being piloted at statewide and watershed scales.

- **Section 3, Screening Process** — Provides a description of the screening process for determining the status of each indicator (retained as a basic indicator, considered at a watershed-scale, advanced in the future, or archived).

- **Section 4, Basic and Watershed Sustainability Indicators** — Details the assessment of each Basic and Watershed indicator, including a description and introductory information, importance and screening considerations, initial data and results, recommendations, and references.

- **Section 5, Advanced (Future) Sustainability Indicators** — Details the assessment of each Advanced (Future) indicator, including a description and introductory information, importance and screening considerations, recommendations, and references.

- **Section 6, Archived Sustainability Indicators** — Describes the assessment of each Archived indicator, including a description, screening considerations, and justification for why the indicator is not supportive of the Sustainability Outlook evaluation.

- **Section 7, Current Statewide Sustainability Dashboard —** Summarizes the current evaluations of all the Basic and Watershed indicators to assess California's progress toward sustainability and describes next steps in Sustainability Outlook development.

- **Section 8, References** – Provides a list of references used in development of the indicators.

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Abbreviations and Acronyms

AB	Assembly Bill
ATL	Advisory Tissue Level
AWMP	Agricultural Water Management Plan
Bay Area	San Francisco Bay Area
Cal EPA	California Environmental Protection Agency
Cal-Nemo	California Non-native Estuarine and Marine Organisms
Cal OES	California Governor’s Office of Emergency Services
CalFire	California Department of Forestry and Fire Protection
Caltrans	California Department of Transportation
CANOD	California Aquatic Non-native Organism Database
CASGEM	California Statewide Groundwater Elevation Monitoring
CDFW	California Department of Fish and Wildlife
CEDEN	California Environmental Data Exchange Network
CPI	Consumer Price Index
CSCI	California Stream Condition Index
CSU	California State University
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
CWP	California Water Plan
DDW	State Water Resources Control Board Division of Drinking Water
DWR	California Department of Water Resources
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FRAP	Fire and Resource Assessment Program
FRID	Fire Return Interval Departure
GAMA	Groundwater Ambient Monitoring and Assessment
GDP	Gross Domestic Product

GIS	Geographic Information System
GMP	Groundwater Management Plan
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
IHCIA	Indian Health Care Improvement Act
IHS	U.S. Department of Health and Human Services, Indian Health Service
JPL	Jet Propulsion Laboratory
km2	square kilometer
LCA	California Land Conservation Act
LCP	Local Coastal Program
Legislature	California State Legislature
MCL	maximum contaminant levels
NAS	Nonindigenous Aquatic Species
NASA	National Aeronautics and Space Administration
NCES	National Center for Education Statistics
NEMESIS	National Estuarine and Marine Exotic Species Information System
NHD	National Hydrography Dataset
NHP	National Historic Place
NM	National Monument
NOAA	National Oceanic and Atmospheric Administration
NRA	National Recreation Area
NRHP	National Register of Historic Places
OEHHA	California Office of Environmental Health Hazard Assessment
OWOW	One Water One Watershed
PAD	Passage Assessment Database
ppb	parts per billion
PPIC	Public Policy Institute of California
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
SAWPA	Santa Ana Watershed Project Authority
SB	Senate Bill

SGMA	Sustainable Groundwater Management Act
SPFC	State Plan Flood Control
State Water Board	State Water Resources Control Board
SWAMP	Surface Water Ambient Monitoring Program
SWP	State Water Project
TAF	thousand acre-feet
TIGER	Topologically Integrated Geographic Encoding and Referencing
UC	University of California
Update 2013	California Water Plan Update 2013
Update 2018	California Water Plan Update 2018
USACE	U.S. Army Corps of Engineers
U.S. EPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WSCP	Water Shortage Contingency Plan

1 Introduction to Sustainability Outlook and Indicators

The long-term goal of the Sustainability Outlook is to establish a single comprehensive and practical method for tracking and reporting progress toward and effectiveness of implementing water management actions and policies that provide shared agreement and consistency across State government and local governments across California's diverse regions. California Water Plan Update 2013 (Update 2013) proposed the use of sustainability indicators to evaluate progress and return on State investments. California Water Plan Update 2018 (Update 2018) establishes methods for performance tracking through the identification of societal values that represent primary interests expressed by the water resource community, intended outcomes, and indicators. In acknowledgement of sustainability as an ongoing process, both the Sustainability Outlook and the representative indicators are intended to be adaptive and help water resource managers address changing circumstances and incorporate lessons learned.

Each sustainability indicator was assessed and evaluated against respective intended outcomes and societal values. As shown in Figure 1-1, there are four separate societal values: Public Health and Safety, Ecosystem Vitality, Healthy Economy, and Opportunities for Enriching Experiences. Each societal value has three or four associated intended outcomes. This initial process to develop the sustainability indicators involved establishing definitions for sustainability in the context of four societal values; creating a framework for linking the values with the outcomes and those outcomes with the indicators; and developing desired outcomes and metrics for those values using existing information, such as Update 2013.

Figure 1-1. The Four Societal Values used to Evaluate the Sustainability Outlook

To provide a complete and thorough assessment of each identified sustainability indicator, this document summarizes the following information:

- Description
- Importance and Screening Considerations
- Initial Data and Results
- Recommendations
- References

In this document, each indicator is presented by the associated societal value, a corresponding intended outcome, and whether or not the indicator is considered Basic/Watershed, Advanced, or Archived. Each intended outcome has several indicators. In some cases, while an indicator is presented under one corresponding outcome, it may provide insight into multiple outcomes.

1.1 Public Health and Safety

Public health and safety is defined as prevention of, protection from, and mitigation of events that could harm or injure people. Events that can pose a risk of harm or injury include accidents, outbreaks, illnesses, crimes, and disasters (natural or man-made). The vision for this societal value is that all Californians are protected from public health and safety threats and emergencies.

The intended outcomes that represent Public Health and Safety include:

- A reliable water supply for domestic needs, sanitation, and fire suppression;
- Reduced number of people exposed to waterborne health threats such as contaminants or infectious agents;
- Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure).

1.2 Ecosystem Vitality

Ecosystem vitality describes the healthy functioning and lasting resiliency of diverse communities of interconnected aquatic, riparian, and wetland organisms across California. Ecosystem resilience is defined as the ability of an ecosystem to withstand or respond to disturbances without undergoing major or irreversible changes in identity, function, or structure. The vision for this societal value is for thriving ecosystems to exist throughout the state.

The intended outcomes that represent Ecosystem Vitality include:

- Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness;
- Maintained and improved ecological functions and processes vital for sustaining ecosystems in California; and
- Achieved designated beneficial uses for water bodies throughout the state.

1.3 Healthy Economy

A healthy economy would include positive and responsible economic development; strong commitments to the long-term health of people and the environment; government encouragement of job-creating investments; and removal of excess regulations that may throttle economic development. A healthy economy is also stable, i.e., there are no excessive fluctuations in the macro economy and there is low inflation. In a healthy economy, all Californians would have opportunities to prosper through a combination of jobs, household production, entrepreneurship, and public services and would be engaged in the political and economic decisions that impact their health and happiness. The vision for this societal value is that California has a healthy economy and that all Californians have opportunities for economic prosperity.

The intended outcomes that represent Healthy Economy include:

- Reliable water supplies of suitable quality for a variety of productive water uses are based on a reliable supply;
- Consideration of economic risks and rewards on floodplains, rivers, and coastal areas;
- More benefits from economics activities;
- Reduced likelihood or occurrence of significant social disruption following a disaster.

1.4 Opportunities for Enriching Experiences

The vision for this societal value is that all Californians have opportunities for enriching experiences to add greater value or significance to their lives.

The intended outcomes that represent Opportunities for Enriching Experiences include:

- Preserved or enhanced culturally or historically significant sites and communities, including continued and enhanced access to water and land used for cultural practices, such as sacred ceremonies;
- Preserved and increased natural areas with aesthetic or intrinsic value (including viewshed[1]);
- Continued and enhanced access to resources that support education and learning;
- Continued or enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces.

[1] Viewshed refers to the view of an area from vantage points in current natural areas.

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2 Methodology

The methodology for developing the initial set of indicators for piloting at both the statewide and watershed scales is described below.

2.1 Statewide versus Watershed Scale

Indicators are the data and information that are used to measure what progress has been made in achieving the intended outcomes at a given point in time. California water management is complex and the underlying regions are diverse. Large volumes of data are already being collected throughout the state by local, regional, and State entities. Not all data are relevant to decision-making in all regions. Neither is it practical nor necessary to use all available data to assess water management sustainability. For these reasons, the Sustainability Outlook identifies a manageable set of indicators that apply statewide and can be used for conducting watershed-scale sustainability assessments.

Applied at the state level, indicators are intended to be broad and cover differing conditions (e.g., coastal and inland areas; north and south of, as well as in, the Delta). At a watershed level, indicators will measure what is relevant to a specific area, which may or may not be the same as what is relevant on a statewide basis (e.g., specific areas of the state where the majority of the population is not served by a public water system; or flood safety improvements in upper watersheds, which may differ from those in valleys). Indicators will likely change as the ability to collect and interpret data changes, the conditions in the state change, or the understanding of intended outcomes evolves.

2.2 Development of Preliminary Set of Indicators

A preliminary set of indicators was compiled from existing information, including:

- Update 2013
- 2014 California Water Action Plan and 2016 Update
- California’s Flood Future: Recommendations for Managing the State’s Flood Risk and other State Flood Management Planning Program materials
- 2012 Central Valley Flood Protection Plan and 2017 Update (draft)
- Disadvantaged Community Visioning Workshop
- Sustainable Groundwater Management Act (SGMA) Draft Strategic Plan
- Materials related to Integrated Regional Water Management strategies
- Water Sustainability Indicators Framework: Final Report (U.C. Davis 2013)
- California Integrated Assessment of Watershed Health (U.S. EPA 2013)
- Sustainable Water Management Profile (Water Foundation and Inland Empire Utilities Agency 2017)
- Other Companion State Plans

Additionally, requests to complete an online survey related to water management effectiveness were emailed to the Water Plan distribution list in early 2017. Results of this survey informed the preliminary indicator set. As there are multiple components to assessing progress towards achieving each intended outcome, there often several indicators for each outcome. And some indicators may apply to multiple outcomes (but are primarily associated with ONE outcome).

2.3 Testing and Revising the Indicators

Using the preliminary indicator set, California Water Plan (CWP) staff met with interested parties, California Department of Water Resources (DWR) subject matter experts, representatives from various State agencies and organizations, advisory groups, and stakeholders to obtain their input on and assessment of the general indicator framework, the preliminary list of indicators, availability and quality of data, and ways to acquire additional and/or better data and information. A listing of the indicator discussions held is presented in Table 2-1.

Table 2-1. Indicators Discussions Held to Support California Water Plan Update 2018[1]

Agency/Organization	Date
DWR, Sustainable Groundwater Management Program	June 1, 2017; July 6, 2017
DWR, Economic Analysis Section	June 1, 2017
State Water Board, Surface Water Ambient Monitoring Program	June 2, 2017
DWR, Interstate Resources	June 6, 2017
DWR, Urban and Agricultural Water Use Efficiency Program	June 6, 2017
California Department of Parks and Recreation, Division of Boating and Waterways	June 12, 2017
California Department of Fish and Wildlife, Water Branch and State Wildlife Action Plan	June 13, 2017
DWR, Environmental Restoration and Enhancement Branch	June 13, 2017
DWR, Water Budget and Analytics Section	June 15, 2017
DWR, Legislative Affairs Office	June 15, 2017
DWR, Office of Tribal Advisor	June 19, 2017
DWR, Strategic Water Planning Branch	June 19, 2017
DWR, Integrated Water Management Program, Disadvantaged Communities	June 19, 2017
DWR, Division of Flood Management, Flood Planning Office	June 20, 2017
California Biodiversity Council, Interagency Alignment Team Workshop	June 22, 2017
California Water and Environment Modeling Forum	June 28, 2017
Water Foundation	July 17, 2017
Chapter 2 Workshop	July 25, 2017
California Department of Forestry and Fire Protection, Fire and Resource Assessment Program	September 20, 2017
California Water Plan Plenary	September 27, 2017
Russian River Pilot Working Sessions	November 15, 2017 December 11, 2017 April 23, 2018
Update 2018 – All Chapters Webathon	January 10, 2018
California Water Action Collaborative	February 5, 2018
California Water Plan Policy Advisory Committee	February 27, 2018

Note:
[1] As of February 6, 2018.

Key:
DWR = California Department of Water Resources
State Water Board = State Water Resources Control Board

Feedback was given in many forms – suggestions, questions, comments, and materials/hyperlinks. Feedback related to:

- Sustainability Outlook
  - Questions on development and use
  - Role of climate change
  - Reflecting evolving processes and issues
- Intended Outcomes
  - Reflecting sustainability for the specific societal value
  - Managing undesirable results
- Statewide versus Watershed Level
  - Aligning/reconciling implementation at various scales throughout the state
  - Connecting watershed-level efforts with statewide and vice versa
  - Defining watersheds and aligning/reconciling with other existing regional definitions
- Indicators
  - Suggestions and questions on revisions, additions, deletions, combinations, and movement to more appropriate outcomes
  - Consistent and clear terminology; specific definitions
  - Minimizing overlap among indicators
  - Illustrating the severity of an issue
  - Ability to reflect current status and impacts of current related actions
  - Appropriateness (indicators of aspects the State can affect versus those the State cannot control)
- Data
  - Potential existing and future data sources
  - Availability, accessibility, visibility, and alignment (or lack thereof)
  - Repeatability of collection and analysis to allow for comparison over time
  - Importance of consistent interpretation and trend analysis

- Need for long time periods to develop data useful for modeling purposes

The feedback received was used to refine, combine, and screen the indicators. Feedback was also used to inform updates of the intended outcomes and the overall development process. In this way, the indicators and Sustainability Outlook are better able to capture the existing and ongoing sustainability efforts of State government and improve both consistency and coordination amongst State agencies.

2.4 Potential Next Steps in Indicator Development

2.4.1 Pilot Programs

At present, DWR is conducting one pilot program in the Russian River watershed and developing another in the Santa Ana watershed. As anticipated, both pilots will use the current set of indicators to demonstrate how the Sustainability Outlook can be applied at the watershed scale. DWR is also working with the Water Foundation to incorporate lessons learned from its recently completed Sustainability Water Management Profile into both pilots. Current results of these pilots will be included in the final draft of Update 2018.

Russian River Watershed. The Russian River watershed was selected as a pilot area because of established relationships, as well as the innovative and participatory local entities with relatively few distinctive jurisdictions or agencies when compared to other watersheds in the state. Work will be performed in alignment with California Forward's and Sonoma County Water Agency's sustainability planning when developing a framework for defining sustainability outcomes and metrics, aligning regulatory processes to achieve sustainable outcomes, improving governance and implementation efficiency, and identifying funding and finance options and capacity across the four societal values. As planned, this pilot will apply the outcome-based planning concepts advanced by the Water Plan at a watershed scale. Additional work under this pilot will provide insight on policy development of watershed-based planning, regulation, governance, and funding and finance innovations.

Santa Ana Watershed Pilot. The Santa Ana River watershed was selected as a pilot area because of established relationships, as well as the innovative sustainability planning of the One Water One Watershed (OWOW) plans coordinated by the Santa Ana Watershed Project Authority (SAWPA). The OWOW 2.0 Plan (2014) created an indicators-based tool for assessing integrated regional water management plan performance, based on earlier DWR grant-supported work at the Council for Watershed Health and Update 2013 work at University of California, Davis. This pilot draws from the earlier work and the experience in the region with application of the Water Foundation’s SWM Profile. The pilot results will further integrate and prove the value of using the Outlook as the basis for understanding progress toward stakeholder-developed watershed goals to serve regional decision-making.

2.4.2 Moving Forward to 2023 and Beyond

Subsequent results of the pilots will be used to test and refine the indicators and the overall Sustainability Outlook approach. DWR intends to work with regional water management groups and other partners to develop appropriately scaled, watershed-based Sustainability Outlooks. Planning at a watershed scale can help water managers evaluate and consider the interdependencies among physical, biological, economic, and social processes, from headwaters to outlets and between basins. It is anticipated that these Watershed Sustainability Outlooks will be included in Update 2023, to support statewide planning and inform State investment priorities. DWR recognizes that most of the work to advance sustainable water resources management will occur at regional and local levels.

Moving forward, additional data and tools will be developed and employed to strengthen the Sustainability Outlook approach, evaluate trends, and assess current and future water resources management sustainability.

Over time, indicators will likely continue to change as the ability to collect and interpret data changes, the underlying conditions in the state and watersheds change, or the understanding of intended outcomes evolves, both at the state and watershed levels.

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3 Screening Process

Each indicator went through a comprehensive screening process to reach the current recommendation of whether it should be archived, kept as a basic indicator, considered at the watershed level only, or advanced in the future. These levels are described in Figure 3-1.

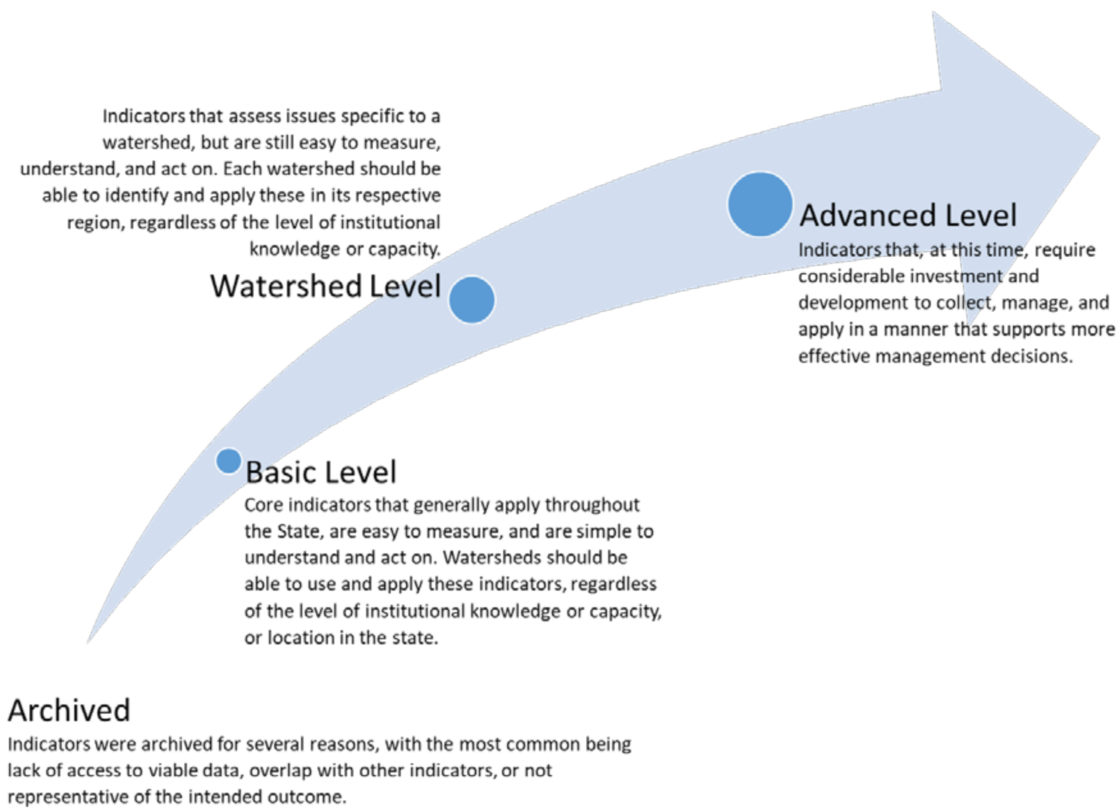

Figure 3-1. Description of Indicator Recommendations

An indicator labeled as “future” does not have complete data available to support its application in all areas. This may be because the data have never been collected, or are not collected statewide or across all watersheds where such indicator would apply. An indicator labeled as “Advanced (Future)” is not only more complex (advanced) but data do not currently exist (future) to apply or test it at this time. An Advanced (Future) indicator could be highly effective but will take time and investment to fully develop and use throughout the state. Prior to use in future California Water Plan updates, the descriptions and targets of these indicators (and potentially the indicators themselves) would need to be revisited and revised to ensure they would be consistent with policies and regulations at the time of their incorporation.

3.1 Screening Criteria and Ranking

The following criteria were the primary basis for screening indicators and associated metrics:

- Representative
- Data Viability

- Cost
- Longevity
- Supportive of Decision Making

Each indicator was screened based on its ability to meet the primary criteria using a Low/Medium/High ranking system, as illustrated in Figure 3-2. In some cases, indicators were given a Medium-High ranking or a Low-Medium ranking.

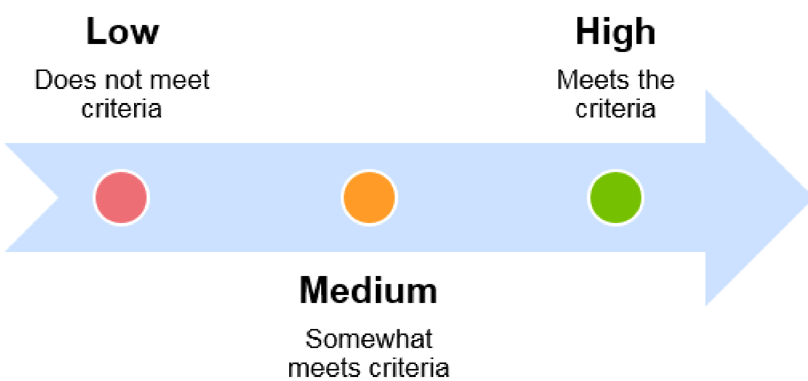

Figure 3-2. Indicator Criteria Rankings

3.1.1 Representative

Whenever possible, indicators should directly measure their respective desired outcome(s). Characteristics of a representative indicator include:

- Designed to reflect on statewide and/or regional scale.
- Adaptable at regional and state levels.
- Informative in evaluating environmental/social/economic conditions, as well as the influences on these conditions.
- Reflective of an important aspect of the social, environmental, or economic pillars.
- Accurate correlation exists with the issue for which it is a proxy.
- Independent, in that it isn’t related to or reliant on other indicators, to design an efficient indicator system. Since some critical indicators may be related and somewhat dependent on each other, independence is considered secondary to developing both easily-measured and representative indicators.

3.1.2 Data Viability

Characteristics of data viability in an indicator include:

- Data are collected to yield measures that are scientifically acceptable and support sound conclusions about the state of the system being studied.
- Data are available and accessible, accurate, comparable over time, complete with historical information, and cover sufficient geographic areas.
- Data collection is standardized.
- Data collection is (or can easily be) consolidated and performed by a single entity or small number of entities.
- Meaningful differences are distinguishable in environmental conditions with an acceptable degree of resolution.
- Data analysis reveals important changes in the factor of interest.
- Data analysis produces the same value if repeated in the same way on the same population at almost the same time.
- Data analysis is straightforward and results are quantifiable.

3.1.3 Cost

Indicator costs should be evaluated for the cost to collect and maintain the data needed. These costs should be manageable, in conjunction with an efficient process for analysis and reporting. At this time, cost is evaluated in relation to other indicators categorized in the same intended outcome.

3.1.4 Longevity

Indicators should be applicable in both short-term and long-term time frames for the ability to report on changes due to management actions. Characteristics of longevity in an indicator include:

- Available data set spans many years to allow for reporting on trends over time.
- Relatively quick response to management intervention. The ability to readily observe change over time (e.g., 2 – 3 years) may be preferable to and provide more efficient management than an indicator that requires a long period of time to detect similar changes (e.g., 20 + years). However, it is also important to recognize that many process take decades or longer to change or recover. Indicators for those projects and programs should be stable over these longer timeframes (decades).
- The range of natural variation can be quantified and accounted for in evaluations.
- Long-term relevance. Some sustainability goals may require long-term solutions, so those indicators should be applicable in the short-term but also intergenerational and usable over the long-term.

- Representative of large aspects of the intended outcome and trends, rather than narrowly focused.
- Provides information at both broad and fine spatial scales, as these indicators can help inform both strategic and site-specific decisions and be more useful.

3.1.5 Supportive of Decision Making

Indicators should measure the effects of management actions and clearly communicate information to various stakeholders for making policy decision on both regional and statewide scales. Characteristics of an indicator that is support of decision-making include:

- Provides information appropriate for making policy decisions.
- Relevant to actual or anticipated policies.
- May be used to evaluate the effects or effectiveness of management actions to meet state, or regional goals and objectives.
- Easily understood by those making different types of decisions (e.g., scientists, public, elected officials).
- Simple to understand and easy to communicate.

3.2 Classification of Indicators Based on Data Availability

Indicators meeting the above criteria were further evaluated as to whether data were available to be applied in the Sustainability Outlook, either at a statewide or watershed scale. This evaluation process is described below and shown in Figure 3-3.

- **Type I** – Adequate data were readily available and could be used to support the development of the indicator. These data were generated by ongoing, systematic monitoring or data collection efforts.
- **Type II** – Full or partial data generated by ongoing systematic and/or collection were available, but either a complete cycle of data had not been collected, was not geographically complete, or further data analysis or management was needed.
- **Type III** – Data were available from a single or limited effort providing a “snapshot in time,” or piecemeal data were available, but no ongoing monitoring or data collection was in place to provide data over an extended period. However, these data were useful in revealing gaps that may need to be filled.
- **Type IV** – The needed data have never been collected. Either:
    - The requirements to collect and monitor the data were well understood and collection and application to the Sustainability Outlook appeared feasible or
    - The requirements to collect and monitor the data were not well understood, cost-prohibitive, or the data would not be expandable on a temporal or spatial scale.

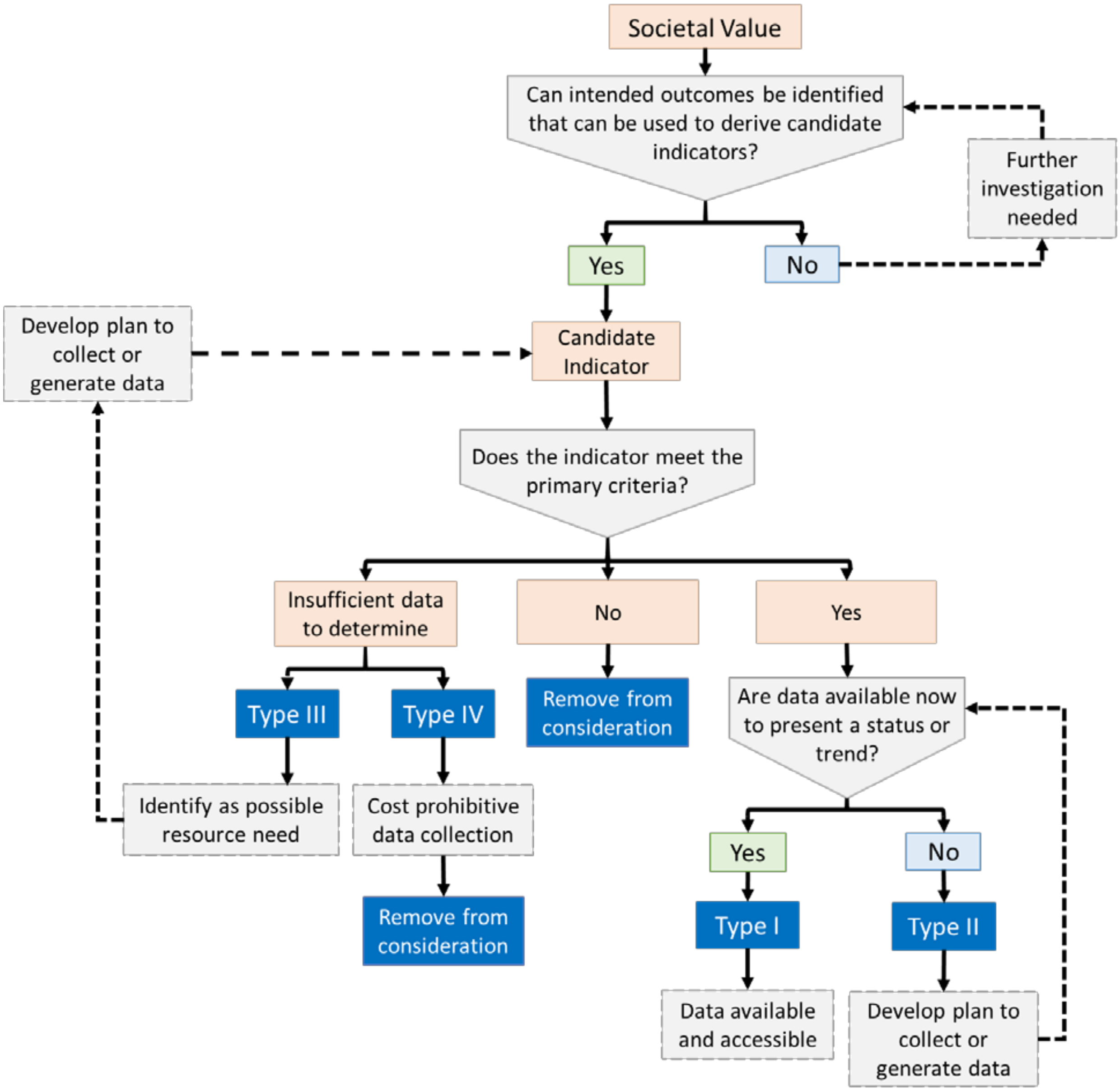

Figure 3-3. Flowchart of Process to Classify Indicators Based on Data Availability

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4 Basic and Watershed Sustainability Indicators

This section describes each sustainability indicator that was considered Basic level (i.e., applicable statewide as well as at a watershed level) or Watershed level as a result of the screening process. Each indicator assessment provides a description of the indicator, its importance, insight on the screening process, recommendations, and any references utilized. In addition, an initial, idealized target for the indicator is described. These targets will be further assessed and revised during future water plan updates.

The **current** list of indicators is shown in Table 4-1 and is subject to change as indicators are more fully developed. Indicators are grouped by societal value (Public Health and Safety, Ecosystem Vitality, Healthy Economy, and Opportunities for Enriching Experiences) and then further sorted by the corresponding intended outcome. In this table and throughout the document, Public Health and Safety is coded in red, Ecosystem Vitality in blue, Healthy Economy in green, and Opportunities for Enriching Experiences in yellow. Each intended outcome has several indicators. In some cases, while an indicator is presented under one corresponding outcome, it may provide insight into multiple outcomes.

The “ID” column provides a reference number for each indicator, which also includes its societal value, however the ordering does not denote importance or weighting. The “Data Type” classification is as described in Section 3.4 (above).

Where data sources, methodologies, or resulting information from indicators overlap, attempts to combine the indicators were, and will continue to be, made. Additional details can be found in the recommendations for each individual indicator.

The current plan focuses on determining baseline conditions and identifying data sources and data gaps for further implementation. Future iterations would incorporate local and regional progress towards targets as well as further development of the indicators themselves.

Table 4-1. Comprehensive List of Intended Outcomes and Associated Basic and Watershed Indicators

Societal Value	ID	Indicator	Level	Data Type
Public Health and Safety	**Intended Outcome – A reliable water supply for domestic needs, sanitation, and fire suppression.**			
	PHS 1	Population and Percentage of Population with Reliable Domestic Water Supplies	Basic	Type II
	PHS 2	Population and Percentage of Population without Access to Reliable Sanitation	Basic	Type II
	Intended Outcome – Reduced number of people exposed to waterborne health threats such as contaminants or infectious agents.			
	PHS 3	Number of Public Water Systems Not in Compliance with Drinking Water Standards	Basic	Type I
	PHS 4	Percentage of Beaches with Safe Coliform Bacteria Levels	Basic	Type III
	PHS 5	Water Supplies Derived from 303(d) Impaired Water Bodies	Basic	Type I
	PHS 6	Potential for Consumption of Mercury-Contaminated Fish	Basic	Type I
	Intended Outcome – Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)			
	PHS 7	Population Served by Local Hazard Mitigation Plans, Emergency Response Plans, or Equivalents	Basic	Type II
	PHS 8	Population Covered by Water Shortage Contingency Plans	Basic	Type II
	PHS 9	Urban Population without State-Mandated Urban Level of Flood Protection	Basic	Type II
	PHS 10	Population in Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year	Basic	Type III
Ecosystem Vitality	**Intended Outcome – Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.**			
	EV 1	Native Fish Diversity Index	Basic	Type I
	EV 2	Non-Native Invasive Species Distribution and Status	Basic	Type I
	Intended Outcome – Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.			
	EV 3	Acreage of Wetlands	Basic	Type I
	EV 4	Degree of Aquatic Fragmentation	Basic	Type II
	EV 5	Impaired Water Bodies – by Hydrologic Region	Watershed	Type I
	EV 6	California Stream Condition Index	Basic	Type I

Table 4-1. Comprehensive List of Intended Outcomes and Associated Basic and Watershed Indicators (contd.)

Societal Value	ID	Indicator	Level	Data Type	Status
Ecosystem Vitality (contd.)	**Intended Outcome – Achieved designated beneficial uses for water bodies throughout the state.**				
	EV 7	Impaired Water Bodies – Count by Watershed	Basic	Type I	
	EV 8	Number of Harmful Algae Blooms	Basic	Type I	
Healthy Economy	**Intended Outcome – Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.**				
	HE 1	Delivery Reliability of SWP, CVP, and Colorado River Aqueduct Systems	Basic (Future)	Type I	
	HE 2	Comparison of Actual Water use to Proposed Statewide Water Use Targets	Basic (Future)	Type I	
	HE 3	Distribution System Leaks and Losses	Watershed	Type II	
	HE 4	Groundwater Basins with Stable or Recovering Groundwater Levels	Basic	Type I	
	HE 5	Groundwater Extraction Rates and Subsidence Rates	Basic (Future)	Type III	
	HE 6	Change in Groundwater Storage	Basic	Type III	
	HE 7	Percentage of Groundwater Basin Areas in Compliance with SGMA	Basic	Type III	
	HE 8	Contaminated Groundwater Wells	Basic	Type II	
	Intended Outcome – Consideration of economic risks and rewards on floodplains, rivers, and coastal areas.				
	HE 9	Socioeconomic Vulnerability to Sea Level Rise Impacts	Basic	Type I	
	HE 10	Areas Covered by Local Coastal Program Vulnerability Assessments Updated for Sea Level Rise	Basic	Type II	
	Intended Outcome – More benefits from economics activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)				
	HE 11	Regional Trend in Cost of Water for Municipal and Industrial, Agricultural, and Other Purposes; Cost Compared to State Average for these Same Supplies	Watershed	Type II	
	HE 12	Volume of Water Transferred on the Open Market; Cost of Water on the Transfer Market	Basic	Type III	
	HE 13	Percent of Average Annual Power Demand Satisfied by Hydropower	Basic	Type I	

Table 4-1. Comprehensive List of Intended Outcomes and Associated Basic and Watershed Indicators (contd.)

Societal Value	ID	Indicator	Level	Data Type	Status
Healthy Economy (contd.)	**Intended Outcome – Reduced likelihood or occurrence of significant social disruption following a disaster.**				
	HE 14	Value of Assets within Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year	Basic	Type I	
Opportunities for Enriching Experiences	**Intended Outcome – Preserved or enhanced culturally or historically significant sites and communities, including continued and enhanced access to water and land used for sacred ceremonies or cultural practices.**				
	OEE 1	Number of Historically and Culturally Significant Sites at Risk of Flooding or Sea Level Rise	Basic	Type II	
	Intended Outcome – Preserved and increased natural areas with aesthetic or intrinsic value (including viewshed).				
	OEE 2	Change in Natural Area	Basic	Type I to Type III	
	Intended Outcome – Continued and enhanced access to resources that support education and learning.				
	OEE 3	Number of School Districts Using Water and Environmental Curriculum in K through 12 Programs	Basic	Type II	
	OEE 4	Number of Students Enrolled in Water and Environmental Resources Management Programs within the UC and CSU Systems	Basic	Type I	
	OEE 5	Number of Water Agencies that Have Educational Programs for Customers	Basic (Future)	Type II	
	Intended Outcome – Continued and enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces				
	OEE 6	Change in Visitor Days at Water Related Park Lands	Basic	Type III	

Key:
CSU = California State University
CVP = Central Valley Project
EV = Ecosystem Vitality
HE = Healthy Economy
K = kindergarten
OEE = Opportunities for Enriching Experiences
PHS = Public Health and Safety
SGMA = Sustainable Groundwater Management Act
SWP = State Water Project
UC = University of California

Public Health and Safety

Intended Outcome: A reliable water supply for domestic needs, sanitation, and fire suppression.

PHS 1: Population and Percentage of Population with Reliable Domestic Water Supplies

This indicator analyzes the level of access to reliable domestic water supplies. For this indicator, access to reliable domestic water supply is defined as the ability to meet (1) water demands consistently across the full range of climatic conditions, and (2) acceptable service standards during catastrophic conditions. A reliable water supply should be of suitable quantity and quality for its purpose.

The target outcome for this indicator is 100 percent of the population having access to reliable domestic water supplies.

Scale:	Statewide
Data Sources:	Urban Water Management Plans (UWMP); State Water Resources Control Board (State Water Board) Division of Drinking Water (DDW); CWP Update 2013; U.S. Department of Health and Human Services, Indian Health Service (IHS)
Data Availability:	Type II
Metric:	Percent of population
Screening Status:	**Basic**

Importance and Screening Considerations

Populations in municipalities and counties should readily have access to clean and sufficient domestic water supplies to meet public health and safety standards. Lack of access to reliable domestic water supplies to meet basic domestic needs can be attributed to a variety of underlying conditions, including drought, poor water quality, affordability, insufficient infrastructure, and others. As California continues to face conditions that may affect access to reliable domestic water supplies, assessing the State's progress towards reducing those effects will continue to be an important indicator of public health and safety.

Through the screening process, this indicator was categorized as a Basic level indicator. This indicator was found to be highly representative of its target outcome of a reliable water supply at both a statewide and watershed scale. This indicator may help decision makers determine areas where segments of the population do not have access to reliable domestic water supplies.

Partial data are available on water quantity and water quality, through different databases. Centralized data on the reliable quantity of water available are collected through UWMPs that are updated every five years. A methodology to determine the number of Californians without access to safe water and sanitation was developed as part of Update 2013 process in the *Californians without Safe Water and Sanitation* report. Two different portions of this methodology are applicable to this indicator and to *PHS 2, Population and Percentage of Population without Access to Reliable Sanitation*, respectively. The portion applicable to this indicator uses water quality information to determine if a water system provides safe water, where water quality data are available, such as through the DDW.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.1 Initial Data and Results

An initial analysis on the reliability of water supplies, focusing on available quantity of water, for urban systems was conducted using data collected through the UWMP process via DWR's Water Use Efficiency Data portal. These data include the population served by each urban water supplier as well as supply and demand in normal years and consecutive dry years. Table 4-2 presents the population and the percent of total California population served by each wholesale or retail urban water supplier that is projected to meet, in 2020, at least 100 percent of normal year demands with their supplies and 80 percent of demand with their supplies during the course of a three-year drought. These data come from the 2015 UWMPs. Per legislation, UWMP documents project out in 5-year increments to 20 years, of as far out as data are available. UWMP multi-year drought projections occur at the first five-year increment. Some overlap may exist in the populations served by wholesale and retail water suppliers. Not all the information shown in Table 4-2, submitted by urban water suppliers, has been reviewed by DWR as part of the UWMP review process.

Table 4-2. Population Served by Urban Water Retailers Able to Meet Demands in Normal and Multi-Year Drought Conditions in Year 2020

	Population Served	Percent of 2020 California Population Projection (40,719,999)
Retail Urban Water Supplier		
Demands Met	27,465,009	67.4%
Demands Unmet	1,509,733	3.7%
Total	28,974,742	71.2%
Wholesale Urban Water Supplier		
Demands Met	3,522,584	8.7%
Demands Unmet	717,554	1.8%
Total	4,240,138	10.4%

Sources: Water Use Efficiency Data Public Portal. January 10, 2018.
California Department of Finance. January 10, 2018.

As shown in Table 4-2, at least 3.7 percent of the California population is served by urban water retailers that cannot adequately meet demands based on quantity of water using their current and/or projected supplies. These data cover between 71.2 percent and 81.6 percent of California's population. (The amount of overlap between populations served by retails urban water suppliers and wholesale urban water suppliers is not addressed.)

The *Californians without Safe Water and Sanitation* report provides a separate methodology to establish the number of Californians without safe drinking water. The report focuses primarily on water quality, whereas the UWMP process focuses primarily on water quantity. The report examines available data by the type of water system that supplies drinking water to each home and splits these into five categories: private domestic well, local small water system, state small water system, tribal water system, and community water system. Table 4-3 displays the available data and data sources used in Update 2013.

Some data have been updated from this report, as noted in the table. For some systems, data are available on the population served and the quality of water provided. However, major data gaps remain.

Table 4-3. Estimate of Californians Without Safe Drinking Water

Type of System (No. of Service Connections)	Total No. of Systems	Total Population Served	No. of Systems Without Safe Water	Population Served Without Safe Water	Percent of Population Served Without Safe Water
Private Domestic Well (1)	200,000 – 600,000[1]	600,000 – 2,000,000[1]	Data Not Available	Data Not Available	Data Not Available
Local Small Water System (2 – 4)	Data Not Available	Data Not Available	Data Not Available	Data Not Available	Data Not Available
State Small Water System (5 – 14)	Data Not Available	Data Not Available	Data Not Available	Data Not Available	Data Not Available
Tribal Water System[2]	(41,923 homes)	138,346	(1,574 homes)	5,195	3.7%
Community Water System (> 15)[3]	2,905	41,695,950	246	377,515	0.9%

Source: Adapted from the Californians Without Safe Water and Sanitation report (Alarcon, Jose et al. 2014) and updated as indicated.

Notes:

[1] State Water Board, 2013, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water*

[2] Approximately 160 tribal water systems are recognized by the U.S. Environmental Protection Agency in California, although this number does not include federally non-recognized tribes or small systems supplying less than 14 homes. No population estimates are available for these tribal water systems. Information on the number of homes is available through the Indian Health Service's Sanitation Tracking and Reporting System. This system documents information about sanitation deficiencies related to American Indian and Alaskan Native individual homes and communities. The total number of homes and number of homes without safe water include the number of homes with an Indian Health Service Deficiency Level of 3, 4, or 5 due to water-related issues as of December 15, 2017. The population estimates assume 3.3 persons per home.

[3] Information on community water systems available through the Human Right to Water Portal. The number of systems out of compliance assumed to be the number of systems without safe water. Populations are as reported by the community water systems, which may include transients in addition to residents. Updated March 13, 2018.

As shown in Table 4-3, major data gaps exist to evaluate the populations with and without reliable domestic water supplies. Small systems of under 15 connections, and not covered under the IHS, are not monitored under State regulations. Generally, these systems lack adequate infrastructure and the economies of scale of larger systems, and may be more vulnerable to water quality issues than larger systems. However, data on small systems are not currently available. Local and state small water systems are not regulated by the State. California does not require sampling of private wells after installation, so individual owners may or may not conduct water quality testing. Groundwater Ambient Monitoring and Assessment's (GAMA) Domestic Well Project helps bridge the gap in information between public and private wells, but continued progress is impeded by a lack of funding.

Of note, tribal communities face a much higher percentage of populations without safe drinking water than communities served by community water systems. The 1988 amendments to the Indian Health Care

Improvement Act (IHCIA) require the IHS to maintain inventories of sanitation deficiencies for new and existing American Indian and Alaskan Native homes and communities. Many American Indian and Alaskan Native tribes cooperate closely with the IHS' Sanitation Facility Construction Program, which works to directly prevent the spread of disease through construction of facilities to provide safe drinking water and waste disposal. This program also helps American Indian and Alaskan Native communities build the administrative and technical capabilities to construct their own sanitation facilities with engineering support from IHS. Although these programs result in projects to improve deficiencies for American Indian and Alaskan Native homes and communities, additional work is required to provide all individuals with safe reliable water supplies.

4.2 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. A method to gather additional data for smaller water systems should be developed to obtain a complete and comprehensive statewide dataset. Similarly, the largest data gaps in analyzing water quality occur for small water systems and individual well owners.

UWMPs apply only to "urban water suppliers," defined as "a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes," so smaller water systems are not represented in this data set. Data collected through UWMPs are readily available, but additional data should be gathered for non-urban water systems using similar methods to those presented in the UWMPs. In addition, information on the locations of the urban water retailers should be identified to provide a spatial representation of where populations without access to reliable domestic water supplies are located.

Water supply reliability may be an issue of water quality and/or water quantity depending on the region. Currently, data on water quality and water quantity would be difficult to reconcile into a single geocoded dataset for analysis to understand regional trends in water reliability. Assessing reliability may also involve tracking the percentage of imported supplies to regions.

In 2018, the California State Legislature (Legislature) enacted two policy bills – Senate Bill (SB) 606 and Assembly Bill (AB) 1668 – to establish both the foundation and needed authorities for long-term improvements in water conservation and drought planning to adapt to climate change and the resulting longer and more intense droughts in California. These bills amended the California Water Code, requiring state agencies to develop statewide water use targets, standards, and guidelines, and water agencies to then report on progress towards meeting those requirements. During the implementation process, DWR and other State agencies will further develop data, information, guidelines, and other technical assistance to help realize the bills' intended outcomes. Both bills include requirements for public access to data and their use, as well as related studies, reports, and investigations. These data, studies, reports, and investigations may be of use to continued development of this indicator.

4.3 References

Alarcon, Jose, et al. 2014. Californians Without Safe Water and Sanitation, California Water Plan Update 2013. California Department of Water Resources. Viewed online at: https://www.waterboards.ca.gov/rwqcb3/water_issues/programs/enviro_justice/ej_docs/2_20_15ca_wo_safewater_san.pdf

California Urban Water Agencies. 2012. Water Supply Reliability Report. Viewed online at: http://www.cuwa.org/pubs/CUWA_WaterSupplyReliability.pdf

California Department of Water Resources. “Submitted 2015 Urban Water Management Plans (UWMP) Data Exports.” Water Use Efficiency Data Public Portal. Viewed online at: https://wuedata.water.ca.gov/default.asp. Last accessed: January 10, 2018.

California Department of Finance. “Demographic Projections.” California Department of Finance. Viewed online at: http://www.dof.ca.gov/Forecasting/Demographics/Projections/. Last accessed: January 10, 2018.

Indian Health Service. “Sanitation Tracking and Reporting System.” Viewed online at: https://wstars.ihs.gov/. Last accessed: December 15, 2017.

Indian Health Service Sanitation Facilities Construction (SFC) Program. 2015. Public Law 86-121 Annual Report. Viewed online at: https://www.ihs.gov/dsfc/includes/themes/responsive2017/display_objects/documents/reports/SFCAnnualReport2015.pdf

Public Health and Safety

Intended Outcome: A reliable water supply for domestic needs, sanitation, and fire suppression.

PHS 2: Population and Percentage of Population without Access to Reliable Sanitation

This indicator assesses the percentage of California population that does not have access to adequate sanitation. While adequate sanitation is partly achieved through proper treatment and handling of wastewater, sanitation can also be interpreted on a larger scale of domestic needs such as sanitary water for cooking, bathing, and washing. For this indicator, access to reliable sanitation is defined as the ability to provide water of adequate supply and quality for domestic purposes.

The target outcome for this indicator is 100 percent of the population has access to reliable sanitation.

Scale:	Statewide
Data Sources:	CWP Update 2013; IHS; State Water Board
Data Availability:	Type II
Metric:	Percent of Population
Screening Status:	**Basic**

4.4 Importance and Screening Considerations

Treatment and handling of wastewater is an important factor in maintaining public health and safety, protecting the environment, and sustainably managing the state's water resources. However, some California residents live in communities or areas that do not have access to adequate, reliable sanitation.

During the screening process, this indicator was categorized as a Basic level indicator. This indicator is closely tied to providing a reliable water supply for domestic needs, its intended outcome. This indicator has statewide applicability. However, significant data gaps exist. Collecting information on sanitation is particularly difficult in rural areas, where sanitation services are not consolidated or provided by a public entity. In addition, merging data from public and private entities may have substantial costs and require significant effort. A methodology to determine the number of Californians without access to reliable sanitation was developed as part of the Update 2013 process in the *Californians without Safe Water and Sanitation* report.

Representative of Outcome:	High
Data Viability:	Medium-High
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.5 Initial Data and Results

Within past analysis of the number of Californians without adequate sanitation in the *Californians without Safe Water and Sanitation* report, wastewater systems were grouped into the following three categories: onsite wastewater treatment system or septic system, tribal wastewater system, and centralized waste water treatment system with sewer collection. Only data on tribal wastewater systems are currently available. The 1988 amendments to the IHCIA require the IHS to maintain inventories of sanitation deficiencies for new and existing American Indian and Alaskan Native homes and communities, including those related to sewer and solid waste. Table 4-4 summarizes existing data and data gaps.

Table 4-4. Estimate of Californians Without Adequate Sanitation

Type of System	Total No. of Systems	Total Population	No. of Systems Without Adequate Sanitation	Population Served Without Adequate Sanitation	Percent of Population Served Without Adequate Sanitation
Onsite Wastewater Treatment System (Septic System)[1]	1,200,000	>3,960,000	Data Not Available	Data Not Available	Data Not Available
Tribal Wastewater System[2]	(41,923 homes)	138,346	(2,166 homes)	7,148	5.2%
Small Wastewater System	577[3]	Data Not Available	Data Not Available	Data Not Available	Data Not Available
Medium & Large Wastewater System	317[3]	Data Not Available	Data Not Available	Data Not Available	Data Not Available

Source: Adapted from the Californians Without Safe Water and Sanitation report (Alarcon, Jose et al. 2014) and updated as indicated.

Notes:

[1] Estimate from State Water Board's 2012 Onsite Wastewater Treatment System policy. The population estimate assumes that all 1.2 million septic systems are for residential use and assumes 3.3 persons per household.

[2] Information on the number of homes is available through the Indian Health Service's Sanitation Tracking and Reporting System. This system documents information about sanitation deficiencies related to American Indian and Alaskan Native individual homes and communities. The total number of homes and number of homes without adequate sanitation include the number of homes with an IHS Deficiency Level of 3, 4, or 5 due to sewer or solid waste-related issues as of December 15, 2017. The population estimates assume 3.3 persons per home.

[3] Information from State Water Board's Integrated Water Quality System (CIWQS) database, as of 2014 Since population data are not available in CIWQS, the number of small water systems was estimated by determining the number of systems with a permitted flow of less than 1 million gallons per day (MGD), and the number of medium and large systems was estimated by determining the number of systems with a permitted flow of more than 1 MGD.

4.6 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. Data availability and gaps are a major issue across the state, especially in rural and small communities. To assess this indicator, data must be collected for all non-tribal wastewater systems, including on the total number of these systems, the residential populations served, and the adequacy of the systems. State, regional, and local governments should coordinate to estimate the statewide total population without reliable sanitation. In addition, data should incorporate spatial information to analyze regional trends in the availability of sanitation.

4.7 References

Alarcon, Jose, et al. 2014. Californians Without Safe Water and Sanitation- California Water Plan Update 2013. California Department of Water Resources. Viewed online at: https://www.waterboards.ca.gov/rwqcb3/water_issues/programs/enviro_justice/ej_docs/2_20_15ca_wo_safewater_san.pdf

California Urban Water Agencies. 2012. Water Supply Reliability Report. Viewed online at: http://www.cuwa.org/pubs/CUWA_WaterSupplyReliability.pdf

Indian Health Service. "Sanitation Tracking and Reporting System." Viewed online at: https://wstars.ihs.gov/. Last accessed: December 15, 2017.

Indian Health Service Sanitation Facilities Construction (SFC) Program. 2015. Public Law 86-121 Annual Report. Viewed online at: https://www.ihs.gov/dsfc/includes/themes/responsive2017/display_objects/documents/reports/SFCAnnualReport2015.pdf

State Water Resources Control Board. 2012. Onsite Wastewater Treatment System Policy. Final Substitute Environmental Document. Viewed online at: https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2012/0032sed.pdf

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS 3: Number of Public Water Systems Not in Compliance with Drinking Water Standards

This indicator assesses the number of public water systems, and the populations served by those systems, not in compliance with drinking water standards. A positive outcome for this indicator is a decreasing trend in the number of public water systems not in compliance with drinking water standards. The target outcome for this indicator is no public water systems are out of compliance with drinking water standards.

The State Water Board DDW regulates public water systems in California. The DDW collects data on compliance with the drinking water regulations included in the California Code of Regulations, including violations by public water systems. Public water systems are defined as systems that serve 25 people a day at least 60 days a year or systems with at least 15 service connections. These public water systems must comply with established drinking water monitoring regulations. Drinking water standards are called maximum contaminant levels (MCL).

Scale:	Statewide
Data Sources:	State Water Board DDW
Data Availability:	Type I
Metric:	Population served by public water systems and number of MCL violations by public water systems
Screening Status:	**Basic**

4.8 Importance and Screening Considerations

More than 98 percent of Californians served by public water systems receive drinking water that meets federal and State drinking water standards. Threats to safe drinking water supply are numerous, many of which may be naturally occurring in addition to those resulting from human activities of industrial, agricultural, or urban origin. In addition, of over 7,500 public water systems in the state, the majority (about 87 percent) serve small communities of 1,500 people or less. Many of these small water systems are challenged by the lack of technical, managerial, and financial capacity, and many do not serve drinking water that meets current standards.

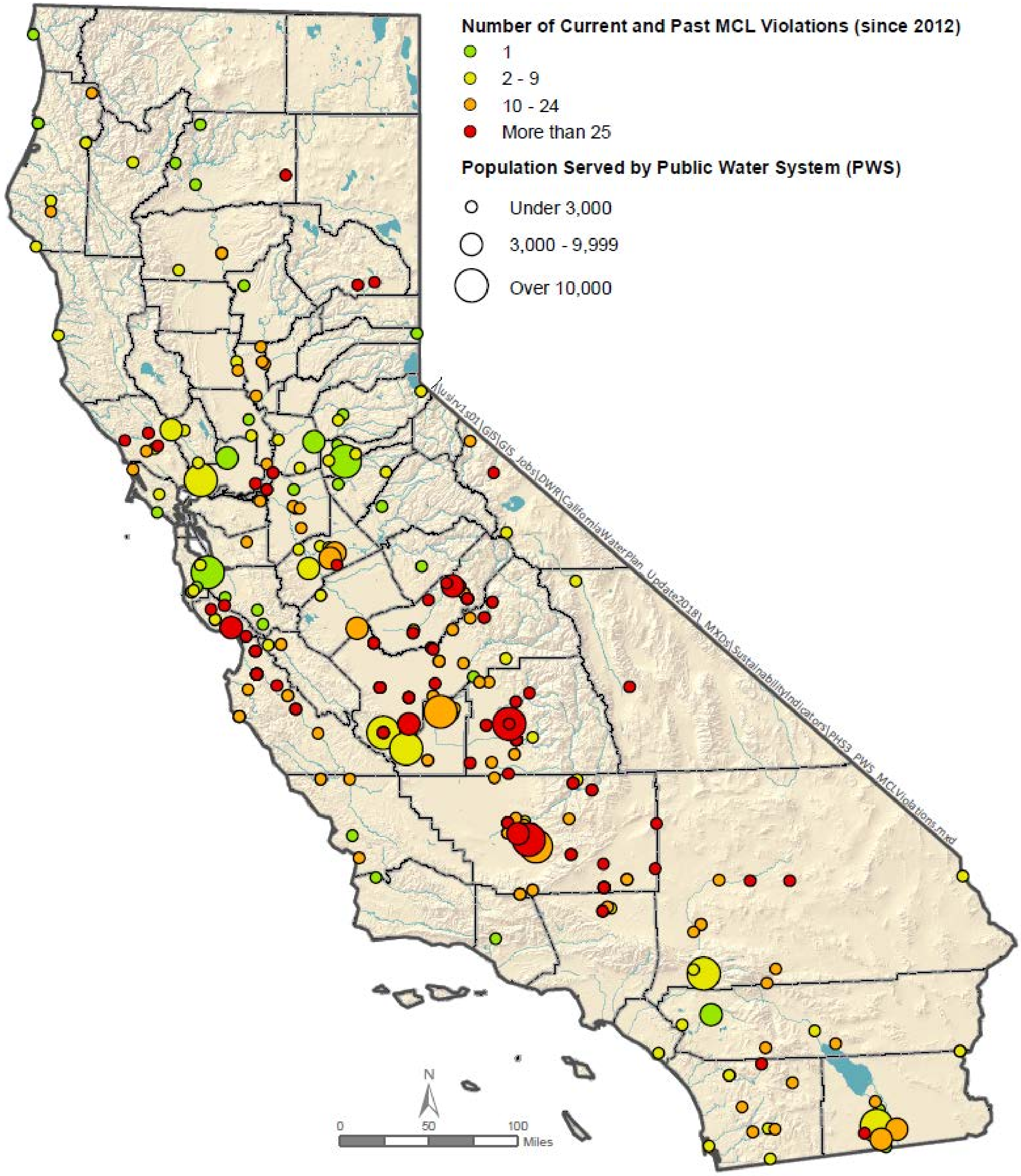
This indicator is categorized as a Basic level indicator. Data are available on MCL violations by public water systems through the DDW, but not those of smaller systems. In addition, water quality is an important component of providing a reliable water supply for domestic needs and sanitation.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Medium-High
Potential Longevity:	High
Supportive of Decision Making:	High

4.9 Initial Data and Results

Data from the State Water Board Safe Drinking Water Information System were used to determine the population and number of MCL violations for each public water system since 2012 for systems still out of compliance. Each water system has a unique identification number that the State Water Board uses to track the different violation category codes (e.g., MCL violations).

These data were mapped based on the counties and mailing addresses of the public water systems. As shown in Figure 4-1, the public water systems with the highest number of MCL violations are small systems that may lack technical, managerial, and financial capability to address those violations and their underlying causes. In addition, public water systems in the Central Valley have both more MCL violations and systems not in compliance with the MCLs compared to California as a whole. Currently, this indicator can only capture MCL violations from systems that follow regular monitoring and reporting requirements.



Source: Human Right to Water Portal. State Water Board. January 18, 2018

Figure 4-1. Public Water System Maximum Contaminant Level Violations

4.10 Recommendations

This indicator is a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

Potential future developments include:

- Analyzing five years of data instead of a single year.
- Gathering data from water systems too small to qualify as public water systems (under 25 people a day for 60 days or under 15 service connections) for a more representative statewide dataset.
- Analyzing the change in the location and quantity of violations with time or funding.

High importance should be placed on gathering data from small water systems. These systems are typically associated with communities that do not serve drinking water that meets current standards, but are challenged by lack of technical, managerial, and financial capacity to address violations and underlying causes.

4.11 References

State Water Resources Control Board. 2015. Safe Drinking Water Plan for California. Viewed online at: https://www.waterboards.ca.gov/publications_forms/publications/legislative/docs/2015/sdwp.pdf

California Urban Water Agencies. 2017. Tackling California’s Water Accessibility and Affordability Issues. Viewed online at: http://www.cuwa.org/pubs/2017_CUWA-Water-Affordability-Fact-Sheet.PDF

State Water Resources Control Board. “Human Right to Water Portal.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/hr2w/index.html. Last accessed: January 29, 2018.

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS 4: Percentage of Beaches with Safe Coliform Bacteria Levels

This indicator assesses the percentage of beaches by county that receive A+, A, or B grades during wet weather monitoring, as analyzed in Heal The Bay's beach report cards. Beach advisories and beach closures occur when water quality testing finds high concentrations of contaminants exceeding health standards. Bacterial testing results are collected by Heal the Bay and reported through their beach report card process using standard grades.

A positive outcome of this sustainability indicator would be to have 100 percent of beaches to have safe coliform bacteria levels during wet weather monitoring.

Scale:	Statewide
Data Sources:	Heal the Bay Ocean Beach Report Card; State Water Board Beach Watch; County Health Departments; California Water Quality Monitoring Council's Safe to Swim Portal
Data Availability:	Type III
Metric:	Percentage of beaches with safe coliform bacteria levels during wet weather monitoring, as shown in Heal the Bay's beach report card
Screening Status:	**Basic**

4.12 Importance and Screening Considerations

Public exposure to harmful bacteria is a direct threat on public health and safety. Regular reporting of bacterial monitoring results at beaches, leading to contact exposure warning when necessary, can protect the public from water borne illnesses and other hazards associated with poor water quality as represented by high bacteria levels.

County health agencies monitor coastal beaches and issue warnings when water quality has contaminants that exceed health standards issued by the California Department of Public Health. The State Water Board provides BeachWatch, which is a non-public database of beach closures. Currently, no statewide water contact recreation standards exist for freshwater streams and lakes, although adoption of statewide bacteria water quality standards across freshwater and coastal waters is scheduled for early 2018.

This indicator is considered Basic level. Data provided to the State Water Board by local county health agencies of coastal counties are used by Heal the Bay to develop grades for beaches along California's coast. These data are inconsistent with respect to time. For example, water quality data at some beaches are collected on a weekly basis, while similar data at another beach data may only be collected after certain precipitation events. However, results are easily understood for decision making.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Medium-High
Potential Longevity:	Medium
Supportive of Decision Making:	Medium-High

4.13 Initial Data and Results

Heal the Bay rates beaches along the California coast and provides weekly and annual grades for certain grade periods. Grades are based off a point-based scoring system based on taking away points for exceedance of *Enterococcus*, Fecal Coliform, and Total Coliform indicators during monitoring. The most recent annual data, from April 1st, 2016 to March 31st, 2017 were used to develop Figure 4-2.

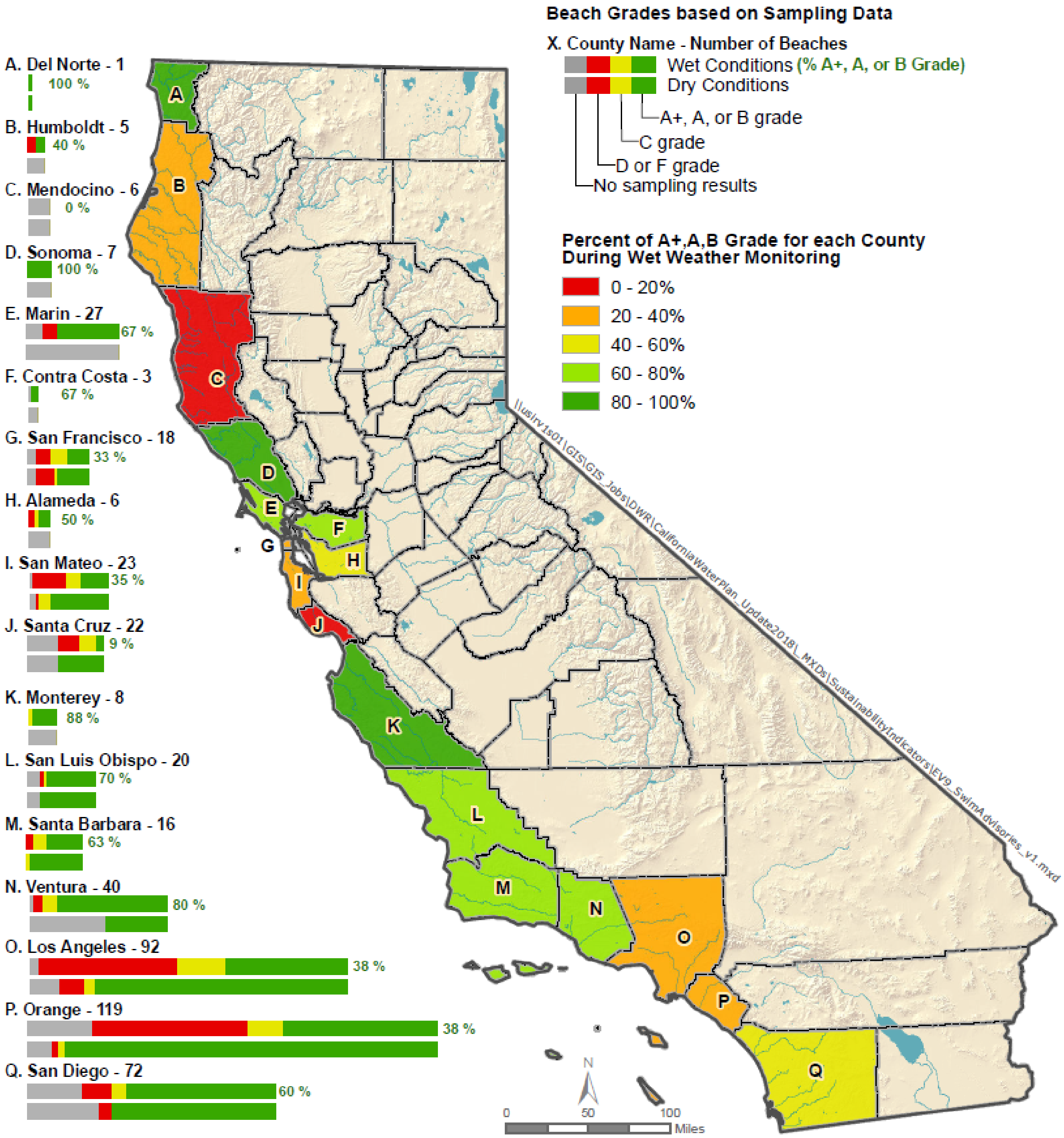
Data shown corresponds to:

1. wet weather conditions, days experiencing a rain event or over the following three days, and
2. dry weather conditions, days with no rain and at least three days after a rain event.

Wet weather conditions are often worse than dry weather conditions due to the impact of storm drain runoff, which flows untreated to the coast and can contain motor oil, animal waste, pesticides, yard waste, and trash. Although this indicator focuses on wet weather conditions, dry weather conditions data is shown to emphasize how these issues impact Californian beaches.

As shown in Figure 4-2, beaches in more urbanized counties face more water quality issues, especially in wet weather conditions. This is especially true for Los Angeles and Orange counties. In addition, dry condition sampling is not conducted at all the beaches presented by Heal the Bay. Expanding sampling programs may provide additional data, which could be used to post swim advisories as necessary to protect public health and safety, rather than only sampling after wet weather. Only two counties have data on all their beaches both in wet and dry conditions.

The Central Coast has the highest percentage of beaches, which during wet weather, have safe coliform bacteria levels.



Source: "Beach Grade." Heal the Bay. February 2, 2018.

Figure 4-2. Beach Grades Reported by Heal the Bay for California Beaches Representing Safe Coliform Bacteria Levels

4.14 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. The beach grades provided by Heal the Bay clearly show areas struggling to maintain safe levels of bacteria at monitored beaches. These areas can cause impacts to public health and safety and may be areas experiencing poor ecosystem health as well.

The State Water Board Beach Watch database may have additional data on beach closures that could be incorporated into this indicator, rather than using only Heal the Bay records. Although the number of beach advisories could provide information related to public health and safety, beach advisories are directly related to the number of rain events that occur at any given beach, more than the results of the water quality monitoring.

Currently, data are only available for coastal beaches. Few counties report freshwater swim advisories or closures electronically. Additional data gathering efforts would be required to centralize data on freshwater swim advisories, closures, and bacterial monitoring.

This indicator should eventually reflect changes made to statewide bacterial objectives, which are pending adoption by the State Water Board as of May 2018.

4.15 References

Heal the Bay. “Beach Grades.” Beach Report Card. Viewed online at: http://brc.healthebay.org/?st=CA&f=1. Last accessed: February 2, 2018.

Heal the Bay. 2017. Heal the Bay's 2016-17 Annual Beach Report Card.

California Water Quality Monitoring Council. “Is it safe to swim in our waters?” My Water Quality. Viewed online at: http://www.mywaterquality.ca.gov/safe_to_swim/index.html. Last accessed: February 2, 2018.

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS 5: Water Supplies Derived From 303(d) Impaired Water Bodies

This indicator assesses the amount of water supply in gallons per day that is derived from 303(d) water bodies in California that are impaired for human health uses. A positive outcome for this indicator is a decreasing trend in the amount of water supply derived from 303(d) impaired water bodies. A target outcome for this indicator is zero water supplies derived from 303(d) impaired water bodies, which could also indicate a decrease in the amount of impaired water bodies statewide.

As required by the Federal Clean Water Act, the Clean Water Act Section 303(d) List of impaired water bodies is reassessed biennially by the State and Regional Water Boards. The Clean Water Act Section 303(d) List identifies impaired and threatened water bodies along with their pollutants. These water bodies do not meet Federal water quality standards.

Scale:	Statewide
Data Sources:	State Water Board eWRIMS database; State Water Board 2014/2016 California Integrated Report (Clean Water Act Section 303(d) List / 305 (b) Report)
Data Availability:	Type I
Metric:	Water supply volume
Screening Status:	**Basic**

4.16 Importance and Screening Considerations

Water supplies derived from 303(d) impaired water bodies may contain higher levels of constituents than water supplied derived from non-impaired water bodies. However, with proper treatment, water from impaired water bodies can still provide a safe water supply for beneficial use.

This indicator is considered a Basic level indicator. Assessing the amount of water supply derived from 303(d) impaired water bodies may be a direct indicator for the number of people who may be exposed to waterborne health threats such as contaminants or infectious agents. The Clean Water Act Section 303(d) List of impaired water bodies is easily accessible and well maintained by the State Water Board and local agencies. In addition, the State Water Board also collects data on points of diversion from surface water sources throughout California, including the amount diverted and stored, for permitting purposes.

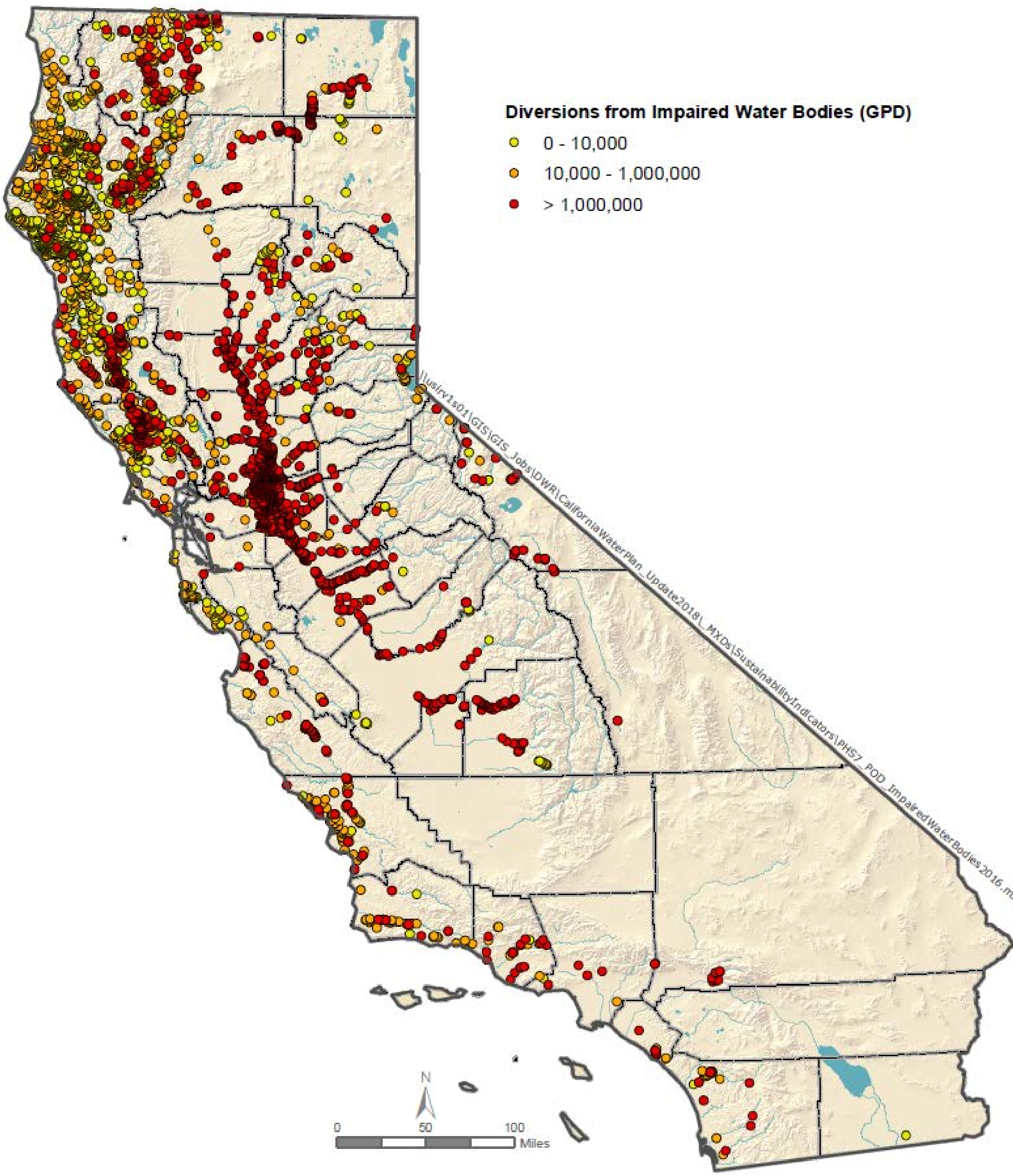
Representative of Outcome:	High
Data Viability:	High
Cost:	High
Potential Longevity:	High
Supportive of Decision Making:	High

4.17 Initial Data and Results

Data on claimed points of diversion throughout California and the amount of direct diversion of each point were pulled from the State Water Board website. In addition, the Geographic Information System (GIS) data for the 2012 list of 303(d) water bodies were used to identify which diversion points were within 400 meters of a listed location. This list represents the current listing, although updates from 2014 are undergoing approval.

Figure 4-3 presents points of diversion that are near impaired water bodies, corresponding to a GIS spatial analysis. The volume of water diverted in gallons per day is also shown. These data represent permitted diversions and not the true volume diverted on a daily basis. In addition, some of these diversions do not result in consumptive use of the water diverted.

However, this map can show areas of the state where the density of diversions from impaired water bodies is higher and closer analysis may be warranted. For instance, along the northern California coast, high quantities of water are diverted from impaired water bodies. This may be a result of a high density of impaired water bodies in the region. In addition, large diversions are also concentrated along the main water bodies in the Central Valley. These areas could be analyzed during planning to note if diversions from these impaired water bodies might directly impact public health and safety.



Sources: "Impaired Water Bodies – 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. April 11, 2018.
"eWRIMS - Electronic Water Rights Information Management System." State Water Resources Control Board. January 29, 2018.

Figure 4-3. Points of Diversion Permits from Impaired Water Bodies

4.18 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

A partial database of surface water diversions is maintained by the State Water Board. Currently, there is a lack of a centralized database containing data on surface water drawn specifically for drinking water use. In addition, the current GIS files provided for the impaired water bodies do not allow non-manual filtering of water bodies by their impaired purpose(s). Therefore, some of the impairments considered may not impact the final use of the diverted water. Many of the diversions are used for energy or stock watering, which may not require an unimpaired source of water.

The current methodology can highlight areas of the state where additional analysis, that could consider the final use of diverted water, may be necessary. The indicator may also need to be redefined to limit the diversions considered from all water supplies to those water supplies that require an unimpaired source of water.

4.19 References

State Water Resources Control Board. 2014/2016 Integrated Report Approval Documents.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2014_2016.shtml. Last accessed: April 11, 2018.

State Water Resources Control Board. “eWRIMS - Electronic Water Rights Information Management System.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/. Last accessed: January 23, 2018.

U.S. Environmental Protection Agency. “Clean Water Act Section 303(d): Impaired Waters and Total Maximum Daily Loads (TMDLs).” U.S.EPA. Viewed online at: https://www.epa.gov/tmdl. Last accessed: November 28, 2017.

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS 6: Potential for Consumption of Mercury-Contaminated Fish

This indicator assesses the potential for consumption of mercury-contaminated fish by evaluating the concentration of mercury or other contaminants found in fish consumed by humans throughout the state. The target outcome for this indicator is that no potential for the consumption of contaminated fish exists throughout the state.

In addition, this indicator helps assess progress towards meeting statewide mercury objectives pertaining to tribal traditional and cultural use, including tribal subsistence fishing. The State Water Board and nine Regional Water Boards have regulatory authority to protect the water quality and beneficial uses of the state’s waters. On May 2, 2016, the State Water Board adopted Resolution 2017-0027, providing a consistent regulatory approach throughout the state by setting mercury limits to protect beneficial uses associated with the consumption of fish by both people and wildlife. Three new beneficial use definitions have been established for future beneficial use designations including Tribal Traditional Culture, Tribal Subsistence Fishing, and Subsidence Fishing.

Although the State Water Board recently defined beneficial uses pertaining to tribal/traditional and cultural use, the provision does not require Regional Water Boards to designate specific waters in their regions with Tribal Traditional Culture, Tribal Subsistence Fishing, and Subsidence Fishing. Defining a beneficial use is distinct from designating beneficial uses made on specific water bodies. There is no prioritization schedule for such designations to occur.

Scale:	Statewide
Data Sources:	California Environmental Data Exchange Network (CEDEN); California Office of Environmental Health Hazard Assessment (OEHHA); California Environmental Protection Agency (Cal EPA)
Data Availability:	Type I
Metric:	Concentration of mercury in fish tissue
Screening Status:	**Basic**

4.20 Importance and Screening Considerations

Nearly all fish contain traces of mercury. High levels of mercury in fish, from their surrounding habitat and water bodies, can cause a human consumer to accumulate high levels of mercury themselves. High levels of mercury can lead to serious health issues and concerns in the human nervous system.

Excessive levels of mercury are negatively affecting beneficial use of many waters of the state by making fish unsafe for human and wildlife consumption. Although mercury occurs naturally in the environment, mercury concentrations exceed background levels because of human activities. Setting mercury objectives will provide useful goals to help keep California’s water quality throughout the state safe for sacred ceremonies and cultural practices.

Currently, there are only beneficial uses defined on specific water bodies and no beneficial uses have been designated. As such, the data are not viable for assessing progress toward meeting statewide mercury objectives pertaining to tribal traditional and cultural use at this time. However, evaluation of this indicator does include measurement of mercury concentrations in fish tissue throughout the state.

This indicator is considered a Basic level indicator. OEHHA monitors mercury levels in fish and provides fish consumption advisories and safe eating guidelines to the public. This indicator can be easily understood by decision makers, making it supportive of decision making.

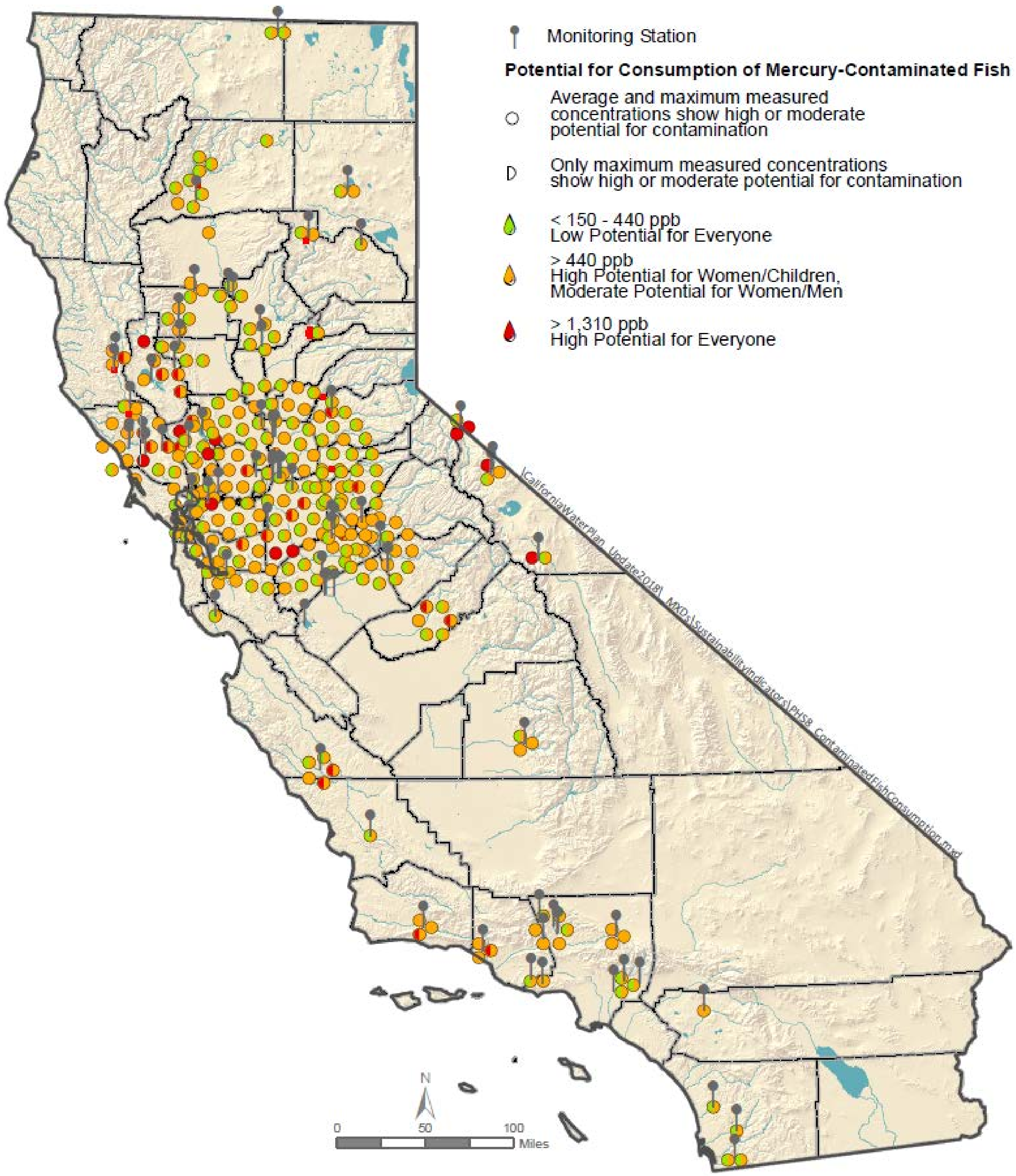
Representative of Outcome:	High
Data Viability:	Medium
Cost:	High
Potential Longevity:	High
Supportive of Decision Making:	High

4.21 Initial Data and Results

Data on mercury concentrations in fish are available on CEDEN. This database is a central location to access and share information about California's water bodies, including streams, lakes, and rivers, and the coastal ocean. CEDEN aggregates the monitoring data gathered from multiple groups in California and makes it accessible to environmental managers and the public. Data on tissue monitoring are organized by the monitoring program name, monitoring project name, and monitoring stations. These data can be downloaded in a spreadsheet format.

Although there are multiple monitoring programs found on CEDEN, this indicator focuses on the programs and projects that measure the total mercury concentrations in fish species at monitoring stations throughout the state. The most recent available 5-year dataset is from June 16, 2011, to June 16, 2016. From the data, both the average and maximum mercury concentrations (in parts per billion (ppb)) were evaluated. Figure 4-4 illustrates the potential for consumption of contaminated fish at each monitoring station. Some stations have more fish monitoring than others, which is demonstrated through point clusters around each monitoring station.

OEHHA sets an Advisory Tissue Level (ATL) for mercury concentrations in fish. ATLs are designed to encourage consumption of fish that can be eaten in quantities likely to provide significant health benefits, while discouraging consumption of fish that, because of contaminant concentrations, should not be eaten or cannot be eaten in amounts recommended for improving overall health. The ATL varies by gender, age, and serving size. The analysis of this indicator focused on the ATL for one serving of fish per week, which amounted to an 8-ounce serving per week. For women between the ages of 18 and 45 and children between the ages of 1 and 17 (referenced as women/children in Figure 4-4), the recommended ATL for one serving of fish per week is greater than 150 to 440 ppb. For women older than 45 and men (referenced as women/men in Figure 4-4), the recommended ATL for one serving of fish per week is greater than 440 ppb to 1,310 ppb.



Source: California Environmental Data Exchange Network (CEDEN). State Water Resources Control Board. January 23, 2018.

Figure 4-4. Potential for Consumption of Mercury-Contaminated Fish Based on Advisory Tissue Levels Set by California Office of Environmental Health Hazard Assessment

The multiple markers focused at each OEHHA monitoring station represent the different fish species tissue that were monitored for mercury concentration. Table 4-5 shows the average and maximum mercury concentration found in the tissue of each fish species, when over the ATL. Based on average concentrations, of the 65 fish species monitored over the five-year period, three fish species show elevated levels of risk. Based on maximum mercury concentrations, 12 additional fish species also have been found with elevated mercury concentrations in tissue. Clark's Grebe shows high potential for consumption of contaminated fish by everyone. Western Grebe, Sacramento Pikeminnow, White Sturgeon, and Smallmouth Bass show high potential for consumption of contaminated fish by women/children and moderate potential by women/men. The color used in Table 4-5 matches those used in Figure 4-4 (above).

Table 4-5. Average and Maximum Mercury Concentrations in Fish Tissue Samples from Fish Species Sampled at Monitoring Stations Statewide

Species	Avg. Mercury Concentration (ppb)	Max Mercury Concentration (ppb)
Sacramento Pikeminnow	615	2150
White Sturgeon	521	878
Smallmouth Bass	440	1460
White Catfish	380	734
Sacramento Blackfish	355	521
Sacramento Sucker	308	910
Green Sunfish	297	590
Largemouth Bass	291	1970
Tule Perch	267	505
Striped Bass	211	863
White Croaker	149	453
Common Carp	139	571
Channel Catfish	104	1000
Silverside	79	542
Rainbow Trout	78	616

Source: California Environmental Data Exchange Network. State Water Resources Control Board. January 23, 2018.

Key:

ppb = parts per billions

Notes:

Red shaded cells show high potential for consumption of contaminated fish by everyone. Orange shaded cells show high potential for consumption of contaminated fish by women/children and moderate potential by women/men. Green shaded cells show low potential for consumption of contaminated fish by everyone.

As expected, women/children face a higher potential for consumption of contaminated fish than women/men. The potential for consumption of contaminated fish is also higher in the northern hydrologic regions and watersheds, which could also be attributed to the presence of more fish species at each monitoring station and more water bodies in those regions.

ATLs are one component of the process to determine fish consumption advisories. Other factors are included in the complex process of data evaluation and interpretation of fish consumption risks, such as the omega-3 fatty acid levels and seasonal effects on contaminant data. Therefore, this indicator only represents the potential for consumption of mercury-contaminated fish and is not a fish consumption advisory.

4.22 Recommendations

At this point, this indicator is a Basic level indicator, but the guidelines and framework for measuring the indicator will continue to develop as more data and a refined methodology become available. In the future, a method to show the fish species found at each monitoring station may be useful for revealing any associations of those species and high mercury concentrations.

Specifically evaluating the mercury concentrations in waters that would eventually be designated for beneficial use pertaining to other cultures or individuals would indicate progress towards meeting the corresponding mercury objectives.

4.23 References

State Water Resources Control Board. California Environmental Data Exchange Network (CEDEN). Viewed online at: http://www.ceden.org/. Last accessed: January 23, 2018.

Klasing, Susan, PhD and Robert Bordberg, PhD. Table updated 2017. Development of Fish Contaminant Goals and Advisory Tissue Levels (ATLs) for Common Contaminants in California Sport Fish. California Environmental Protection Agency. Viewed online at: https://oehha.ca.gov/media/downloads/fish/report/atlmhgandothers2008c.pdf

State Water Resources Control Board. “Statewide Mercury Provisions.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/mercury/. Last accessed: January 23, 2018.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS 7: Population Served by Hazard Mitigation Plans, Emergency Response Plans, or Equivalents

This indicator assesses the population served by Local Hazard Mitigation Plans, Emergency Response Plans, or equivalent plans. The target outcome for this indicator is 100 percent of the population having coverage under Local Hazard Mitigation Plans, Emergency Response Plans, or equivalents.

Local Hazard Mitigation Plans provide opportunities for communities to focus on public involvement, risk assessment, and mitigation strategies. These plans help prevent loss of life, injuries, and damage to infrastructure and other community assets. Emergency plans provide guidance during catastrophic events and/or system failures to achieve the same goals.

Scale:	Statewide
Data Sources:	California Governor’s Office of Emergency Services (Cal OES); Census Data
Data Availability:	Type II
Metric:	Status of Local Hazard Mitigation Plans
Screening Status:	**Basic**

4.24 Importance and Screening Considerations

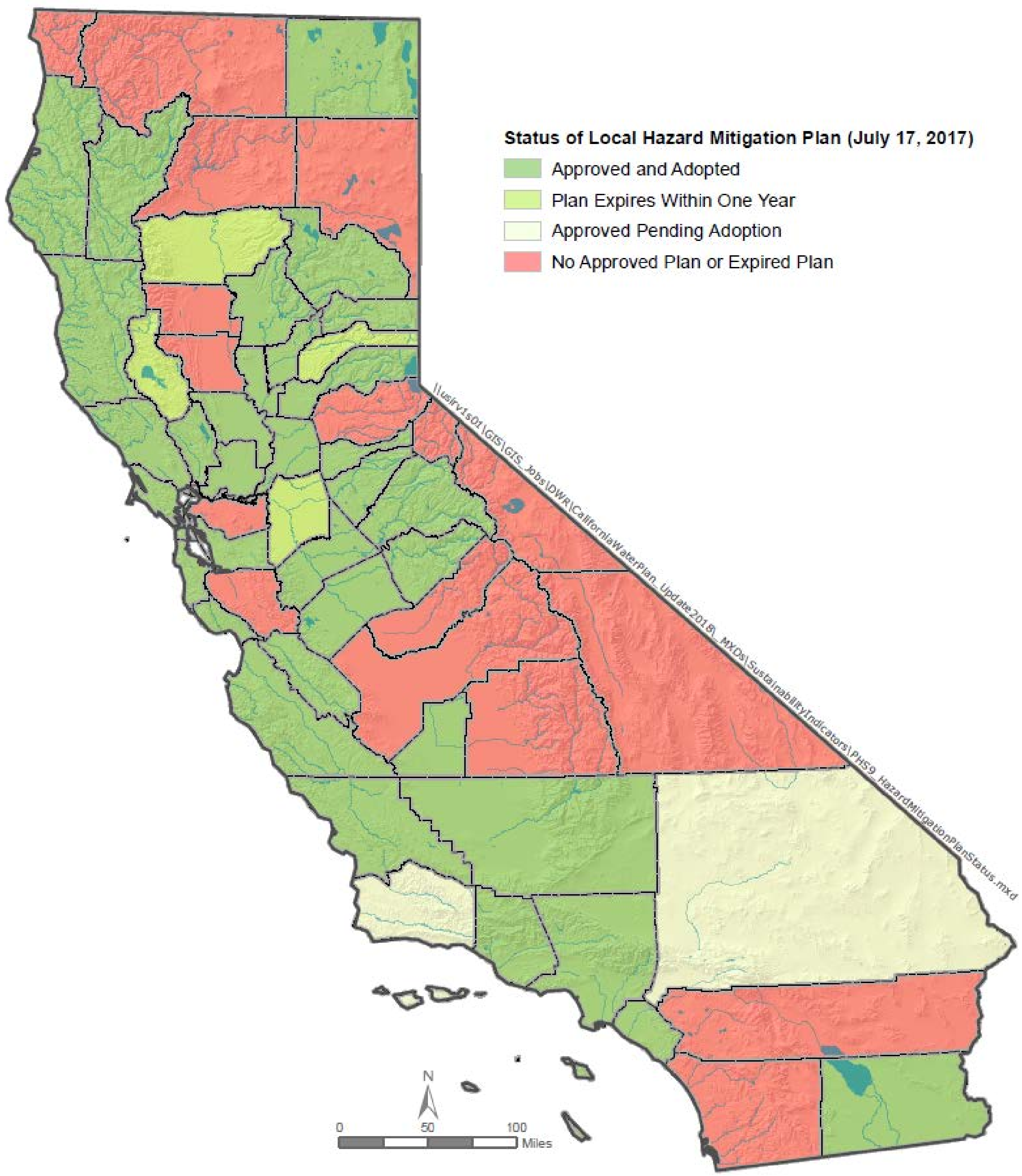
California faces numerous risks and threats to its people, property, economy, environment, and is prone to earthquakes, floods, significant wildfires, and drought impacts. While hazards cannot always be prevented, mitigation planning focuses on reducing the impact of such events when they do occur. In California, hazard mitigation planning is particularly important for emergency response during flood, fire, and drought events.

This indicator is categorized as a Basic level. Comprehensive datasets are partly available, but some communities may not have emergency plans if they are not required. Counties are heavily encouraged to develop Federal Emergency Management Agency (FEMA)-approved Local Hazard Mitigation Plans, but no regulatory requirements exist. As presented in the Initial Data and Results section below, only data on Local Hazard Mitigation Plans were evaluated due to limited access to tracking of community or local level emergency response plans. Therefore, this indicator may not be as supportive of decision making as others at this time.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

4.25 Initial Data and Results

Figure 4-5 shows the status of Local Hazard Mitigation Plans throughout California, as of July 17, 2017. These data are maintained by Cal OES. Cal OES works to anticipate and enhance prevention and detection capabilities to protect the state from all hazards and threats. Cal OES assists local and State agencies in developing their own emergency preparedness and response plans and also develops and maintains the State Emergency Plan.



Source: "Local Hazard Mitigation Program – Local Mitigation Planning." Cal OES. December 7, 2017.

Figure 4-5. Status of Local Hazard Mitigation Plans

As shown in Table 4-6 below, approximately 25 percent of the California population is not covered by a Local Hazard Mitigation Plan. However, about 65 percent of the population is covered by an approved and adopted plan. The other 10 percent of the population is either covered by an approved and adopted plan that expires within one year or is covered by a plan that is approved, but pending adoption.

Table 4-6. Population Covered or Not Covered by Local Hazard Mitigation Plans as of July 17, 2017

Status of Local Hazard Mitigation Plan	Population	Percent of Statewide Population
Approved and Adopted	24,984,427	65.1%
Approved and Adopted by Expires Within One Year	974,636	2.5%
Approved Pending Adoption	2,610,919	6.8%
No Approved Plan or Expired Plan	9,836,161	25.6%

4.26 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. In the future, data collection could be simplified if local counties reported on the status and location of their emergency planning documents on a centralized site. In addition, this indicator may require additional work with local municipalities to include plans created at a community-level rather than at a county-level.

The data used for this Figure 4-5 could be combined with population data for each county to visually display the population not served by a Local Hazard Mitigation Plan. In addition, populations covered by plans at a local, state, and county level or only at more regional levels may need to be considered separately. The level of planning may impact the effectiveness of these plans.

This indicator has the potential to become a central asset in evaluating the state's level of preparedness in the face of natural disasters or extreme hydrologic conditions.

4.27 References

California Governor's Office of Emergency Services. 2015. 2014 - 2018 Strategic Plan Summary. Version 1. Viewed online at: http://www.caloes.ca.gov/NewsMediaSite/Documents/Cal%20OES%20Strategic%20Plan%20Summary%20Booklet%20(FINAL).pdf

Governor's Office of Emergency Services. "Local Hazard Mitigation Program - Local Mitigation Planning." Cal OES. Viewed online at: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program. Last accessed: December 7, 2017.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS 8: Population Covered by Water Shortage Contingency Plans

This indicator assesses the percentage of the population covered by Water Shortage Contingency Plans (WSCP). In a drought year, the state may not have enough water to meet all water demands. Drought preparedness plans, which are a component of a WSCP, help ensure communities can plan for prolonged periods of drought.

The target outcome for this indicator is 100 percent of the population having coverage under WSCPs.

Scale:	Statewide
Data Sources:	UWMPs
Data Availability:	Type II
Metric:	Percentage of Population Covered by WSCPs in Each Hydrologic Region
Screening Status:	**Basic**

4.28 Importance and Screening Considerations

In recent years, dry conditions statewide have underscored the importance of water use efficiency and achieving greater climate and drought resilience and preparedness. 2012 through 2014 are on record as California's driest three consecutive years with respect to statewide precipitation, and 2013 was the driest on record in numerous communities across the state.

During the recent drought (2011-2017), many communities were unable to provide stable, safe water supplies to their residents for household uses. In response to the persistent dry conditions, numerous executive orders directed local urban water suppliers to immediately implement WSCPs, among other actions.

This indicator is considered a Basic level indicator. Data on the status of WSCPs are available through UWMPs, which are plans that focus on water planning at the local water supplier level. Assessing the overall coverage and extent of existing WSCPs can help direct attention to areas where additional work is required to prepare for drought. As previously noted, droughts are an inherent occurrence in California, so this indicator is representative in the short-term and long-term as drought preparedness plans or WSCPs continue to play an important role in protecting public health and safety.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	High
Potential Longevity:	High
Supportive of Decision Making:	High

4.29 Initial Data and Results

The Urban Water Management Planning Act requires water agencies to develop UWMPs. A UWMP provides a framework for long-term water planning and informing the public of a supplier's plans for ensuring adequate water supplies to meet existing and future demands. Among other requirements, an urban water supplier is required to report, describe, and evaluate its water shortage contingency planning.

According to DWR's *2015 Guidebook for Urban Water Suppliers*, an urban water supplier is defined as a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. This also includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers.

Each UWMP has a distinct service area boundary that may extend beyond a city or county boundary. Some service boundaries may even encompass several city or district boundaries. Displaying whether or not an area is covered by a WSCP requires extensive manual input of service area boundaries at this time. Table 4-7 provides placeholder data pending future development of a map. Currently, the only centralized geographic data for all the urban water suppliers are coded by hydrologic region. Recommendations for further development of an indicator map to support a more thorough evaluation of this indicator are described in the recommendations below.

As demonstrated in Table 4-7, nearly 100 percent of the population in the South Coast and San Francisco Bay regions is covered by WSCPs. Overall, about 91 percent of the California population is covered by WSCPs. The total population that is covered by a UWMP has already achieved the target outcome of 100 percent of the population covered by a WSCP. In order to get to 100 percent of the total state population covered by a WSCP, the state would need to change the minimum threshold for preparing a WSCP or require an equivalent plan outside the UWMP framework.

Table 4-7. Number of Retail Urban Water Suppliers with WSCPs and the Percent of Total California Population Served by Urban Water Suppliers with a WSCP in each Hydrologic Region

Hydrologic Region	Number of Retail UWMPs with WSCPs	Percent of California Population Served by Urban Water Suppliers (Retail only) with WSCPs
South Coast	175	99.7%
San Francisco Bay	43	92.9%
Colorado River	12	85.6%
Tulare Lake	38	82.8%
Sacramento River	38	80.4%
Central Coast	38	80.3%
North Lahontan	4	65.8%
San Joaquin River	22	64.8%
North Coast	13	59.7%
South Lahontan	15	57.3%
Statewide	**388**	**91.1%**

Sources: Water Use Efficiency Data Public Portal. January 10, 2018.
American Community Survey 5-Year Data (2009-2016). U.S. Census Bureau. January 10, 2018.
Key:
WSCP = Water Shortage Contingency Plan
UWMP = Urban Water Management Plan

4.30 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

Private and public water agencies develop UWMPs and WSCPs. Some of the UWMPs are for cities while others are for counties and some are even for private water agencies. As previously mentioned, there are no consistent boundaries for service area boundaries that each UWMP covers. To display this information on a geo-referenced map in the future, it is recommended that DWR require geospatial map layers of each urban water supplier boundary as part of the next round of UWMP updates. The *2015 UWMP Guidebook for Urban Water Suppliers* states that DWR's preference is to obtain electronic service area boundary maps. Rather than stating this as a preference in the Guidebook, DWR should require that a geospatial map layer of the service area be submitted. The following metadata should be included: map projection, contact information for the map's creator, start and end dates for which the map is valid, constraints, attribute table definitions, and a digitizing base. Requiring the geospatial map layer would eliminate the need to manually define the boundary of each UWMP to create a map that would geographically show areas that are covered or not covered by WSCPs.

Once service area boundaries are defined and mapped, the map should display the status of DWR's review of each WSCP through a color scale (e.g., reviewed, not yet reviewed, and under review).

In 2018, the Legislature enacted two policy bills – SB 606 and AB 1668 – to establish both the foundation and needed authorities for long-term improvements in water conservation and drought planning to adapt to climate change and the resulting longer and more intense droughts in California. These bills amended the California Water Code, requiring state agencies to develop statewide water use targets, standards, and guidelines, and water agencies to then report on progress towards meeting those requirements. During the implementation process, DWR and other State agencies will further develop data, information, guidelines, and other technical assistance to help realize the bills' intended outcomes. Both bills include requirements for public access to data and their use, as well as related studies, reports, and investigations. These data, studies, reports, and investigations may be of use to continued development of this indicator.

4.31 References

California Department of Water Resources. "Submitted 2015 Urban Water Management Plans (UWMP) Data Exports." Water Use Efficiency Data Public Portal. Viewed online at: https://wuedata.water.ca.gov/default.asp. Last accessed: January 10, 2018

California Department of Water Resources. 2016. Guidebook for Urban Water Suppliers- 2015 Urban Water Management Plans. Viewed online at: http://www.water.ca.gov/urbanwatermanagement/docs/2015/UWMP_Guidebook_Mar_2016_FINAL.pdf

U.S. Census Bureau. "American Community Survey 5-Year Data (2009-2016)." Viewed online at: https://www.census.gov/data/developers/data-sets/acs-5year.html. Last accessed: January 10, 2018.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS 9: Urban Population Without State-Mandated Urban Level of Flood Protection

This indicator assesses the urban population without the Urban Level of Flood Protection Criteria mandated in the Central Valley Flood Protection Act of 2008. The target outcome for this indicator is all urban and small communities[1] have the appropriate level of flood protection.

Scale:	Statewide
Data Sources:	DWR; Central Valley Flood Protection Plan (CVFPP)
Data Availability:	Type II
Metric:	Population within Floodplains
Screening Status:	**Basic**

4.32 Importance and Screening Considerations

California is at risk for catastrophic flooding that could have wide-ranging impacts due to the size of its economy and the number of people residing in the state. Flooding can affect California at different times of the year and in different forms – from storm water flooding in urban areas to alluvial fan flooding at the base of hillsides. One in five Californians live in a floodplain. Four of the nation's largest cities (Los Angeles, San Diego, San Jose, and San Francisco) are all at risk for some type of flooding. All California counties having some level of exposure.

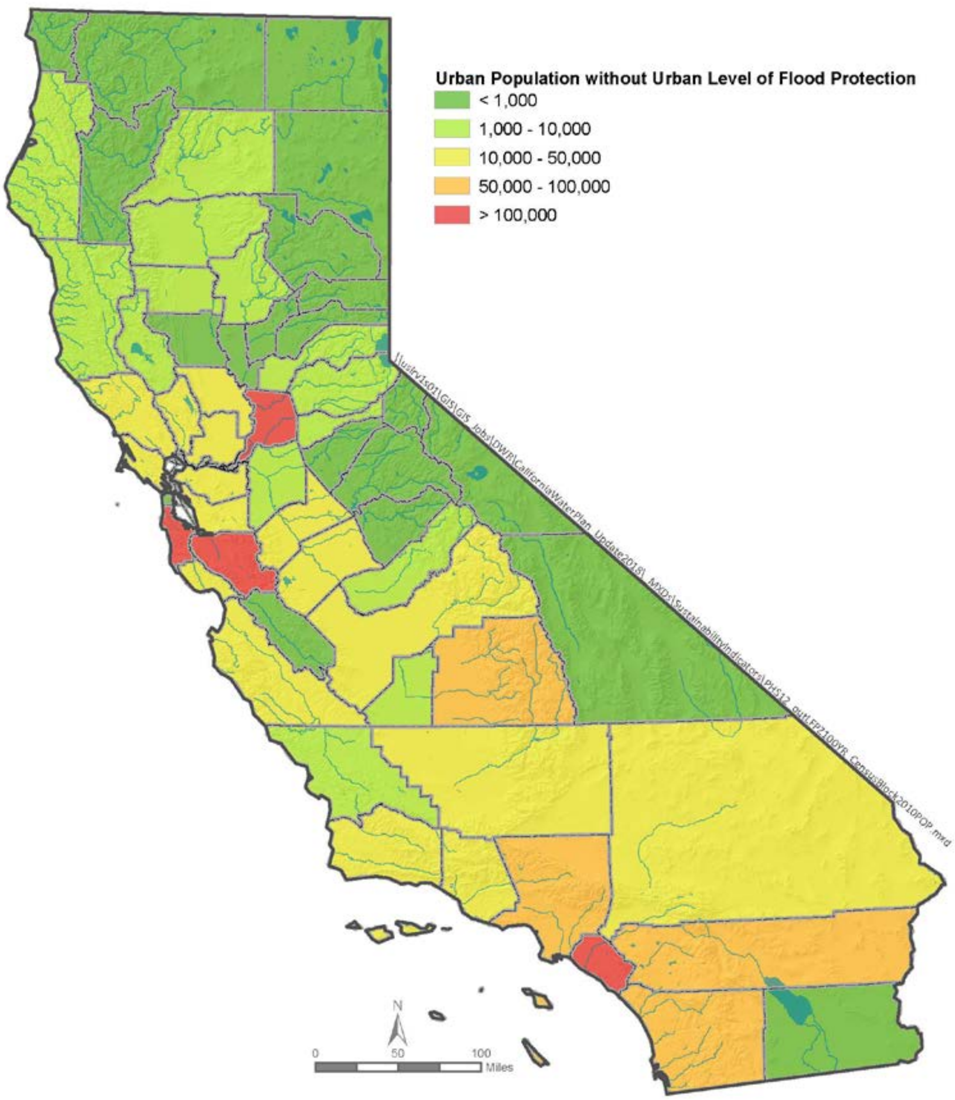
Central Valley cities and counties that wish to continue to develop in urban and urbanizing areas are required to achieve an urban level of flood protection (200-year flood), defined in California Government Code Section 65007(l) and California Water Code Section 9602(i). New development in non-urbanized areas, including small communities, must meet the national FEMA standard of flood protection, per California Government Code Sections 65865.5, 65962, and 66474.5. This corresponds to the minimum level of flood protection (100-year flood) required to remove or exclude an area or community from a Special Flood Hazard Area as defined by FEMA. Outside the areas protected by SPFC facilities, the State supports achieving appropriate levels of flood protection, particularly for existing urban and adjacent urbanizing areas.

Overall, this indicator was categorized as a Basic level indicator. This indicator relates directly to the State's efforts towards lowering the risk associated with flooding in developed urban and adjacent urbanizing areas. Data are readily available from DWR to assess the urban population at risk in the Central Valley but not in the rest of the state.

Representative of Outcome:	High
Data Viability:	High
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.33 Initial Data and Results

To assess this indicator, California Department of Transportation's (Caltrans) 2010 Adjusted Urban Areas data were spatially compared with DWR's Best Available Maps. For urban areas in the Central Valley with populations greater than 10,000 people, the population living within the 200-year floodplain was counted. For small communities as well as large communities outside of the Central Valley, the population living in the 100-year floodplain was counted. The 100-year floodplain was developed by DWR's SFMPP that conducted an in-depth analysis in November 2012. The 200-year floodplain was developed by a U.S. Army Corps of Engineers (USACE) comprehensive study and is included as DWR's Best Available Maps. The floodplain maps were adjusted when the land was protected by State Plan Flood Control (SPFC) Facilities, as mapped by the Levee Flood Protection Zones from DWR. Population information was based on 2010 Census Blocks. Figure 4-6 summarizes this information to develop an estimate of the urban population without Urban Level of Flood Protection in each county.



Sources: "Levee Flood Protection Zone", Best Available Maps USACE Comprehensive Study 200-year Floodplain, Flood Hazard Exposure Analysis 100-year Floodplain, TIGER Products, U.S. Census Bureau, CalTrans GIS Data.

Figure 4-6. Urban Population Without State-Mandated Urban Level of Flood Protection

4.34 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

DWR has made the tools, data, and other relevant information available to support findings related to urban level of flood protection. By continuing to update this information and make it publicly accessible, policy makers as well as the public can make informed decisions to mitigate the risk of catastrophic flooding that the state currently faces.

4.35 References

California Department of Water Resources. "Central Valley Flood Protection Plan." California Department of Water Resources. Viewed online at: www.water.ca.gov/cvfmp. Last accessed: February 6, 2018.

California Department of Water Resources. "Best Available Maps." California Department of Water Resources. Viewed online at: http://gis.bam.water.ca.gov/bam/. Last accessed: February 12, 2018.

California Department of Water Resources. "Levee Flood Protection Zone." California Department of Water Resources. Viewed online at: http://gis.lfpz.water.ca.gov/lfpz/. Last accessed: February 12, 2018.

California Department of Water Resources. 2013. Statewide Flood Management Planning Program Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

U.S. Census Bureau. "TIGER Products." Viewed online at: https://www.census.gov/geo/maps-data/data/tiger.html. Last accessed: December 12, 2017.

California Department of Transportation. "CalTrans GIS Data." Viewed online at: http://www.dot.ca.gov/hq/tsip/gis/datalibrary/. Last accessed: December 12, 2017.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS 10: Population in Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year

This indicator assesses the population that lives in floodplains with equal to or greater than a 1 percent chance of flooding in any given year (also defined as a 100-year floodplain) throughout the state. This indicator differs from *PHS 9, Urban Population without State-Mandated Urban Level of Flood Protection*, in that it includes rural agricultural areas, in addition to urban areas and small communities. Information from the archived indicator *PHS, Population in Floodplains with Equal to or Greater than 0.2 Percent Chance of Flooding in any Given Year* is provided to include consideration of areas that have a 1-in-500 chance of flooding in any given year. The target outcome for this indicator is zero percent of the population lives in 100-year floodplains (residential population) without appropriate flood risk mitigation.

During initial indicator development, some feedback related to reflecting more frequent flooding events (i.e., 2 percent chance of flooding in any given year, or 50-year floodplains). As the state is experiencing extreme events (droughts and floods) of both greater frequency and intensity, and no State or Federal agencies currently develop or maintain 50-year floodplain maps, this indicator was formulated and initially evaluated for 100-year floodplains.

Scale:	Statewide
Data Sources:	FEMA, Department of Finance, U.S. Census Bureau
Data Availability:	Type III
Metric:	Population
Screening Status:	**Basic**

4.36 Importance and Screening Considerations

State, Federal, and local agencies have made significant investments in the state's flood management system, including levees and bypasses. While these structures help reduce risk, a floodplain can never be fully protected, and significant inhabited land lies outside of the protected areas from these facilities. This indicator was developed using data from DWR, FEMA, and the U.S. Census Bureau to delineate the population at risk living in 100-year floodplains throughout California.

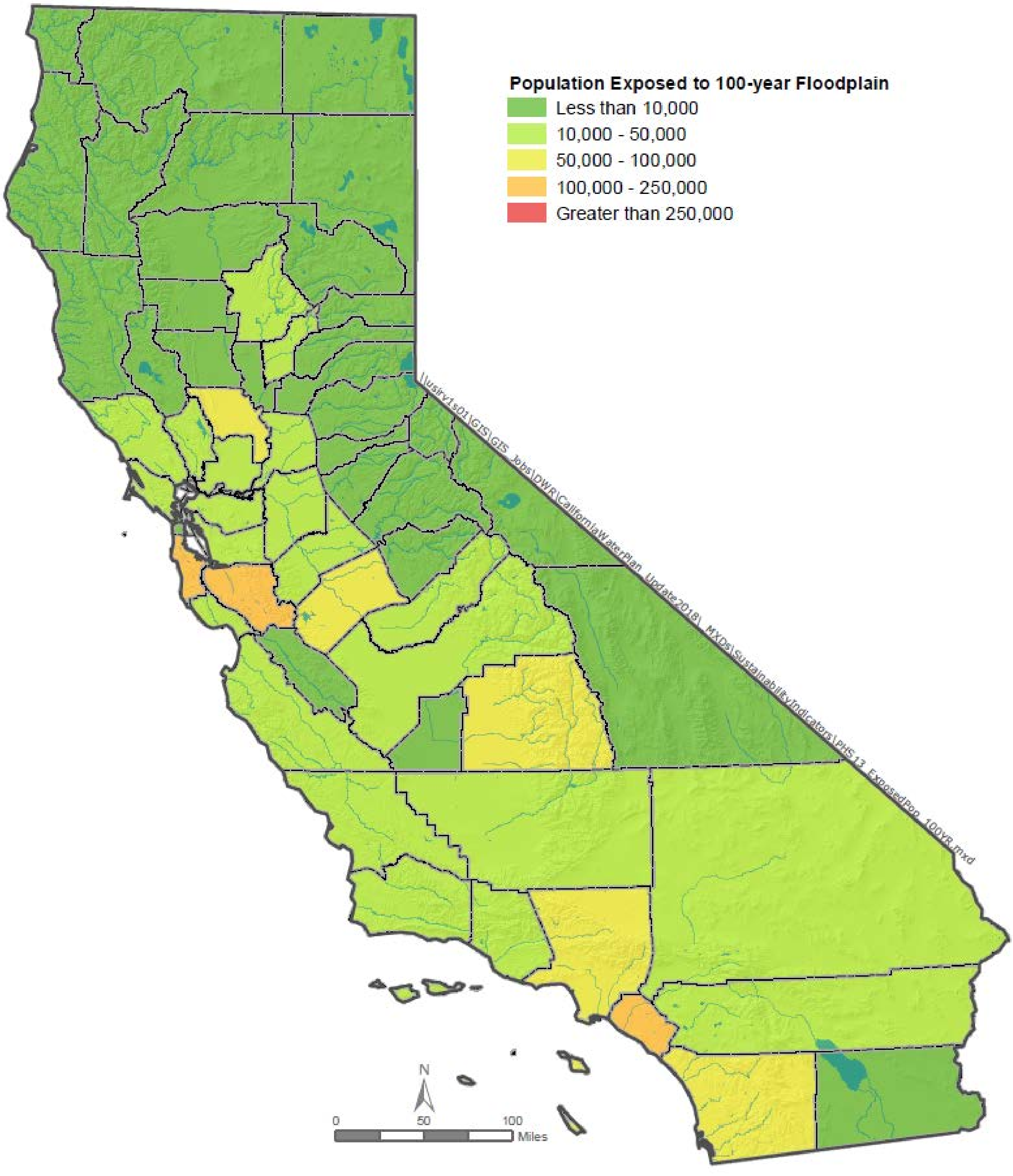
Overall, this indicator is categorized as a Basic level indicator. However, data are incomplete in some regions of the state, and FEMA floodplain maps are likely out-of-date in some regions. Additional analysis or surveying may be required to obtain a complete and recent dataset for a full analysis.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Low
Potential Longevity:	High
Supportive of Decision Making:	High

4.37 Initial Data and Results

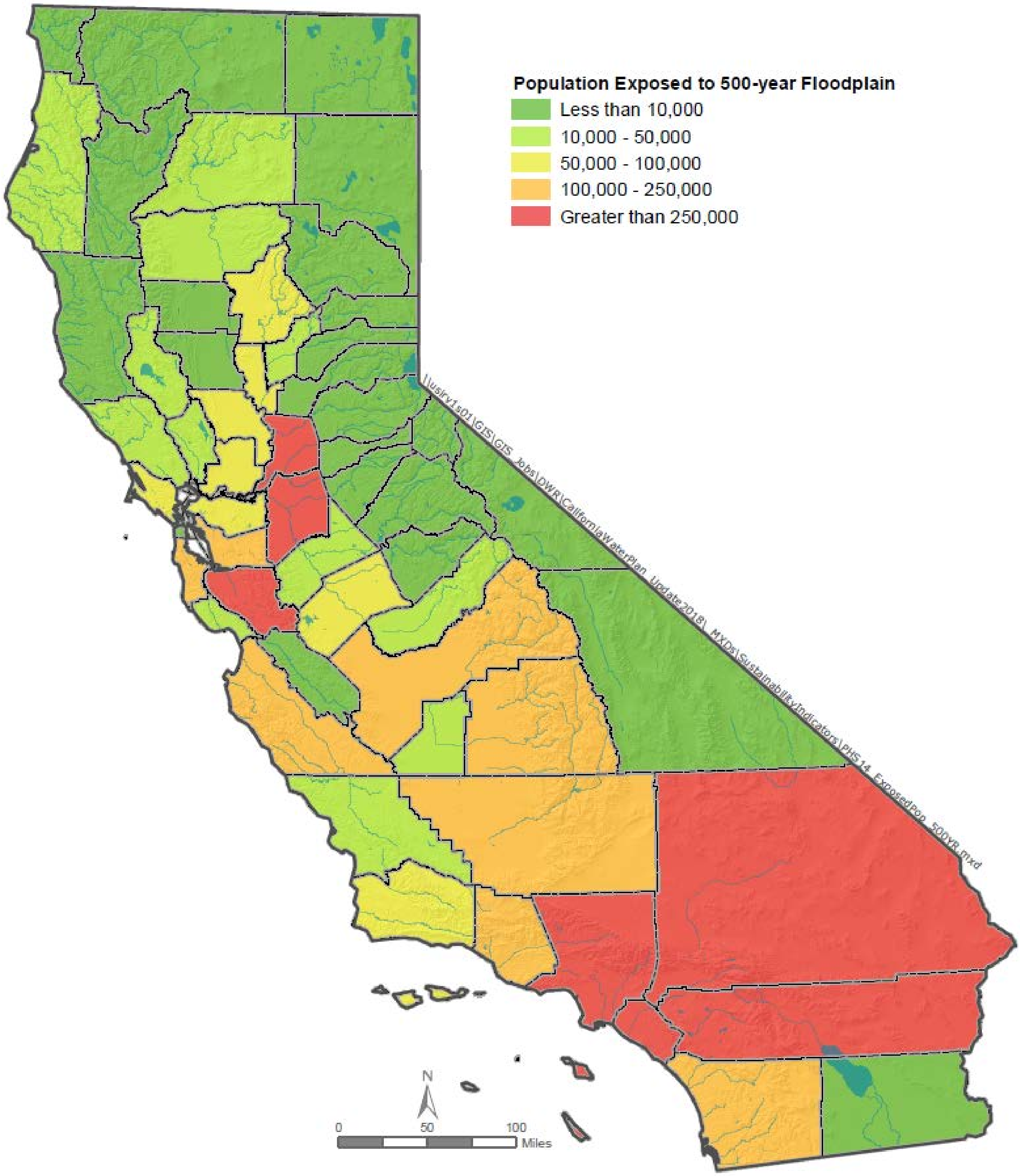
The methodology for this indicator was developed by DWR's SFMPP that conducted an in-depth analysis in November 2012 of flood exposure risks throughout California. Results from the latest update on the exposure analysis conducted through this study are presented in Figure 4-7 and Figure 4-8. The floodplains used for this analysis included either detailed 100-year and 500-year floodplain extents developed for the CVFPP, where available, or FEMA Flood Insurance Rate Maps. Populations were based on FEMA Hazus data taken from the 2000 census.

Exposure to flood hazards exist across the state, with the potential for the greatest damage concentrated in developed urban areas. Figure 4-7 shows the population exposed to a 1 percent chance of flooding in any given year. Significantly more of the state's population is exposed to a 0.2 percent chance of flooding, as shown in Figure 4-8. Across California, at every risk threshold, large urban areas have the greatest number of people at risk of flooding in any given year.



Source: Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

Figure 4-7. Population Exposed to 100-year Floodplain



Source: Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

Figure 4-8. Population Exposed to 500-year Floodplains

4.38 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

Flooding is a common occurrence in California, so many agencies have already collected data on floodplains throughout the state, including DWR, USACE, and FEMA. A future methodology for evaluating this indicator should involve compiling and reconciling data from DWR, USACE, and FEMA to determine the most accurate limits of 100-year floodplains throughout the state. Additional surveying may also be needed to supplement and update the data from these agencies.

A future methodology could also incorporate risk-based mapping. Risk-based maps that show a comprehensive assessment of the area's flood risk in easily understandable terms could increase public understanding of flood risk and management. For example, DWR has developed floodplain maps for 10 urban communities in the Central Valley (Chico, Yuba City, Marysville, Woodland, Davis, Sacramento, West Sacramento, Stockton, and Lathrop) that include information regarding water surface elevations for a 200-year flood event. Although not yet applicable to 100-year floodplains, this evolving source of data should be considered as a potential source of additional information that may be adapted for this indicator.

The appropriate level of flood protection for varying densities of residential development should be considered and incorporated into this indicator.

4.39 References

Taylor, Mac. 2017. Managing Flood in California. Legislative Analyst's Office. Viewed online at: http://www.lao.ca.gov/reports/2017/3571/managing-floods-032217.pdf

California Department of Water Resources. "Central Valley Flood Protection Plan." California Department of Water Resources. Viewed online at: www.water.ca.gov/cvfmp. Last accessed: February 6, 2018.

California Department of Water Resources. 2013. Statewide Flood Management Planning Program Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

Ecosystem Vitality

Intended Outcome: Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.

EV 1: Native Fish Diversity Index

This composite indicator assesses several components that together provide a composite Native Fish Diversity Index. This indicator is adapted from the Community Diversity Index presented in the *California Water Sustainability Indicators Framework: Assessment at State and Regional Scale* final report, published within the CWP Update 2013 materials.

The Native Fish Diversity Index, currently under development, would combine information on the following four metrics to provide a thorough evaluation of fish habitat throughout different California watersheds:

- Native fish conservation status – describes threatened and endangered species
- Percentage of expected native fish species observed in watersheds – describes environmental conditions and disturbances
- Proportion of non-native fish species – shows areas of heavy disturbance
- Status of several key fish species into a single index – emphasizes species that have experienced rapid declines in the past decades, such as the Central Valley Chinook Salmon or the Delta Smelt

The target outcome for this under-development indicator is a high index value, once a quantitative scoring system is established. A high index value would indicate that native fish species are neither endangered or threatened, environmental disturbance is low, and key fish species are thriving.

Scale:	Statewide
Data Sources:	UC Davis PISCES; California Department of Fish and Wildlife (CDFW); CWP Update 2013
Data Availability:	Type I
Metric:	Composite index of native fish conservation status, percent of expected native fish species, proportion of non-native fish species, and status of key fish species
Screening Status:	**Basic**

4.40 Importance and Screening Considerations

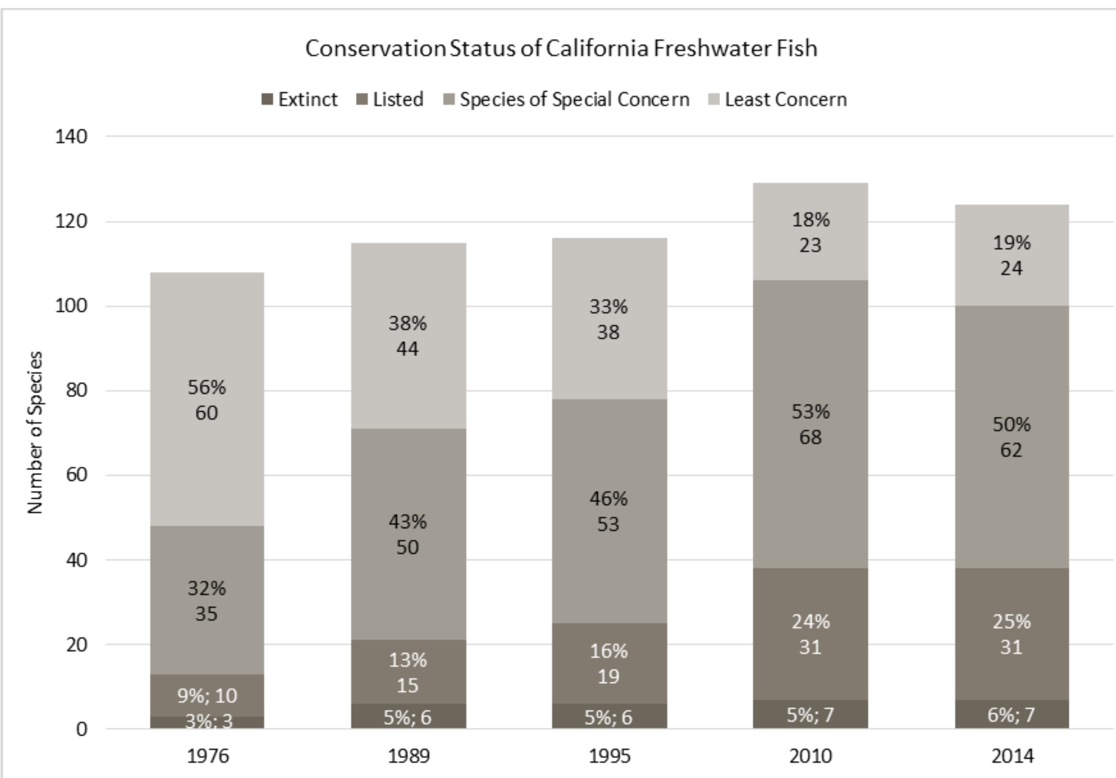
Varying and distinct conditions throughout California watersheds have inherently produced diverse fish species, many endemic to California. Fish habitats vary widely from desert pools to estuaries to high mountain lakes. Many of these habitats are facing habitat loss or disturbance due to expansion of human communities and climate variability. A composite indicator would show the status of fish species across the state and would be used as a tool to recognize areas of high and low watershed and stream ecosystem health.

At present, this under-development indicator is considered a Basic level indicator. This indicator directly represents native species distributions and richness throughout the state. Some data analysis must be performed to convert monitoring information into the intended metric. Some data are currently available through PISCES, a comprehensive database maintained by University of California (UC) Davis that compiles the best-known ranges for California's native fish as well as many non-native fish. However, additional data on invasive species are currently lacking. This indicator may reveal additional information about the impact of stressors on native fish communities, including introduced species, anthropogenic activities, and habitat conversion or degradation, making it supportive of decision making.

Representative of Outcome:	High
Data Viability:	High-Medium
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.41 Initial Data and Results

Native Fish Conservation Status. The conservation status of native fish over time since 1976 is shown in Figure 4-9 as reported in several studies, including the 2015 Fish Species of Special Concern in California, 3rd edition, published by CDFW. This report presents information on all California's Species of Special Concern, representing 81 percent of California's freshwater fish, as a continuation of similar past reports (Moyle 1976, Moyle et al. 1989, Moyle et al. 1995, Moyle at al. 2015).

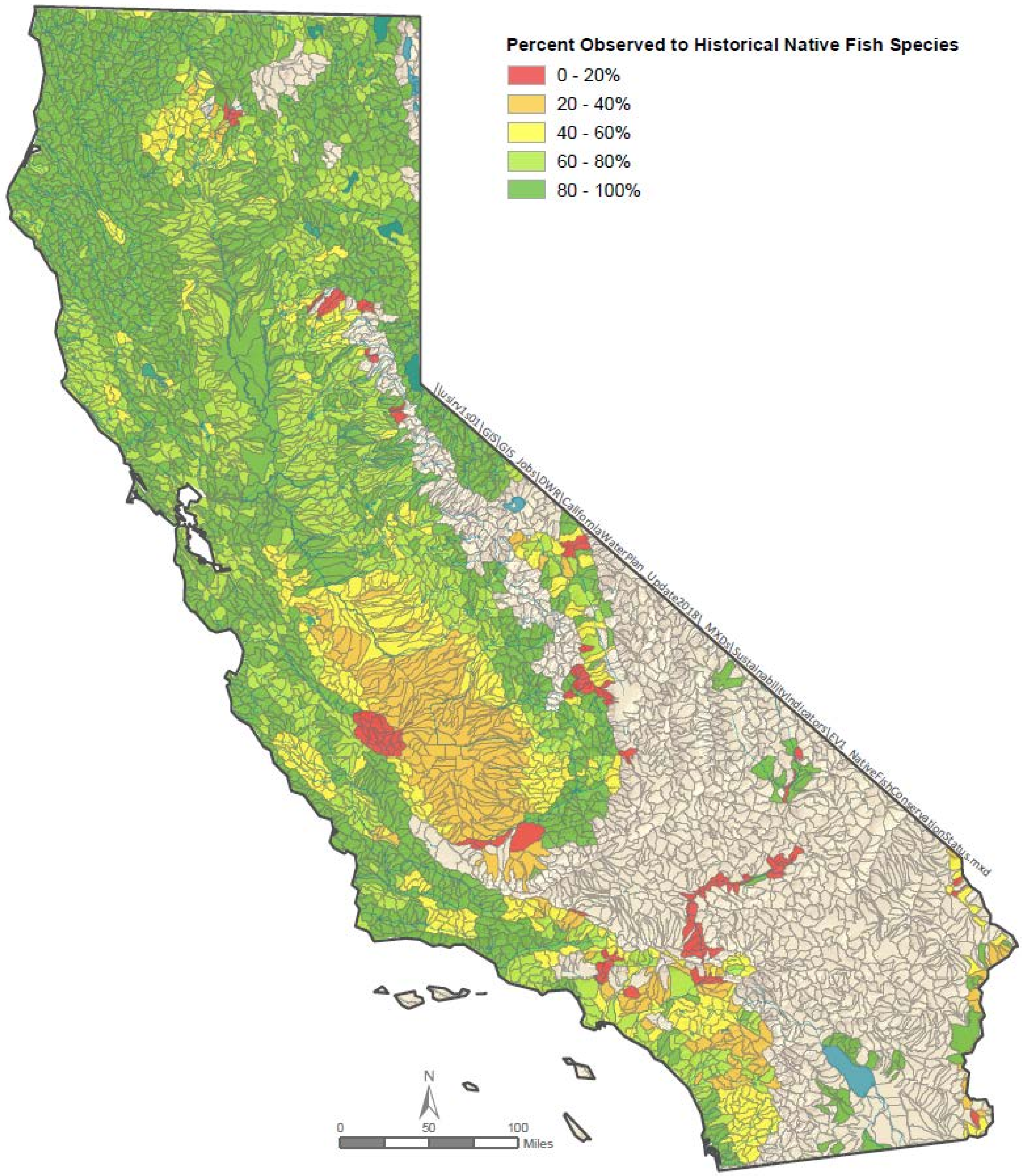


Sources: Moyle 1976, Moyle et al. 1989, Moyle et al. 1995, Moyle at al. 2015

Figure 4-9. Conservation Status of California Freshwater Fish

Percentage of Expected Native Fish Species Observed in Watersheds. The percentages of observed native fish species compared to the historical native fish species in individual watersheds were calculated using the range data provided through PISCES. This analysis assumed the full extent of all ranges, regardless of season, adding to the species richness in all watersheds.

All species included in the database at the time of the analysis were used. For each watershed, the number of observed fish species was compared to the number of historical fish species to derive a final percentage. Watersheds with more observed fish species than historical fish species were given a 100 percent richness percentage score. Watersheds with no historical fish species are not shaded. These watersheds were analyzed on a fine scale anticipate the incorporation of additional data sources and the calculation of a final index score on a larger watershed scale. Figure 4-10 shows the results of this analysis.



Source: "Fish Data." UC Davis PISCES. January 30, 2018.

Figure 4-10. Percent Observed to Historical Native Fish Species

As shown in Figure 4-10, the San Joaquin Valley has lost much of its native fish richness, likely due to heavy modification of natural flow patterns. Upper reaches of watersheds also show losses in fish richness, potentially due to the presence of dams and other fish passage barriers in those areas. Many high alpine and desert regions in California have not had historical populations of native fish and were not scored in this analysis.

Proportion of Non-Native Fish Species. Data representing a comparison of native and invasive fish populations were not yet developed in a comprehensive database, so this metric was not analyzed.

Status of Several Key Fish Species. No determination of key California fish species for regions of the state has been made for this indicator, therefore this metric was not analyzed.

4.42 Recommendations

At present, this under-development indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

To continue development of the Native Fish Diversity Index, additional data and methodology for the final two metrics related to non-native fish species and on key native fish species are required. Data on non-native species are currently only partly developed in PISCES and through CDFW. Key native fish species should be chosen to represent the varied regions in California upon consultation with stakeholders. The conservation status of California freshwater fish should be incorporated into the PISCES database information upon new reports on fish species of special concern in California. This would allow for a geographically distributed review of areas where fish species of special concern are concentrated. In addition, a quantitative calculation of the Native Fish Diversity Index to be applied at a watershed level should be established to allow comparison across the state.

If data remains undeveloped in the near future, this indicator should be redefined to represent available data. Missing components could be formulated as Advanced indicators or more simply formulated to represent available data on fish ranges in California. The redefined indicator would then be "Percentage of Expected Native Fish Species Observed." A second indicator could be used to emphasize the conservation status of these native fish species or this information could simply be incorporated into the redefined indicator. No key species would be chosen or analyzed. Non-native fish species would be represented in *EV 2: Non-Native Invasive Species Distribution and Status*.

4.43 Recycling

Center for Watershed Sciences, University of California, Davis. "Fish Data." UC Davis PISCES. Viewed online at: https://pisces.ucdavis.edu/fish. Last accessed: January 30, 2018.

Shilling, Fraser. 2014. California Water Sustainability Indicators Framework: Assessment at State and Regional Scale. Final Report. California Department of Water Resources. Prepared by: Department of Environmental Science and Policy at University of California, Davis. Viewed online at: https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Sustainability/Files/Publications/California-Water-Sustainability-Indicators-FrameworkAssessment-at-State-and-Region-Scales--Final-Rep.pdf

Moyle, P.B. 1976. Inland Fishes of California. University of California Press, Berkeley.

Moyle, PB, JE Williams, and E Wikramanayake. 1989. Fish species of special concern of California. California Department of Fish and Game, Sacramento.

Moyle, PB, RM Quiñones, JV Katz, and J Weaver. 2015. Fish Species of Special Concern in California. Third edition. University of California, Davis and California Department of Fish and Wildlife. Viewed online at: https://www.wildlife.ca.gov/Conservation/SSC/Fishes

Moyle, PB, RM Yoshiyama, JE Williams, and ED Wikramanayake. 1995. Fish species of special concern of California. Second edition. California Department of Fish and Game, Inland Fisheries Division. Rancho Cordova, CA.

Ecosystem Vitality

Intended Outcome: Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.

EV 2: Non-Native Invasive Species Distribution and Status

This indicator assesses the distribution and status of aquatic non-native invasive species throughout California's watersheds and management responses to eliminate or contain these species.

The target outcome for this indicator is that no invasive species are present in California watersheds, indicating the presence of well-balanced aquatic ecosystems throughout the state.

Scale:	Statewide
Data Sources:	United States Geological Survey (USGS) Nonindigenous Aquatic Species (NAS) Database
Data Availability:	Type I
Metric:	Invasive species distribution and status
Screening Status:	**Basic**

4.44 Importance and Screening Considerations

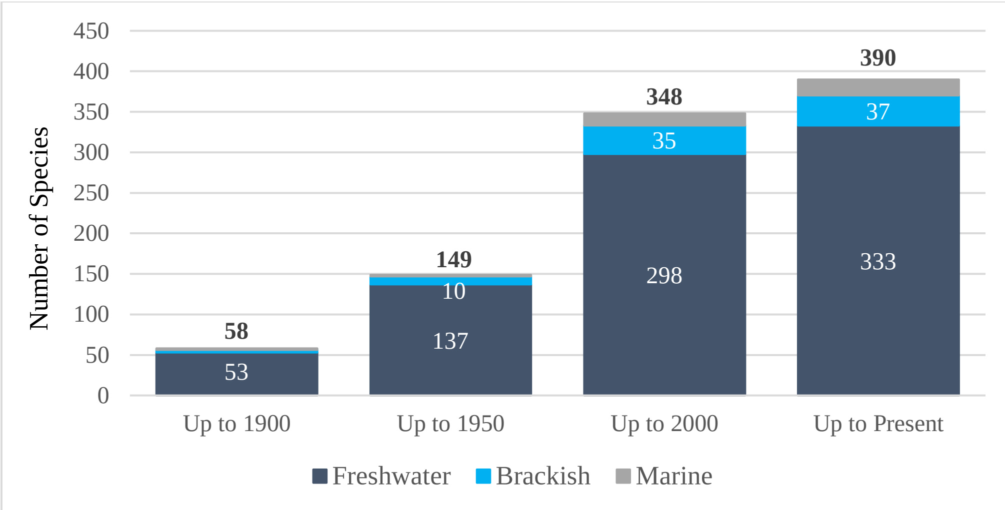
Invasive species can pose a significant threat to vital and diverse ecosystems. Often introduced unintentionally through human activity, invasive species may have no natural predators in their new habitat. If established, the proliferation of invaders can have far-reaching effects on the species native to the ecosystem as well as for communities who rely on the ecosystem. These effects can include reduction of biodiversity, degradation of water quality, and change in water availability. California is actively involved in efforts to prevent the introduction of invasive species into the state, detect and respond to introductions when they occur, and prevent the spread of invasive species that have become established.

This indicator is considered a Basic level indicator. Data on invasive species distribution and status are developed by a variety of different agencies and organizations. The status and distribution of invasive species may indicate if current preventative measures are effective and the need to establish new policies or guidelines to prevent the spread and presence of harmful invasive species throughout California's watersheds, making the indicator highly supportive of decision making.

Representative of Outcome:	Medium
Data Viability:	Low
Cost:	High
Potential Longevity:	High
Supportive of Decision Making:	High

4.45 Initial Data and Results

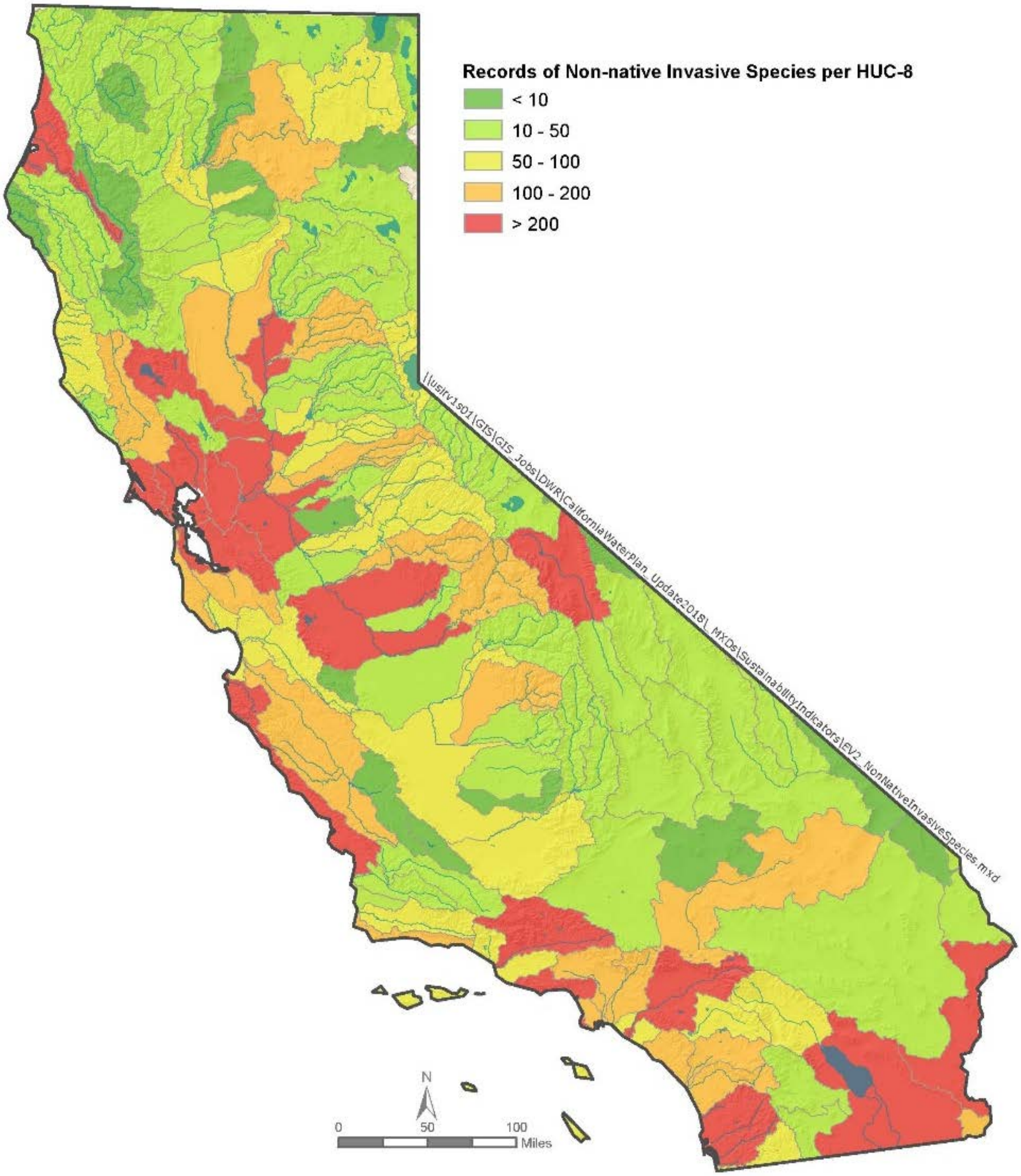
The NAS Database, maintained by USGS, exists to make relevant and informative data on aquatic invasive species readily available and easy to access. This database was used to procure state-wide aquatic invasive species records, graphs, and maps. Figure 4-11 details the total number of aquatic invasive species introduced in the state over time. Note that the introduction of a species does not necessarily equate to the establishment of that species in the new habitat.



Source: USGS NAS Database

Figure 4-11. Freshwater/Marine Species Introduced over Time in California

Figure 4-12 shows the spatial distribution and frequency of various aquatic invasive species records. Note that each record does not necessarily quantify the prevalence of a species in that region or guarantee the future survival or establishment of that species.



Source: USGS NAS Database

Figure 4-12. Distribution and Frequency of Aquatic Invasive Species Records

4.46 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

The California Department of Fish and Game (now CDFW) developed the California Aquatic Invasive Species Management Plan in January 2008, and this plan included “Early Detection and Monitoring” as one of eight major objectives. Among the actions included in this objective, programs to support early detection of high priority aquatic invasive species are prioritized. In addition, the plan recognizes the importance of determining the spatial distribution of aquatic invasive species and includes an action to “…include maps of existing aquatic invasive species in California’s coastal and inland waters in the Department of Fish and Wildlife Biogeographic Information and Observation System.” Continued work by CDFW to achieve these objectives will increase the availability of accurate and accessible data.

In 2012, CDFW merged their California Aquatic Non-native Organism Database (CANOD) with the National Estuarine and Marine Exotic Species Information System (NEMESIS), creating the California Non-native Estuarine and Marine Organisms (Cal-NEMO) database. This database was considered for use in this indicator, but was not used due to the limitation of the database to marine and estuarine species only. For a state-wide indicator, it is important to be able to assess freshwater invasive species as well. It is recommended that this database be expanded and used in the future to provide a complete state-managed assessment of the status of non-native aquatic species in California.

4.47 References

Shilling, Fraser. 2014. California Water Sustainability Indicators Framework: Assessment at State and Regional Scale. Final Report. California Department of Water Resources. Prepared by: Department of Environmental Science and Policy at University of California, Davis. Viewed online at: https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Sustainability/Files/Publications/California-Water-Sustainability-Indicators-FrameworkAssessment-at-State-and-Region-Scales--Final-Rep.pdf

California Department of Fish and Game. 2008. California Aquatic Invasive Species Management Plan. Viewed online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=3868

California Department of Fish and Wildlife. “California’s Invaders.” California Department of Fish and Game, Invasive Species Program. Viewed online at: https://www.wildlife.ca.gov/Conservation/Invasives/Species. Last accessed: February 7, 2018.

Fofonoff PW, Ruiz GM, Steves B, Simkanin C, & Carlton JT. 2018. California Non-native Estuarine and Marine Organisms (Cal-NEMO) System. Viewed online at: http://invasions.si.edu/nemesis/. Last accessed: April 24, 2018

U.S. Geological Survey. 2018. Nonindigenous Aquatic Species Database. Viewed online at: https://nas.er.usgs.gov/. Last accessed: April 24, 2018.

Ecosystem Vitality

Intended Outcome: Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.

EV 3: Acreage of Wetlands

This indicator assesses the distribution and current acreage of wetlands throughout California. Wetlands form transitional areas between water bodies and fully terrestrial ecosystems. Wetlands are found throughout California's ecosystems and serve to regulate climate, store surface water, replenish groundwater aquifers, protect shorelines, serve as critical habitat, and provide opportunities for education and recreation.

The target outcome for this indicator is to maintain or increase the acreage of wetlands in the state.

Scale:	Statewide
Data Sources:	U.S. Fish and Wildlife Service
Data Availability:	Type I
Metric:	Wetland distribution and acreage
Screening Status:	**Basic**

4.48 Importance and Screening Considerations

California currently has approximately 3 million acres of wetlands. These wetlands, despite the important beneficial functions they perform, wetlands are at risk due to urban and agricultural development. A large proportion of historical wetlands have been lost.

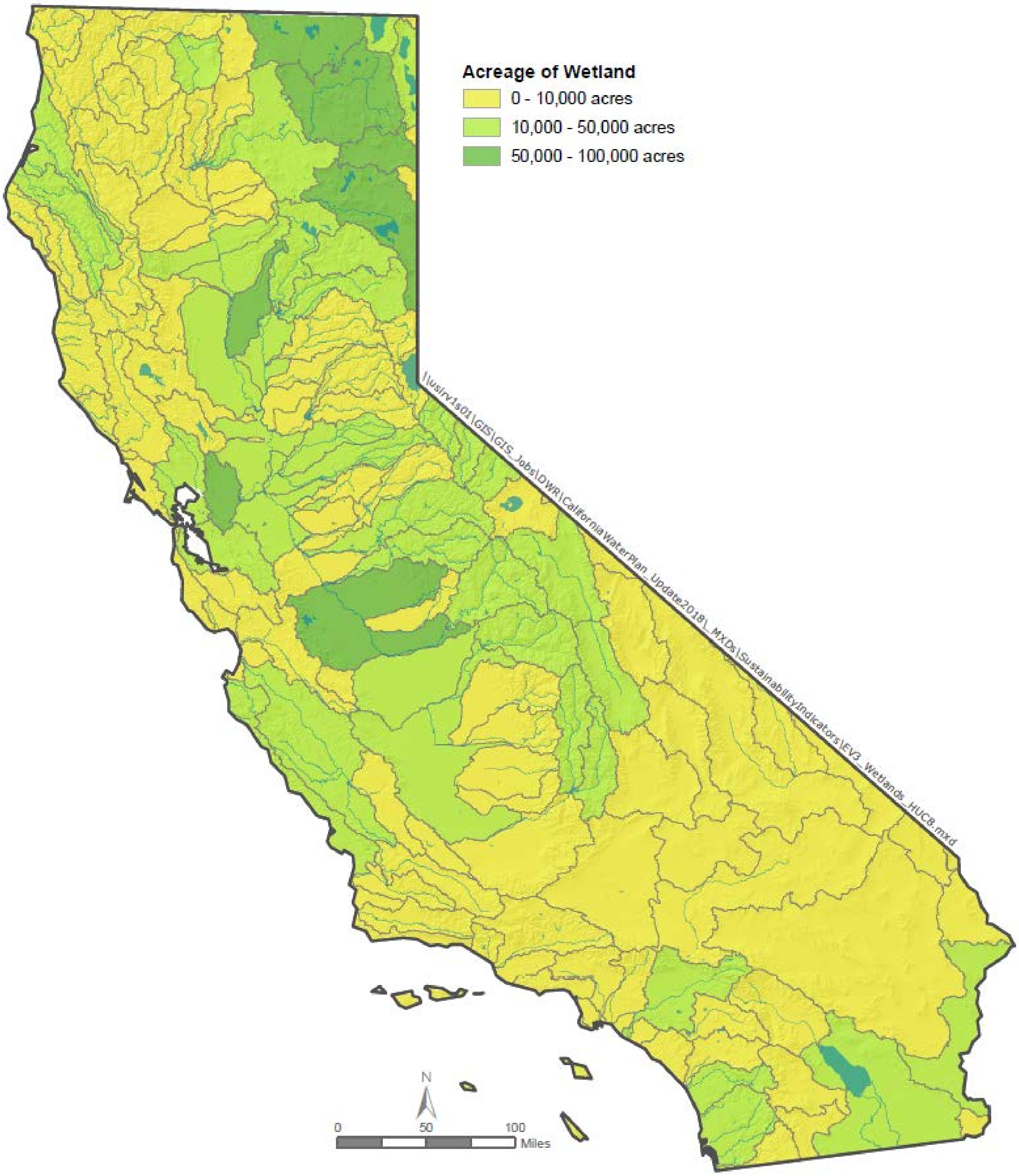
Overall, this indicator is considered a Basic level indicator. Data on wetlands throughout the United States, including California, are collected by the U.S. Fish and Wildlife Service as part of the Wetlands Data Layer of the National Spatial Data Infrastructure. The distribution of wetland acreage directly represents ecosystem distribution in the state and can be used to direct policies or projects to areas that are in particular need, making the indicator highly supportive of decision making.

Representative of Outcome:	Medium
Data Viability:	Low
Cost:	High
Potential Longevity:	High
Supportive of Decision Making:	High

4.49 Initial Data and Results

The U.S. Fish and Wildlife Service maintains and distributes the National Wetlands Inventory. This data provides the extent and location of wetlands throughout the United States. Figure 4-13 includes wetlands captured in the National Wetlands Inventory under the Estuarine and Marine, Freshwater Emergent, and Freshwater Forested/Shrub wetland types. The total acreage of wetlands shown is 1,656,000 acres.

Several key areas for existing wetlands in California include northeastern California, the Delta, and watersheds in the Central Valley, especially those containing National Wildlife Refuge areas.



Source: National Wetlands Inventory. May 2018. U.S. Fish and Wildlife Service.
Figure 4-13. Distribution of Wetland Acreage Through California

Table 4-8 illustrates the distribution by type of wetland acreage in California. Freshwater emergency wetland is the most common wetland type by acreage.

Table 4-8. Acreage by Wetland Type

Type	Acreage
Estuarine and Marine Wetland	101,729
Freshwater Emergent Wetland	1,082,922
Freshwater Forested/Shrub Wetland	471,820

Sources: "National Wetlands Inventory Product Summary." May 8, 2018. U.S. Fish and Wildlife Service.

4.50 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. Continued efforts to develop the Wetlands Data Layer are underway. Local and state agencies should cooperate with efforts by the U.S. Fish and Wildlife Service to further develop this geospatial data. Trends in acreage should be tracked to understand the impacts of future projects on wetland acreage.

4.51 References

Natural Resource Agency. 2010. State of the State's Wetlands: 10 Years of Challenges and Progress. Viewed online at: http://www.resources.ca.gov/docs/SOSW_report_with_cover_memo_10182010.pdf

U.S. Fish and Wildlife Service. "National Wetlands Inventory Product Summary." Viewed online at: https://www.fws.gov/wetlands/Data/Wetlands-Product-Summary.html. Last accessed: April 12, 2018.

U.S. Fish and Wildlife Service. 2018. "National Wetlands Inventory." Viewed online at: https://www.fws.gov/wetlands/Data/Wetlands-Product-Summary.html. Last accessed: April 12, 2018.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV 4: Degree of Aquatic Fragmentation

This indicator assesses the degree of aquatic fragmentation. Aquatic fragmentation identifies the proportion of the stream segments crossed by artificial structures, such as dams and roads. This indicator is adapted from the *California Water Sustainability Indicators Framework: Assessment at State and Regional Scale* final report, published within the CWP Update 2013 materials.

The target outcome for this indicator is for 100 percent of watersheds to be unfragmented. This increases ecological health by allowing aquatic species and systems to thrive through the conservation of the historical natural watershed connectivity.

Scale:	Statewide
Data Sources:	U.S. Geological Survey National Hydrography Dataset (NHD); CalTrans; U.S. Forest Service; CDFW Passage Assessment Database (PAD); CWP Update 2013
Data Availability:	Type II
Metric:	Density of road intersections and dams along streams
Screening Status:	**Basic**

4.52 Importance and Screening Considerations

Streams and rivers throughout California watersheds are disconnected by physical barriers, including dams, culverts, in-stream impoundments, or segmented due to sections with high temperature or excessive aquatic plant growth. Assessing watershed connectivity is critical to understanding effective conservation of rivers and networks of wetlands to ensure natural processes including upstream connectivity, maintenance of biological diversity, fish migratory routes, free-flowing rivers, and significant water yield areas and water quality.

This indicator is categorized as a Basic level indicator. Decision makers could use this indicator to assess the direct and indirect impacts of natural or artificial barriers on waterways throughout California. Many databases of California roads and streams exist from various sources. Additional data on dams and other structures with impacts on fish passage are available through the CDFW PAD.

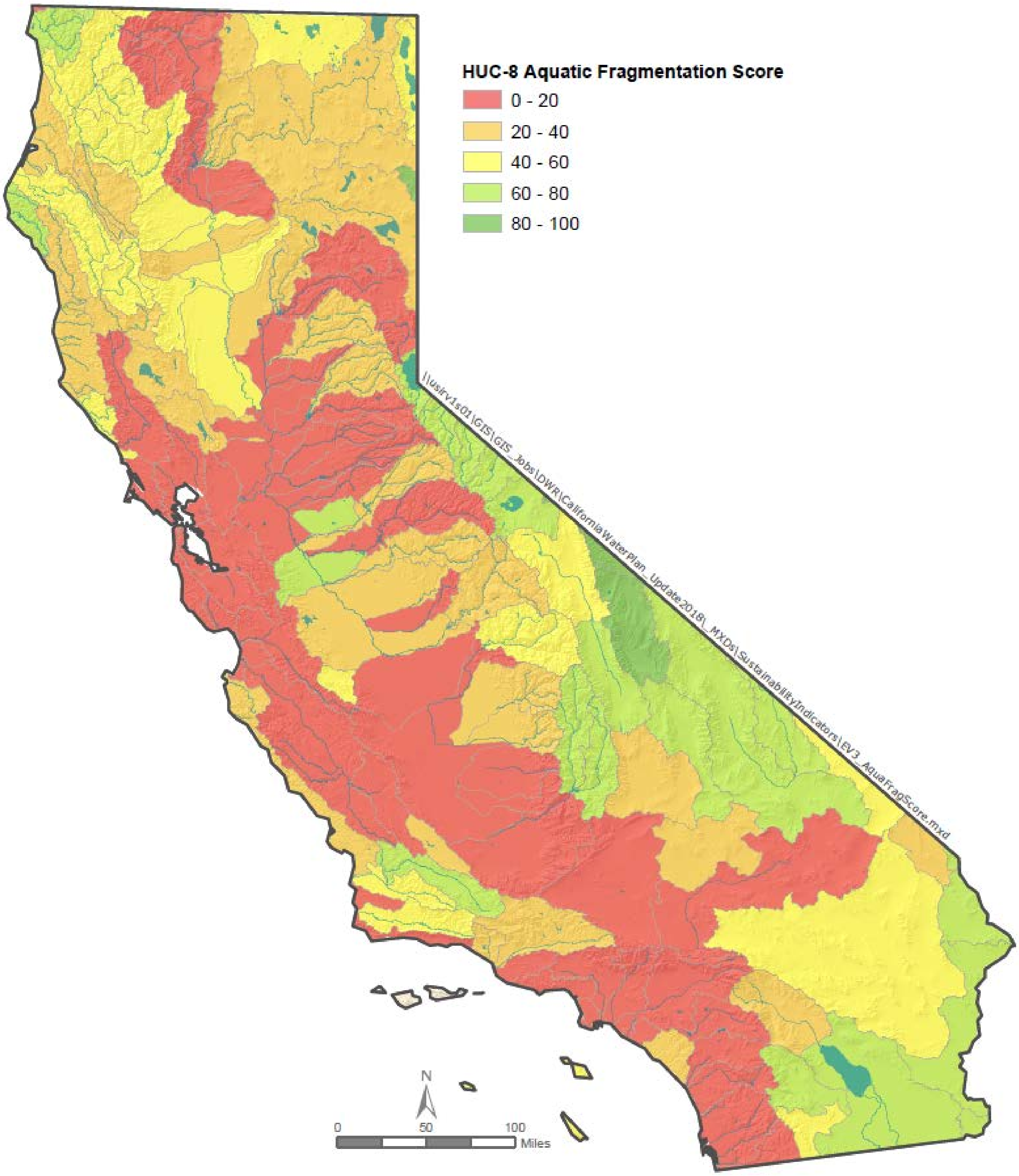
Representative of Outcome:	High
Data Viability:	High
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.53 Initial Data and Results

The initial data used to calculate aquatic fragmentation were a road network of California distributed through the Topologically Integrated Geographic Encoding and Referencing (TIGER) database from the U.S. Census Bureau. Additional data from CalTrans and the U.S. Forest Service were also incorporated.

NHD was used to provide watershed boundaries and the stream data. In addition, dam locations were provided by PAD and moved to intersect with the nearest stream provided by the NHD dataset. However, these data require manual inspection to determine the accuracy of this spatial analysis and, therefore, are not included in the results presented below.

The number of road and stream intersections, as well as an approximation of the number of on-stream dams, was calculated for each watershed. The length of stream was also determined for each watershed. The density of road-stream intersections was calculated for each watershed. For each watershed, this density was then converted into a degree of aquatic fragmentation score. A density of road/stream intersections and dams of 0 crossings/square kilometer (km^2) of stream per watershed was given a score of 100. A literature review conducted in the *California Water Sustainability Indicators Framework: Assessment at State and Regional Scale* final report suggests a value of 0.6 crossings/km^2 to represent a "high pressure" on aquatic biodiversity. This level of fragmentation was assigned a score of 0. These initial results are shown in Figure 4-14.



Sources: TIGER Products, U.S. Census Bureau
National Hydrologic Dataset, U.S. Geologic Survey
CalTrans GIS Data, CalTrans
National Forest System Roads, U.S. Forest Service

Figure 4-14. Degree of Aquatic Fragmentation

4.54 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator continue to develop.

The initial methodology for assessing the degree of aquatic fragmentation throughout California's watersheds, following the approach proposed in the *California Water Sustainability Indicators Framework: Assessment at State and Regional Scale* final report, did not consider that bridges or causeways spanning the entire floodplain of a stream would limiting the impact of road crossings. A methodology to account for road crossings that do not represent a barrier, due to the mitigating effects of a crossing's design, should be developed for this indicator.

Incorporation of PAD data would allow this indicator to represent additional types of barriers that contribute to aquatic fragmentation. The methodology to account for these barriers should include manual verification of a large sample size to estimate the accuracy of the spatial analysis method used during the development of this indicator's current methodology.

In addition, impacts from aquatic fragmentation are felt both upstream and downstream of watershed boundaries. Therefore, this indicator is a general proxy for this impact on ecosystem health and should be considered in conjunction with other indicators, such as *EV 6: California Stream Condition Index*, for a more complete analysis of ecosystem health on upstream and downstream watersheds.

4.55 References

Shilling, Fraser. 2014. California Water Sustainability Indicators Framework: Assessment at State and Regional Scale. Final Report. California Department of Water Resources. Prepared by: Department of Environmental Science and Policy at University of California, Davis. Viewed online at: https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Sustainability/Files/Publications/California-Water-Sustainability-Indicators-FrameworkAssessment-at-State-and-Region-Scales--Final-Rep.pdf

California Department of Fish and Wildlife. "Passage Assessment Database (PAD)." Viewed online at: https://nrm.dfg.ca.gov/PAD/. Last accessed: December 12, 2017.

U.S. Census Bureau. "TIGER Products." Viewed online at: https://www.census.gov/geo/maps-data/data/tiger.html. Last accessed: December 12, 2017.

U.S. Department of the Interior, U.S. Geologic Survey. "Hydrography." Viewed online at: https://nhd.usgs.gov/. Last accessed: December 12, 2017.

California Department of Transportation. "CalTrans GIS Data." Viewed online at: http://www.dot.ca.gov/hq/tsip/gis/datalibrary/. Last accessed: December 12, 2017.

U.S. Department of Agriculture, U.S. Forest Service. "Download National Datasets." U.S. Department of Agriculture. Viewed online at: https://data.fs.usda.gov/geodata/edw/datasets.php. Last accessed: December 12, 2017.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV 5 Impaired Water Bodies – by Hydrologic Region

This indicator assesses the number of impaired water bodies for constituents of aquatic concern on a watershed scale. This is representative of not only the degree of impairment, visible at a statewide scale under *EV 7: Impaired Water Bodies – Count by Watershed*, but also the constituents of concern for each individual watershed, which vary across the state.

Listing a water body as impaired within California's Integrated Report (Clean Water Act Section 303(d) List / 305 (b) Report) is governed by the Water Quality Control Policy of California's Clean Water Act Section 303(d) Listing Policy. For each water body on the list, the State identifies the pollutant causing the impairment, when known. The State and Regional Water Boards assess water quality data for California's waters every two years to determine if they contain pollutants at levels that exceed protective water quality criteria and standards.

The target outcome for this indicator is to have no impaired water bodies on the Clean Water Act Section 303(d) List.

Scale:	Regional
Data Sources:	State Water Board 2014/2016 California Integrated Report (Clean Water Act Section 303(d) List / 305 (b) Report)
Data Availability:	Type I
Metric:	Number of impaired water bodies, pollutants
Screening Status:	**Watershed**

4.56 Importance and Screening Considerations

An increasing population across the state has resulted in increased runoff of agricultural, industrial, and urban pollutants to both surface and ground water. Increased agricultural and urban wastewater discharges, changes in commercial practices and recreational activities, changes in temperature and precipitation patterns caused by climate change, changes in the timing of river flows, as well as other causes have altered water quality and negatively impacted many of California's ecosystems. Analyzing the types of pollutants with the highest impacts in the 10 hydrologic regions statewide may help focus future ecosystem improvement efforts. For example, watersheds with significant agricultural land acreage, such as those in the Central Valley, may have different constituents of concern than watersheds located in the San Francisco Bay Area (Bay Area).

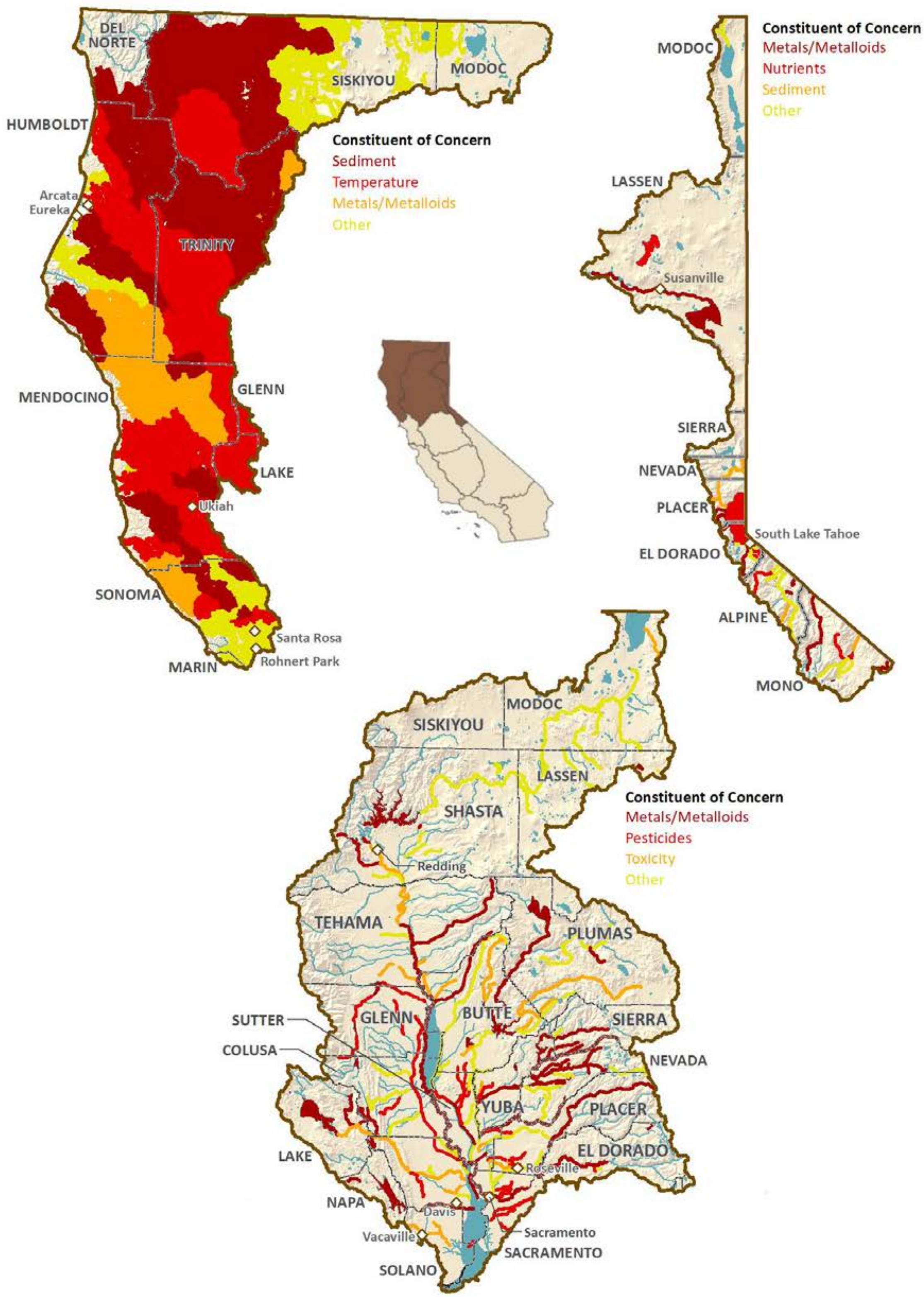
This indicator is considered Watershed level. The number of impaired water bodies throughout California are usually indicative of the overall ecological health of each watershed, however a cause of impairment may not directly impact ecologic health. Data on impaired water bodies are already collected and reported by the State Water Board, and therefore are readily available. The methodology for this indicator involves assessing both the number of impaired water bodies and their common constituents of concern. Identification of the trends would allow decision makers to recognize and prioritize actions on common pollutants in the state.

Representative of Outcome:	Medium
Data Viability:	High
Cost:	High
Potential Longevity:	High
Supportive of Decision Making:	High

4.57 Initial Data and Results

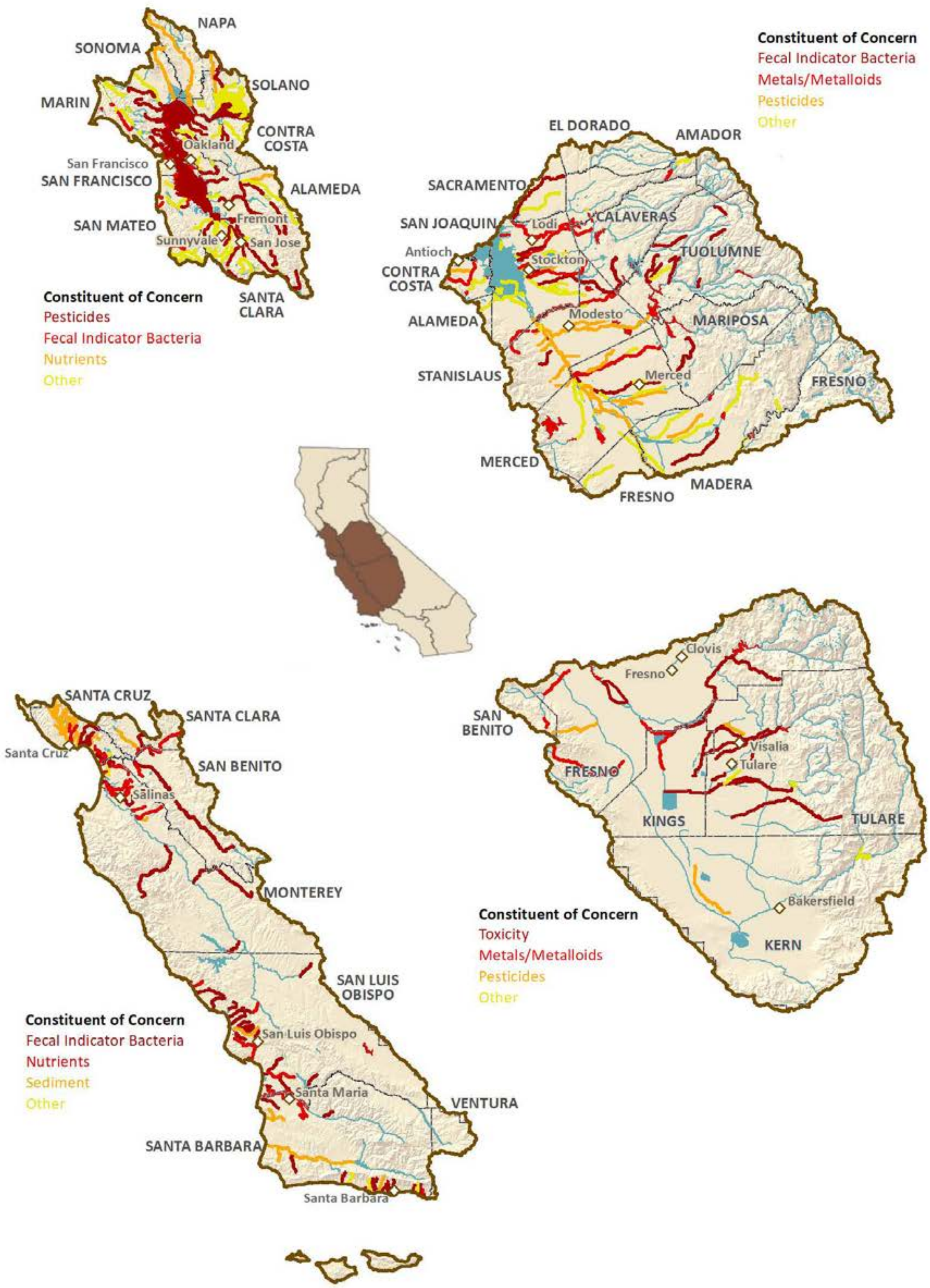
The water bodies on the Clean Water Act Section 303(d) List are updated regularly, approximately every two years. The 2014/2016 California Integrated Report's list was used to produce Figures 4-15 through 4-17. The 2018 California Integrated Report listing process was begun November 3, 2016 with a Notice of Public Solicitation for water quality data and information. When the Clean Water Act Section 303(d) List is approved by the U.S. Environmental Protection Agency (U.S. EPA), GIS files are provided showing all impaired water bodies. These GIS files, along with information on the pollutants causing impairment in each water body, were used to analyze each of ten hydrologic regions for their top constituents of concern. These ten hydrologic regions represent major Californian watersheds.

The top causes of impairment are fairly consistent throughout the state and include contaminants within the fecal indicator bacteria, metals/metalloids, and pesticide categories. In eight of the ten hydrologic regions, metals/metalloids are in the top three causes of impairment. The specific contaminant changes by hydrologic region. Six of the ten hydrologic regions, concentrated in the Central Valley, have water bodies impaired due to pesticides. Fecal indicator bacteria occur in more heavily urbanized areas of the state, including the South Coast and San Francisco Bay hydrologic regions.



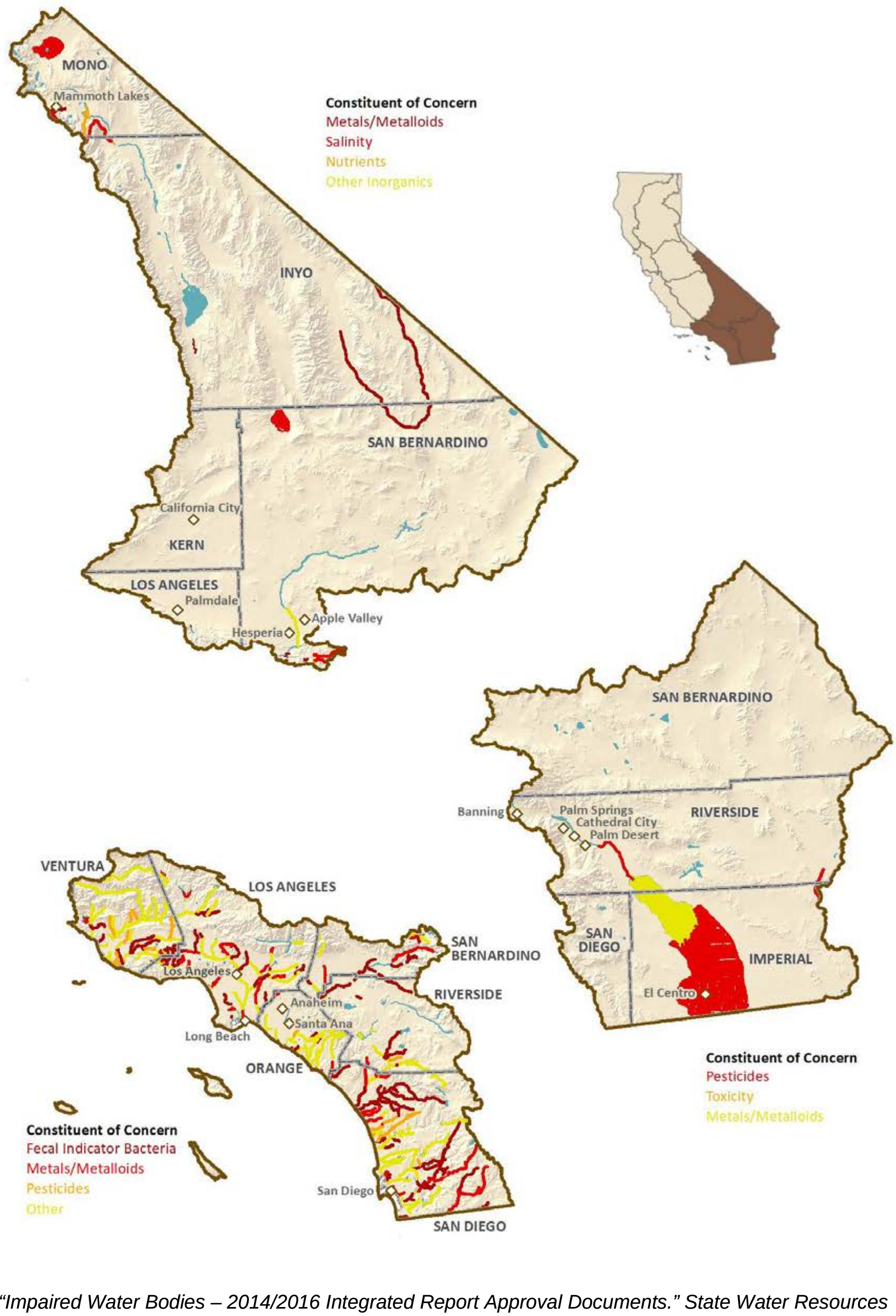
Source: "Impaired Water Bodies – 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. April 11, 2018.

Figure 4-15. Impaired Water Bodies in the North Coast, North Lahontan, and Sacramento Hydrologic Regions



Source: "Impaired Water Bodies – 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. April 11, 2018.

Figure 4-16. Impaired Water Bodies in the Bay Area, San Joaquin, Central Coast, and Tulare Lake Hydrologic Regions



Source: "Impaired Water Bodies – 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. April 11, 2018.

Figure 4-17. Impaired Water Bodies for the South Lahontan, South Coast, and Colorado River Hydrologic Regions

4.58 Recommendations

This indicator is a Watershed level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

The process for listing water bodies is well established in California. Updates should continue to be completed regularly to maintain an up-to-date database of impaired water bodies. The GIS representations of the impaired water bodies are planned to be updated in future listing cycles. The GIS-based data should incorporate information on the impaired purpose within the GIS. This would allow this indicator to identify only water bodies related to impairment of ecosystem health.

4.59 References

State Water Resources Control Board. 2014/2016 Integrated Report Approval Documents.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2014_2016.shtml. Last accessed: April 11, 2018.

U.S. Environmental Protection Agency. “Clean Water Act Section 303(d): Impaired Waters and Total Maximum Daily Loads (TMDLs).” U.S. EPA. Viewed online at: https://www.epa.gov/tmdl. Last accessed: November 28, 2017.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV 6: California Stream Condition Index

This indicator assesses the California Stream Condition Index (CSCI), which is a bioassessment index used by various entities to measure the presence and abundance of aquatic plants and animals, providing an indication of waterway and landscape disturbance, geomorphic conditions, appropriate water availability, and water quality. This indicator is adapted from the *California Water Sustainability Indicators Framework: Assessment at State and Regional Scale* final report, published within the CWP Update 2013 materials.

The State Water Board developed the CSCI as a regulatory and informational tool to measure and protect water quality and stream processes. The State Water Board adopted the CSCI as a defensible and useful indicator of water quality and stream disturbance. The index was developed using a large, representative dataset and covers a broad range of environmental variability among natural stream types across California. The CSCI evaluates stream and watershed conditions based on the composition of benthic macro-invertebrate communities relative to the expected composition. The index is composed of two metrics: (1) the ratio of observed to expected taxonomic groups, and (2) the proportion of the assemblage falling into different functional groups that represent species diversity, ecosystem function, and sensitivity to stress.

The target outcome associated with this indicator is a high index score, indicating a stream's ability to support native species and natural processes. The desired condition for this indicator is the mean of the referenced condition (CSCI value = 1.01). Conversely, the undesired condition is the absence of any expected natural benthic macroinvertebrate species (CSCI value = 0).

Scale:	Statewide
Data Sources:	State Water Board Surface Water Ambient Monitoring Program (SWAMP); CWP Update 2013
Data Availability:	Type I
Metric:	California Stream Condition Index
Screening Status:	**Basic**

4.60 Importance and Screening Considerations

The presence and abundance of aquatic plants and animals provide an indication of waterway and landscape disturbance, geomorphic conditions, water availability, and water quality. Biomonitoring has the ability to provide information about past or episodic pollution and the cumulative effects on watersheds. The CSCI provides a direct indicator of the ability of a stream to support wildlife.

Through screening, this indicator is considered a Basic level indicator. The CSCI has been used by the CDFW and the State Water Board as a bioindicator of water quality, providing integrated information on toxic chemical concentrations, dissolved oxygen levels, nutrients, and habitat quality. The State Water Board already collects data associated with the CSCI and provides a standardized calculation, providing a highly viable dataset. The indicator can be easily understood and represented, thereby supporting decision makers.

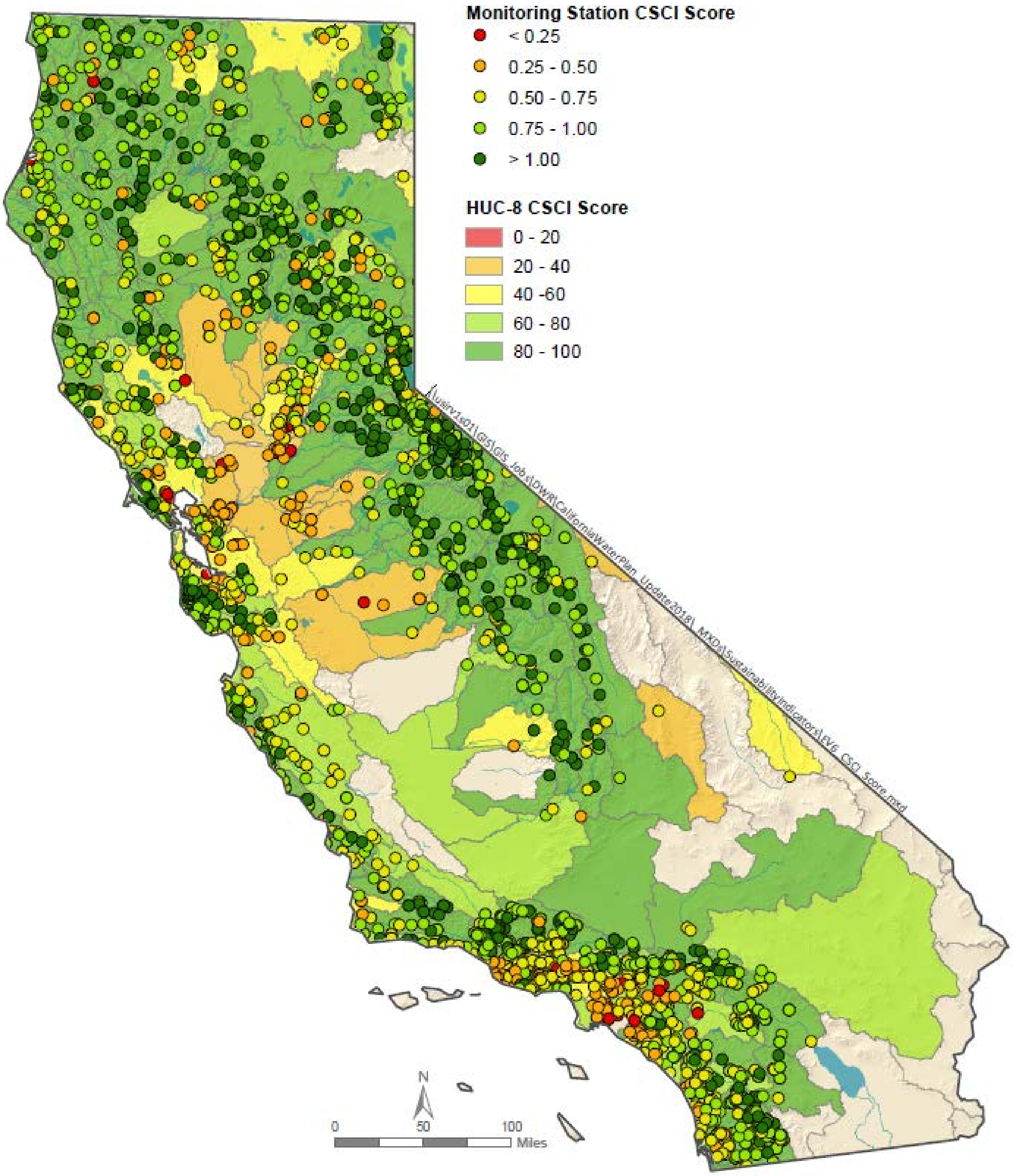
Representative of Outcome:	High
Data Viability:	High
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.61 Initial Data and Results

A database of California Stream Condition Index scores was used, as developed by the State Water Board, to calculate an overall score for each HUC-8 watershed across the state. Data for this indicator were evaluated following the approach established in the *California Water Sustainability Indicators Framework: Assessment at State and Regional Scale* final report. The CSCI for each recorded point in a watershed boundary was averaged for the watershed. Afterwards, each watershed received a score based on this average CSCI value. Any CSCI average above 1.01, received a score of 100 for the watershed. A watershed with an average CSCI score between 0.87 and 1.01, received a proportional score between 90 and 100. Similarly, a watershed with an average CSCI score between 0.72 and 0.87, received a proportional score between 50 and 90. All watersheds with average CSCI scores between 0 and 0.72 received a proportional score between 0 and 50.

Figure 4-18 displays both the average CSCI score across each HUC 8 watershed as well as the individual scores from monitoring stations used to calculate this HUC 8 score. Watersheds with no available monitoring station scores are unshaded. As shown, Central Valley watersheds, especially in and near the Delta have lower scores. However, these scores are based on fewer monitoring stations than the average scores of watersheds in the Sierra Nevada, in southern California, and south of the Bay Area. The degree to which conditions at isolated sites reflect upstream conditions depends on the size and natural processes of the upstream watershed (Shilling 2014).

California's rural undeveloped regions have higher CSCI scores. As visible on this map, monitoring has occurred more heavily in certain regions of the state, including southern California. Future monitoring will rotate through California regions based on funding availability. Therefore, the map shows multiple years of monitoring rather than a single year to provide greater spatial resolution.



Source: Bioassessment Scores Map. State Water Resources Control Board. 2017.

Figure 4-18. California Stream Condition Indices Across California Watersheds

4.62 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

The methodology for assessing the CSCI as an indicator provides a quick analysis of stream ecosystem health. Current monitoring should continue both at current monitoring stations and new monitoring stations to improve the current spatial resolution of data points.

4.63 References

Shilling, Fraser. 2014. California Water Sustainability Indicators Framework: Assessment at State and Regional Scale. Final Report. California Department of Water Resources. Prepared by: Department of Environmental Science and Policy at University of California, Davis. Viewed online at: https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Sustainability/Files/Publications/California-Water-Sustainability-Indicators-FrameworkAssessment-at-State-and-Region-Scales--Final-Rep.pdf

Rehn, Andrew C, Raphael Mazor, and Peter R Ode. 2015. The California Stream Condition Index (CSCI): A New Statewide Biological Scoring Tool for Assessing the Health of Freshwater Streams. Surface Water Ambient Monitoring Program. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/csci_tech_memo.pdf

State Water Resources Control Board. “Bioassessment Scores Map.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/csci_scores_map.shtml. Last accessed: December 1, 2017.

Ecosystem Vitality

Intended Outcome: Achieved designated beneficial uses for water bodies throughout the state

EV 7: Impaired Water Bodies – Count by Watershed

Similar to *EV 5, Impaired Water Bodies – by Hydrologic Region*, this indicator assesses the number of impaired water bodies, but on a statewide scale. The State and Regional Water Boards assess water quality data for California's waters every two years to determine if they contain pollutants at levels that exceed protective water quality criteria and standards. A complete listing of impaired water bodies throughout the state can be found within California's Integrated Report (Clean Water Act Section 303(d) List / 305 (b) Report).

The target condition for this indicator is that zero percent of water bodies in the state are listed on the Clean Water Act Section 303(d) List, indicating that water bodies are not impaired and therefore, are able to support a healthy and thriving ecosystem.

Scale:	Statewide
Data Sources:	State Water Board 2014/2016 California Integrated Report (Clean Water Act Section 303(d) List / 305 (b) Report); U.S. Geological Survey (NHD
Data Availability:	Type I
Metric:	Percentage of water bodies on Clean Water Act Section 303(d) List
Screening Status:	**Basic**

4.64 Importance and Screening Considerations

An ever-increasing population across the state has resulted in increased runoff of agricultural, industrial and urban pollutants to both surface and ground water. In addition, increased agricultural and urban wastewater discharges, changes in commercial practices and recreational activities, changes in temperature and precipitation patterns caused by climate change, changes in the timing of river flows, as well as other causes have altered water quality and have negatively impacted many of California's ecosystems. An indicator that assesses the number of impaired water bodies for constituents of aquatic concern represents how those identified stressors may be impacting California's ecosystems in each watershed.

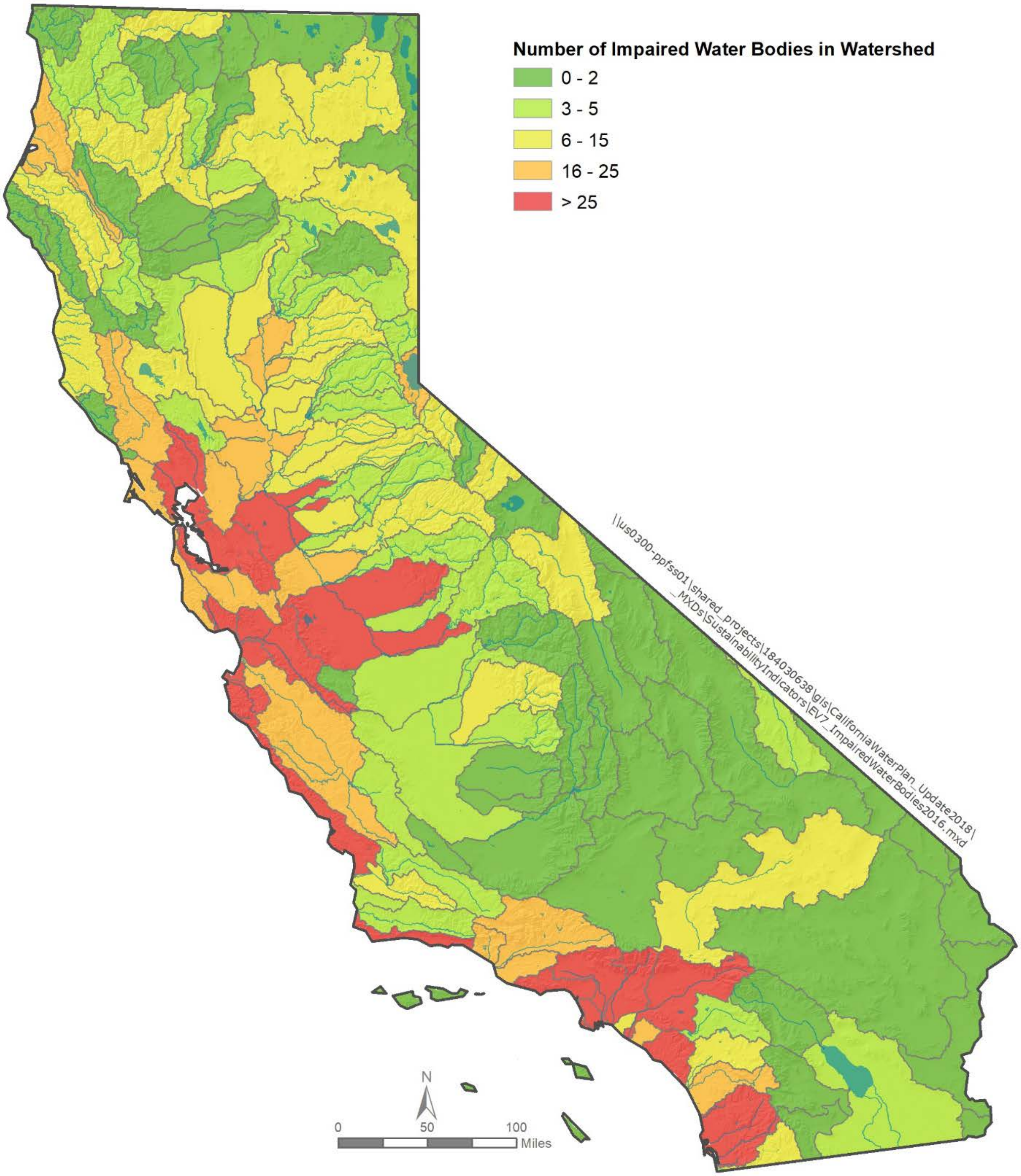
This indicator is considered a Basic level indicator as a result of the screening process. The number of impaired water bodies throughout California's watersheds can be indicative of the overall ecological health of California watersheds. Although overlap with other indicators exist, the individual assessments are unique. For example, assessing the number of impaired water bodies on a statewide scale could highlight the correlation between agriculture and the prevalence of impaired water bodies. Data on impaired water bodies are already collected by the State Water Board, so would be readily available and relatively easy to collect at a statewide level.

Representative of Outcome:	Medium-High
Data Viability:	High
Cost:	Low
Potential Longevity:	High
Supportive of Decision Making:	High

4.65 Initial Data and Results

The water bodies on the Clean Water Act Section 303(d) List are updated regularly, approximately every two years. The 2014/2016 California Integrated Report was used to produce Figure 4-19. The 2018 California Integrated Report listing process was begun November 3, 2016 with a Notice of Public Solicitation for water quality data and information. When the Clean Water Act Section 303(d) List is approved by the U.S. EPA, GIS files are provided showing all impaired water bodies. These GIS files were used to analyze the percent of impaired water bodies by watershed. The total number of water bodies used for this indicator was drawn from the U.S. Geological Survey NHD. The analysis considers the impaired area or length in a watershed compared to the impaired area or length in a watershed, respectively. This analysis does not account for watersheds with fewer overall water bodies or for watersheds with fewer individual impaired water bodies listed, but a higher length and surface area of water bodies. Urban areas have a higher number of impaired water bodies.

As can be seen in Figure 4-19, urban centers in California, including areas in and near San Francisco, Los Angeles, and San Diego, have the highest number of impaired water bodies by watershed. Coastal areas also have a high degree of impairment.



Source: "Impaired Water Bodies – 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. April 11, 2018.

Figure 4-19. Number of Impaired Water Bodies by Watershed

4.66 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. Future work on this indicator should narrow the analysis to water bodies impaired specifically for ecosystem-related purposes.

The process for listing water bodies is well established in California. Updates should continue to be completed regularly to maintain an up-to-date database of impaired water bodies. The GIS representations of the impaired water bodies are planned to be updated in future listing cycles. The GIS-based data should incorporate information on the impaired purpose within the GIS. This would allow this indicator to identify only water bodies related to impairment of ecosystem health.

4.67 References

State Water Resources Control Board. 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2014_2016.shtml. Last accessed: April 11, 2018.

U.S. Environmental Protection Agency. "Clean Water Act Section 303(d): Impaired Waters and Total Maximum Daily Loads (TMDLs)." U.S. EPA. Viewed online at: https://www.epa.gov/tmdl. Last accessed: November 28, 2017.

Ecosystem Vitality

Intended Outcome: Achieved designated beneficial uses for water bodies throughout the state

EV 8: Number of Harmful Algae Blooms

This indicator surveys the number of harmful algae blooms that occur throughout California. Although this indicator is focused on ecosystem vitality, contact exposure warning information has also been collected to help determine potential effects on public health and safety.

A positive outcome of this sustainability indicator is a decreasing trend overtime in the number of harmful algae blooms in coastal and inland water bodies. The target outcome for this indicator is for no harmful algae blooms to occur throughout the state. From a public health and safety perspective, all individual harmful algae blooms should be associated with a public contact exposure warning.

Scale:	Statewide
Data Sources:	State Water Board SWAMP; State Water Board BeachWatch
Data Availability:	Type I
Metric:	Number of reported contact exposure warnings issued
Screening Status:	**Basic**

4.68 Importance and Screening Considerations

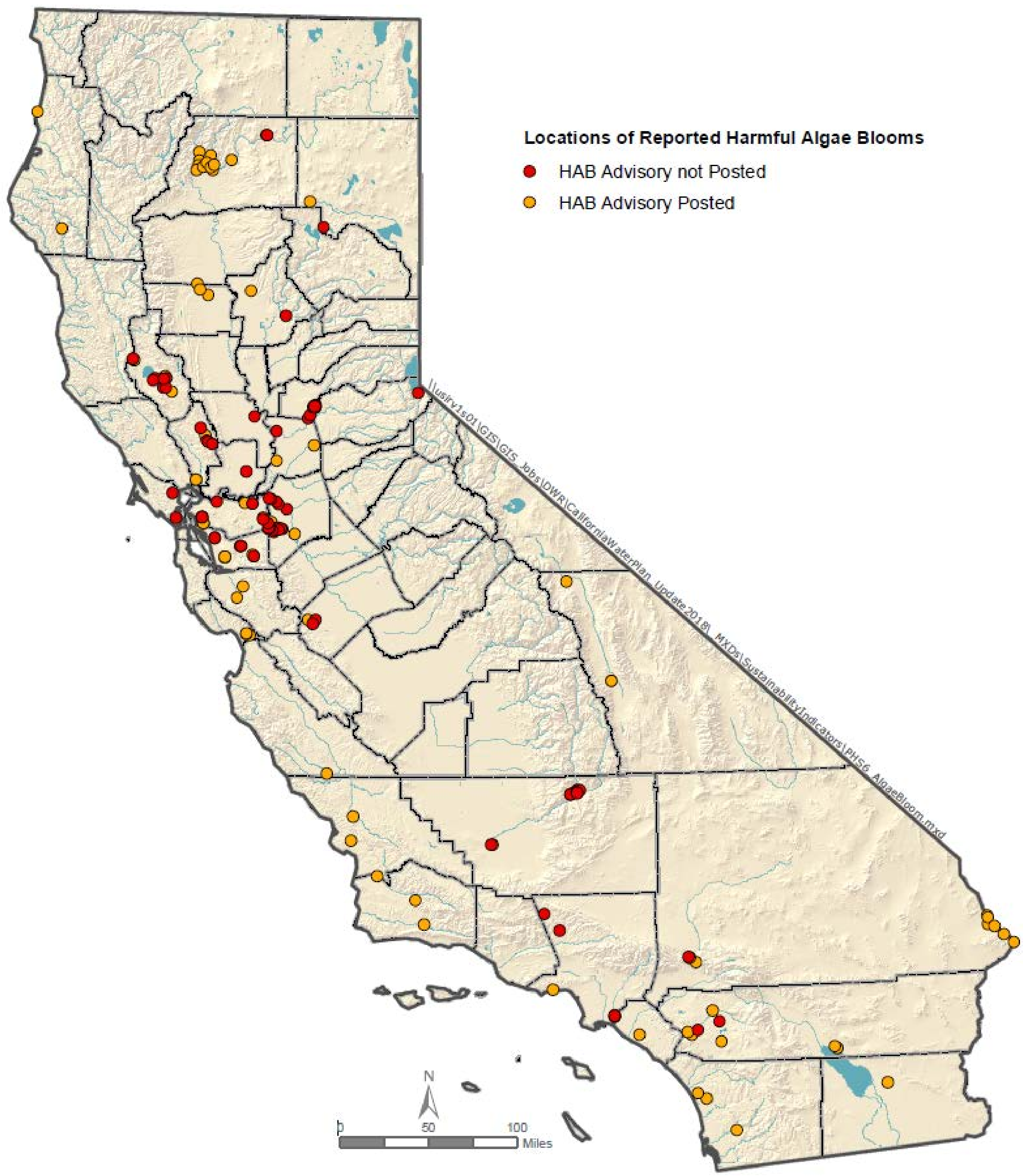
Harmful algae blooms can often be directly correlated to poor water quality, a direct threat to the beneficial use of water. The number of harmful algae blooms, especially repeated incidents in the same water body, may indicate water quality issues that need to be addressed. Issuing contact exposure warnings when harmful algae and bacteria are present in water bodies throughout California can protect the public from water borne illnesses and other hazards associated with poor water quality.

This indicator is categorized as a Basic level indicator. Data on contact exposure warnings issued due to freshwater harmful algae blooms are voluntarily reported to the State Water Board SWAMP. In addition, data on algae blooms are collected at six sites along the California coast. These data are adaptable and easy to understand at regional, state, and local levels, making this indicator supportive of decision making.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Medium – High
Potential Longevity:	High
Supportive of Decision Making:	High

4.69 Initial Data and Results

Initial data on past harmful algae blooms are presented in Figure 4-20. These data were collected by the State Water Board SWAMP and reported through the California Water Quality Monitoring Council's Harmful Algal Blooms Portal. Information on coastal algae blooms is not included in this analysis due to a lack of access to a centralized database. While some harmful algae blooms result in a posted warning, many reported blooms have no posted signs to alert potential visitors. Although warnings may not be posted at certain locations, some of the harmful algae blooms are located on private lands, where posted warning signs may not be feasible or necessary. In addition, notifications to nearby residents may be sent out instead of posted signs. At several locations, such as Lake Shasta in northern California, algae blooms recur frequently, offering potential to implement prevention policies.



Source: "Where are harmful algal blooms occurring in California?" California Water Quality Monitoring Council. February 6, 2018.

Figure 4-20. Contact Exposure Warnings Issued for Harmful Algal Blooms

4.70 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. Mitigating the causes of harmful algae blooms are critical to ecosystem vitality in water bodies with repeated blooms. Currently available centralized datasets only include voluntary reporting of harmful algae blooms and responses for freshwater bodies. Additional data should be collected to consistently capture information on both harmful algae blooms and contact exposure warning occurrences across all water bodies in the state. Data collection should be expanded to include coastal waters in addition to freshwater harmful algae blooms. New methods to identify the number of harmful algae and bacteria blooms, including crowd-based reporting methods, should be integrated into existing databases as appropriate.

4.71 References

California Water Quality Monitoring Council. "Where are harmful algal blooms occurring in California?" My Water Quality. Viewed online at: http://www.mywaterquality.ca.gov/habs/where/freshwater_events.html. Last accessed: February 6, 2018.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.

HE 1: Delivery Reliability of SWP, CVP, Colorado River Aqueduct Systems

This composite indicator assesses the water supply reliability of the following systems: the California State Water Project (SWP), the federal Central Valley Project (CVP), and the Colorado River Aqueduct. For the purposes of this indicator, reliability is defined as each system's ability to meet contracted or promised water supply allocations on an annual basis.

Scale:	Statewide
Data Sources:	DWR; U.S. Department of the Interior, Bureau of Reclamation (Reclamation)
Data Availability:	Type I
Metric:	Percent difference of actual water deliveries to long term average
Screening Status:	**Basic (Future)**

4.72 Importance and Screening Considerations

The SWP, CVP, and Colorado River Aqueduct are important water supply systems that continue to provide many areas of California with agricultural and municipal water supplies. However, each system's ability to supply water may be affected by extreme hydrologic conditions.

Operated by Reclamation, the CVP extends from the Cascade Range in the north to the plains along the Kern River in the south. Initial features of the federal project were built to provide flood protection for the Central Valley and supply domestic and industrial water in the valley. The CVP also improves Sacramento River navigation, generates electric power, conserves fish and wildlife, creates opportunities for recreation, and helps address some water quality issues.

Similar to the CVP, the SWP is a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. Its main purpose is to store and distribute contracted water supplies with 70 percent going to urban users and 30 percent going to agricultural users. Many communities are reliant on the water supplies they receive from this State-owned operation.

The 242-mile Colorado River Aqueduct provided the water that made the large-scale population and economic growth of Southern California possible in the second half of the 20th century. The aqueduct stretches 242 miles from the Colorado River on the California-Arizona border to its final holding reservoir in Southern California. The Metropolitan Water District of Southern California operates the Colorado River Aqueduct.

CVP water irrigates more than 3 million acres of farmland and provides drinking water to nearly 2 million consumers. SWP water meets the needs of 20 million Californians and irrigates more than 600,000 acres. Southern California continues to rely on water supplies from the Colorado River Aqueduct. Water supplies from these systems are particularly important for supporting one of California's most valued economic resources - agriculture. In 2016, California's farms and ranches received approximately $45.3 billion for their output, and California remains the leading U.S. state in cash farm receipts. Over a third of the country's vegetables and two-thirds of the country's fruits and nuts are grown in California.

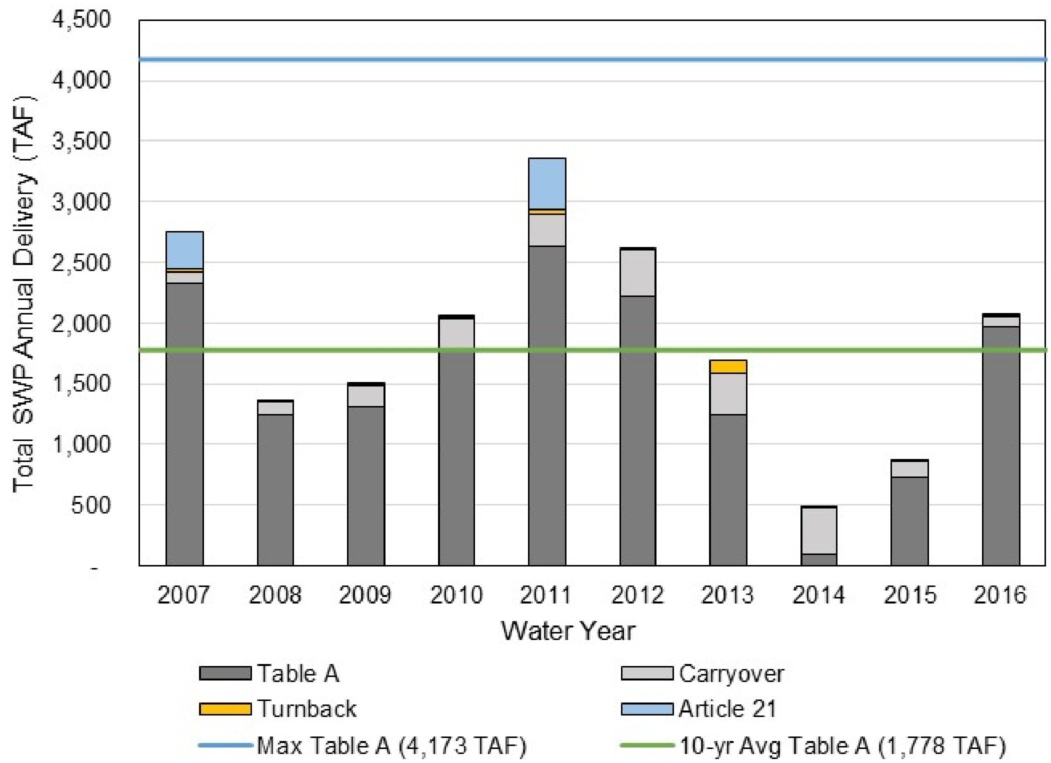
Currently, there are no initial data sources identified for assessing the reliability of the Colorado River Aqueduct, but DWR releases a SWP Delivery Capability Report and Reclamation provides CVP contract water delivery information annually. Therefore, this indicator is considered Basic (Future) during the initial screening process. Once a data source is identified for the Colorado River Aqueduct, a complete analysis of this composite indicator may be performed.

This indicator will be more applicable on a regional scale because deliveries from the SWP, CVP, and Colorado River Aqueduct only cover a portion of California's water supply systems. Although the SWP makes deliveries to two-thirds of California's population and the CVP delivers enough water to supply about 2.5 million people for a year, this indicator may not be as relevant in some regions, especially those that do not have a strong reliance on water supplies from the SWP, CVP, or Colorado River Aqueduct, such as the northern coastal area.

Representative of Outcome:	Low-Medium
Data Viability:	High
Cost:	Low-Medium
Potential Longevity:	High
Supportive of Decision Making:	Low-Medium

4.73 Initial Data and Results

SWP Contractor deliveries are presented as four different delivery types in the SWP Delivery Capability Report: Table A delivery, Article 21 delivery, carryover delivery, or turn back delivery. Figure 4-21 shows that deliveries of SWP Table A water for 2007 – 2016 range from an annual minimum of 475 thousand acre-feet (TAF) to a maximum of 2,901 TAF, with an average of 1,778 TAF. Historical deliveries of SWP Table A water over this 10-year period are less than the maximum of 4,173 TAF/year. Total annual historical SWP deliveries, including Table A, Article 21, turnback pool, and carryover water, range from 477 to 3,352 to 477 TAF over the 10-year period.



Source: 2017 State Water Project Draft Delivery Capability Report. California Department of Water Resources. 2017.

Figure 4-21. Total Historical State Water Project Deliveries, 2007 – 2016 (by Delivery Type)

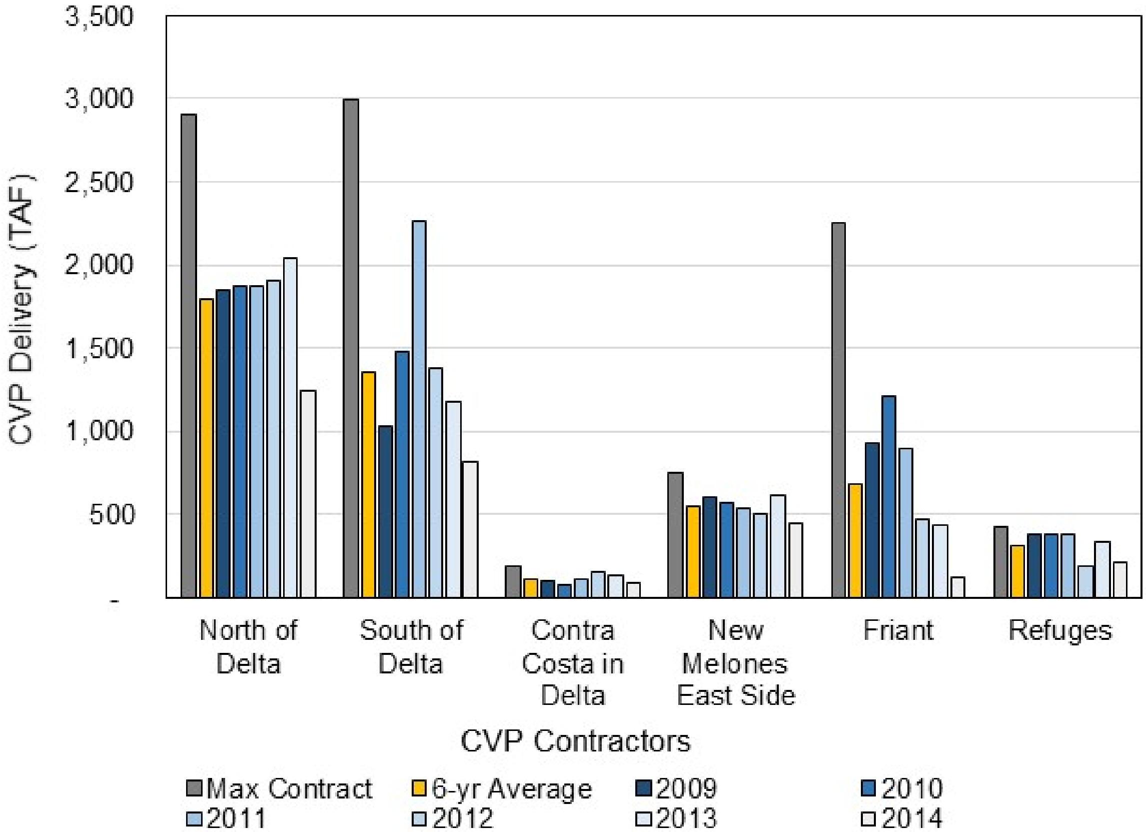
Table 4-9 provides the percent change from the long-term 10-year average Table A Deliveries from 2007 to 2016. The long-term average is 1,778 TAF. Of the 10 years, only 4 years have delivered Table A supply above the 10-year long-term average.

Table 4-9. Percent Change of Annual State Water Project Table A Deliveries from Long-term 10-year Average Table A Deliveries (2007 to 2016)

Year	Table A Delivery (TAF)	Percent Change from Long-term 10-year Average Table A Deliveries (1,778 TAF)
2007	2,332	31.2%
2008	1,246	-29.9%
2009	1,308	-26.4%
2010	1,774	-0.2%
2011	2,633	48.1%
2012	2,227	25.3%
2013	1,238	-30.4%
2014	92	-94.8%
2015	725	-59.2%
2016	1,976	11.1%

Source: 2017 State Water Project Draft Delivery Capability Report. California Department of Water Resources.
Key:
TAF = thousand acre-feet

Similar to the SWP Delivery Capability Report, the CVP provides historical contract water delivery information by water year. CVP water contractors include those North-of-Delta, South-of-Delta, Contra Costa Water District in the Delta, New Melones East Side, Friant, and Refuges. Figure 4-22 and Table 4-10 below provide the actual water deliveries for water years 2009-2014, as well as the maximum contract and long-term 6-year average of actual deliveries from 2009-2014 for each grouping. In general, water year 2014 deliveries were well below the 6-year average of CVP deliveries for all water contractors. A similar trend was detected in SWP delivery data (presented above). This trend is evidence that CVP and SWP reliability are dependent on hydrologic conditions.



Source: 2015 Central Valley Contract Water Delivery Information. U.S. Department of the Interior, Bureau of Reclamation.
Notes:
Deliveries to Friant and South of Delta agricultural contractors in 2014 was rescheduled water from 2013.
Delivery data to refuges are direct deliveries from Reclamation. Refuge deliveries accomplished through transfers or substitutions are included in delivery amounts of contractor that made the transfer.

Figure 4-22. Historical Central Valley Project Deliveries, 2009 – 2014

Table 4-10. Percent Change from Annual CVP Contract Deliveries to the Long-term 6-year Average CVP Contract Deliveries from 2009 to 2014.

Percent Change from Long Term 6-year Average of Actual Deliveries						
Year	**North of Delta**	**South of Delta**	**Contra Costa Water District in Delta**	**New Melones East Side**	**Friant**	**Refuges**
Max Contract (TAF)	2,898	2,989	195	755	2,249	422
6-yr Average (TAF)	1,799	1,359	113	546	678	312
2009	3%	-24%	-11%	10%	37%	23%
2010	4%	9%	-35%	5%	79%	21%
2011	4%	67%	-2%	-2%	33%	22%
2012	6%	1%	42%	-9%	-31%	-39%
2013	13%	-13%	22%	13%	-36%	7%
2014	-31%	-40%	-17%	-17%	-82%	-34%

Source: 2015 Central Valley Contract Water Delivery Information. U.S. Department of the Interior, Bureau of Reclamation.

Notes:

Deliveries to Friant and South of Delta agricultural contractors in 2014 was rescheduled water from 2013.

Delivery data to refuges are direct deliveries from Reclamation. Refuge deliveries accomplished through transfers or substitutions are included in delivery amounts of contractor that made the transfer.

Key:

TAF = thousand acre-feet

4.74 Recommendations

This indicator is Basic (future) level, so the guidelines and framework will continue to develop based on the existence of more reliable data or methodologies to evaluate the delivery reliability of the SWP, CVP, and the Colorado River Aqueduct.

In the future, an assessment similar to what was performed for the SWP and CVP should be included for the Colorado River Aqueduct. Assessing the long-term average delivery of each system is an appropriate way to represent a reliability trend, as annual maximum contract amounts are rarely met. The owners and operators of the Colorado River Aqueduct should have historical documentation of deliveries and contract amounts, but it would be helpful for that information to be stored in a centralized database or published in an annual report similar to the SWP Delivery Capability Report and the CVP Contract Water Delivery Information.

4.75 References

California Department of Water Resources. 2017. The State Water Project Draft Delivery Capability Report 2017. Viewed online at: https://msb.water.ca.gov/documents/86800/e00836f7-68f5-4f00-aeb8-450dc475436b

California Department of Water Resources. California State Water Project Overview. Viewed online at: http://wdl.water.ca.gov/swp/

California Department of Food and Agriculture. California Department of Food and Agriculture. Viewed online at: https://www.cdfa.ca.gov/. Last accessed: February 2, 2018.

U.S. Department of the Interior, Bureau of Reclamation. November 2015. “CVP Contract Water Delivery Information.” Viewed online at: https://www.usbr.gov/mp/cvp-water/docs/cvp-water-deliveries.pdf. Last Accessed: May 10, 2018.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 2: Comparison of Actual Water Use to Proposed Statewide Water Use Targets

This indicator assesses progress toward achieving statewide water use targets by providing a comparison of actual water use to statewide water use targets. AB 1668 and SB 606 have been enacted by the Legislature to codify the policies and authorities for making water conservation a California way of life. These bills amended the California Water Code, requiring state agencies to develop statewide water use targets, standards, and guidelines, and water agencies to then report on progress towards meeting those requirements.

Scale:	Statewide
Data Sources:	SB 606 and AB 1668 (draft language); UWMPs and AWMPs (future data sources)
Data Availability:	Type I
Metric:	Proportion of actual water use to water use targets
Screening Status:	**Basic (Future)**

4.76 Importance and Screening Considerations

As evidenced by recent drought conditions, the need to pursue water use efficiency is important to ensure future water supply reliability statewide and an economical water market. Achieving statewide water use targets will help ensure efficient water use. This indicator could provide evidence of the impact that a statewide focus on water use efficiency has on the overall state water balance.

This indicator is considered a Basic (Future) level indicator. This indicator would be included in future Water Plan updates because the two bills are yet to be enacted, the standards and guidelines are not developed, and data are not available for evaluation. Even when statewide water use goals or targets change, assessing where the state may be over or under water use targets could be useful to decision makers. The data may need to be accessed through multiple entities and resources, which may make data collection standardization difficult.

Representative of Outcome:	Medium-High
Data Viability:	Medium
Cost:	Low-Medium
Potential Longevity:	Medium-High
Supportive of Decision Making:	High

4.77 Initial Data and Results

No initial data are presented because legislation is currently being drafted that would provide guidance to evaluate this indicator. The enactment of this legislation is eminent, which is why this indicator is considered Basic (Future) rather than Advanced. A description of the potential methodology to evaluate this indicator and legislation pertaining to water use targets is presented below.

4.78 Recommendations

Water Conservation Bill of 2009 SB X7-7 requires the state to achieve a 20 percent reduction in urban per capita water use in California by December 31, 2020. Each urban retail water supplier is required to develop urban water use targets and an interim water use target. The Urban Water Management Planning Act requires every public and private urban water supplier that directly or indirectly provides water for municipal purposes to prepare and adopt an urban water management plan to be updated every 5 years.

For assessing water use targets, the Urban Water Management Planning Act could help provide data and establish framework to evaluate this indicator. UWMPs are prepared by every urban water supplier that either provides over 3,000 acre-feet of water annually, or serves more than 3,000 urban connections. For an UWMP, the water supplier assesses the reliability of its water sources over a 20-year planning horizon and reports progress toward the 20 percent reduction in per-capita urban water consumption by the year 2020 under existing law. AB 1668, when enacted, would require the State Water Board, in coordination with DWR, to adopt long-term standards for the efficient use of water and would establish specified standards for per capita daily indoor residential water use.

Each UWMP is required to include total water demands. However, there is no mandated method for measuring/estimating water use meaning that data may need to be post-processed to allow for comparison of water use amongst UWMPs. The statewide water use target from AB 1668 for per capita water use could be used to compare the actual water use (demand) per capita. The per capita use targets may be different in each hydrologic region due to factors such as climate, land use pattern, population, and socioeconomic distribution.

It would be helpful to visualize the progress towards meeting state water use targets on a map organized by county. However, similar to *PHS 8,* there is no consistency in the service area boundaries for UWMPs. Private and public water agencies develop UWMPs. Some of the UWMPs are for cities while others are for counties and some are even for private water agencies. To display this information on a geo-referenced map in the future, it is recommended that DWR require geospatial map layers of each urban water supplier boundary as part of the next round of UWMP updates. (The *2015 UWMP Guidebook for Urban Water Suppliers* states that DWR's preference is to obtain electronic service area boundary maps.) The following metadata should be included: map projection, contact information for the map's creator, start and end dates for which the map is valid, constraints, attribute table definitions, and a digitizing base. Requiring the geospatial map layer would eliminate the need to manually define the boundary of each UWMP to create a map that would geographically show an area's progress towards meeting statewide water use targets. If no geospatial map layers for UWMP boundaries can be obtained, then analyzing this indicator by hydrologic region, as was done in *PHS 8,* would be sufficient.

SB 606 and AB 1668 establish both the foundation and needed authorities for long-term improvements in water conservation and drought planning to adapt to climate change and the resulting longer and more intense droughts in California. These bills amended the California Water Code, requiring state agencies to develop statewide water use targets, standards, and guidelines, and water agencies to then report on progress towards meeting those requirements. During the implementation process, DWR and other State agencies will further develop data, information, guidelines, and other technical assistance to help realize the bills' intended outcomes. Both bills include requirements for public access to data and their use, as well as related studies, reports, and investigations. These data, studies, reports, and investigations may be of use to continued development of this indicator.

4.79 References

California Department of Water Resources. 2016. Guidebook for Urban Water Suppliers- 2015 Urban Water Management Plans. Viewed online at: http://www.water.ca.gov/urbanwatermanagement/docs/2015/UWMP_Guidebook_Mar_2016_FINAL.pdf

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 3: Distribution System Leaks and Losses

This indicator assesses water supply distribution system leaks and losses. This indicator attempts to identify the volume of economically recoverable real losses within water supply distribution systems. The target outcome for this indicator will be established following development of performance standards by the State Water Resources Control Board for the volume of water losses for urban retail water suppliers.

Scale:	Regional
Data Sources:	UWMPs; AWWA M36; DWR Water Loss Audit Reporting Website, DWR Water Audit Manual; SWRCB Water Loss Control
Data Availability:	Type II
Metric:	Volume of water lost in distribution systems
Screening Status:	**Watershed**

4.80 Importance and Screening Considerations

Water loss control is one of several conservation strategies in California. Beyond reactive maintenance for gross leaks and breaks, water loss control should involve evaluating and, when economically justified, improving infrastructure and operations. This can include leak detection and repair, pressure management, meter testing and calibration, and pipeline and service connection replacement or rehabilitation. This type of water loss control allows water systems to improve water efficiency, potentially delaying the need to develop additional water resources.

Through screening, this indicator was identified as a Watershed level indicator. Current programs often focus on urban systems, although this indicator could be expanded to consider rural systems if current water loss programs in the state are expanded in the future to include these systems. The DWR Water Use Efficiency guidelines and data on water loss audits provide viable data to represent this indicator. In addition, the implementation of Senate Bill 555 (Statutes 2015) will result in water loss performance standards by the State Water Resources Control Board. Its implementation by DWR has resulted in additional public water loss data and standardized methodologies that can be incorporated into this indicator.

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.81 Initial Data and Results

Initial data on water loss volumes were derived from 2015 UWMPs. As shown in Table 4-11, regions with the highest water losses represent urbanized areas of the state. The South Coast (Los Angeles), San Francisco Bay (Bay Area), and Sacramento River (Sacramento area) hydrologic regions have the highest quantity of reported water losses.

Table 4-11 also notes the losses that have undergone review by DWR, as part of the broader UWMP documentation. However, future updates should consider use of datasets that have been entirely validated, potentially through the DWR validated water loss audits.

Table 4-11. Water Losses Reported by Hydrologic Region for Urban Water Supplies over 12 Months

Hydrologic Regions	No	Under Review	Yes	Total AF
South Coast	10,710	42,142	124,924	177,776
San Francisco Bay	7,553	9,349	59,836	76,738
Sacramento River		13,979	31,230	45,209
Tulare Lake		1,865	30,089	31,954
San Joaquin River	143	8,101	13,867	22,112
Colorado River	1,031	2,391	16,347	19,769
South Lahontan	4,862	2,035	4,633	11,530
Central Coast		1,660	9,789	11,450
North Coast		2,793	2,774	5,567
North Lahontan	687	276	1,634	2,598

Source: Water Use Efficiency Data Public Portal. January 10, 2018.
Key:
AF = acre-feet

4.82 Recommendations

This indicator is most applicable to urban regions. A geographic representation of the spread of data may be possible if system locations are included as part of standard data collection. In addition, data should be analyzed against performance standards established by the State Water Resources Control Board rather than by total volume.

Future development of this indicator should use data from DWR's water loss audit program. The current water audit program, using the American Water Works Association methodology, provides an accounting procedure using agency data to determine water loss that estimates both apparent and real water system losses. The program requires the agency to determine an audit period and gather data for that period. The AWWA M36 Manual, Water Audits and Water Loss Control Programs, version 4, defines the types of data necessary and contains worksheets to guide an audit. These resources help ensure standardized data collection. Leak detection programs are typically established following a data-strong validated water loss audit and a benefit-cost analysis to verify economic feasibility.

Performance indicators in the audit will estimate volumes of lost water (and/or their monetary value) to help guide where further actions would be economically feasible.

4.83 References

American Water Works Association. 2016. Manual of Water Supply Practices -- M36 Water Audits and Loss Control Programs, 4th Edition. Denver: American Water Works Association.

California Department of Water Resources. "Submitted 2015 Urban Water Management Plans (UWMP) Data Exports." Water Use Efficiency Data Public Portal. Viewed online at: https://wuedata.water.ca.gov/default.asp. Last accessed: January 10, 2018.

California Department of Water Resources. 2016. Water Audit Manual. Prepared by: Water Systems Optimization. Viewed online at:

http://www.water.ca.gov/urbanwatermanagement/docs/2015/DWR%20Water%20Audit%20Manual%20FINAL.pdf

State Water Resources Control Board. "Water Loss Control." Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/water_loss_control.html. Last accessed: February 8, 2019.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 4: Groundwater Basins with Stable or Recovering Groundwater Levels

This indicator assesses the overall health of groundwater basins throughout the state through assessment of groundwater levels. The California Statewide Groundwater Elevation Monitoring (CASGEM) Program tracks seasonal and long-term groundwater elevation trends in groundwater basins statewide. This information is reported through the DWR Groundwater Information Center.

The target outcome or trend for this indicator is to show stable or recovering groundwater levels in groundwater basins throughout the state, indicating continued reliability of groundwater supplies.

Scale:	Statewide
Data Sources:	DWR Groundwater Information Center
Data Availability:	Type I
Metric:	Groundwater levels
Screening Status:	**Basic**

4.84 Importance and Screening Considerations

Groundwater levels directly impact the availability of water to those that use it. As groundwater levels drop, pumping costs rise. Driven by recent and extended droughts, groundwater levels have declined at rapid rates. Rapid declines can lead to subsidence, resulting in costly damage to water supply, transportation, and flood infrastructure. Despite efforts initiated through SGMA to reverse historical trends, significant investment and time will be necessary to achieve more sustainable management of groundwater in California.

This indicator is considered Basic level. Data on groundwater levels are readily available through CASGEM in most groundwater basins and additional data may soon be available through SGMA. This indicator represents the intended outcome and is a good assessment of trends associated with groundwater basin health over time.

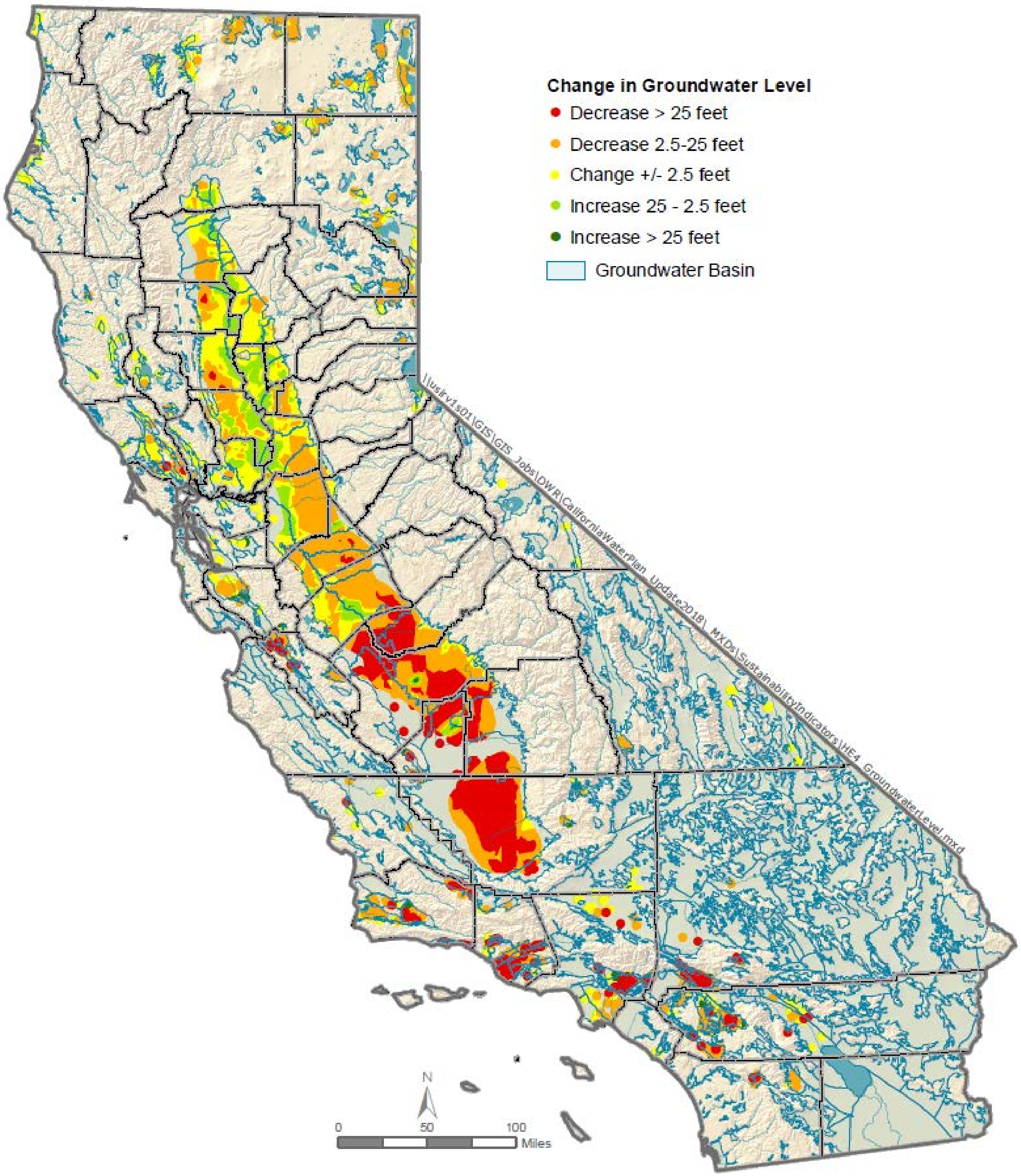
Representative of Outcome:	High
Data Viability:	Medium-High
Cost:	Medium-High
Potential Longevity:	High
Supportive of Decision Making:	High

4.85 Initial Data and Results

Initial data for this indicator were downloaded from DWR’s Groundwater Information Center. This information is collected from CASGEM and other DWR programs for groundwater basins throughout the state. The changes in groundwater level throughout the state can be shown both through levels at individual points and through contours that provide a smoothed approximation of groundwater levels.

Figure 4-23 shows the change in groundwater levels throughout the state from spring 2012 to spring 2017. A period of five years was considered to include the cumulative impacts of both dry and wet years.

Groundwater levels have decreased significantly in most basins in the southern half of the state, while areas in the northern half of the state have seen some recovery in groundwater levels since 2012. As can be seen in the map, groundwater elevation data are lacking for many basins in the southeast portion of the state. However, the majority of these basins are not considered high or medium priority basins by DWR. The criteria to determine priority designation considers population, number of wells, irrigated acreage, and documented impacts on groundwater within the basin.



Source: "Groundwater Information Center." California Department of Water Resources. December 21, 2017.
Figure 4-23. Change in Groundwater Levels from Spring 2012 to Spring 2017

4.86 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework will continue to develop. Declining groundwater levels can cause additional pumping expenses, loss of reliable water supplies, and potential subsidence. Additional data should be gathered to augment existing data for basins outside of the Central Valley to allow more detailed contours to be developed for these areas. SGMA may provide the necessary tools to gather some of these data in high and medium priority basins where there is currently no available information.

4.87 References

California Department of Water Resources. “Groundwater Information System.” CASGEM Public Portal. Viewed online at: http://water.ca.gov/groundwater/gwinfo/. Last accessed: December 21, 2017.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 5: Groundwater Extraction Rates and Subsidence Rates

This indicator assesses the groundwater extraction rates and subsidence rates in each groundwater basin statewide. This indicator is related to *HE 4: Groundwater Basins with Stable or Recovering Groundwater Levels*. As groundwater levels decrease, aquifers can compact, causing land subsidence. Groundwater levels decrease when the rate of groundwater extraction is higher than the rate of groundwater recharge.

DWR has a long-standing history of collecting and analyzing groundwater data and investigating and reporting groundwater conditions. DWR is responsible for implementing SGMA and CASGEM, and for characterizing California's groundwater basins through Bulletin 118 updates. Future data for this indicator may be developed through SGMA implementation. Potential additional data sources include the State Water Board and National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL) groundwater data.

The target outcome for this indicator are sustainable groundwater extraction rates that do not lead to further land subsidence or other undesirable results as defined through SGMA.

Scale:	Regional
Data Sources:	SGMA, State Water Board, NASA JPL
Data Availability:	Type III
Metric:	Groundwater extraction rates and land subsidence rates
Screening Status:	**Basic (Future)**

4.88 Importance and Screening Considerations

Groundwater resources play a vital role in maintaining California's economic and environmental sustainability. During dry years, groundwater contributes up to 46 percent of the water supply statewide and serves as a critical buffer against the impacts of drought and climate change. Some communities in the state rely solely on groundwater to meet water supply needs. Groundwater extraction in excess of natural and managed recharge has caused historically-low groundwater elevations and led to alarming subsidence rates in many regions of California.

During the screening process, this indicator was considered a Watershed level indicator. The screening status has been changed to Basic (Future), based on current data availability. Data may only be available following further development of Groundwater Sustainability Plans and other SGMA implementation activities. However, this indicator is easy to measure, simple to understand, and clear on actions that need to be taken. Once data are developed, this indicator may prove to be more relevant in certain watersheds or regions and require a more in-depth analysis for these specific regions.

Representative of Outcome:	Medium-High
Data Viability:	Low-Medium
Cost:	Medium
Potential Longevity:	Medium-High
Supportive of Decision Making:	High

4.89 Initial Data and Results

No initial data are presented. Data must be further developed, through SGMA, for a methodology to be developed.

4.90 Recommendations

This indicator is Basic (Future) level, as large data gaps prevent the development of guidelines and methodology. Declining groundwater levels due to over pumping affect water supply reliability and may also threaten existing infrastructure due to subsidence. Little monitoring of groundwater extraction rates occurs under current regulations.

This indicator may need to be redefined or recombined with other indicators to provide useful information to decision makers. Subsidence rates may be more directly tied to groundwater levels. Areas of subsidence could be shown as part of *HE 4, Groundwater Basins with Stable or Recovering Groundwater Levels*. This indicator would cover only groundwater extraction rates and/or include information on recharge rates.

4.91 References

National Aeronautics and Space Administration. California Institute of Technology, Jet Propulsion Laboratory. Viewed online at: https://www.jpl.nasa.gov/. Last accessed: December 21, 2017.

California Department of Water Resources. SGMA Public Portal. Viewed online at: http://www.water.ca.gov/groundwater/sgm/. Last accessed: December 12, 2017.

California Department of Water Resources. “Groundwater Information Center.” CASGEM Public Portal. Viewed online at: http://water.ca.gov/groundwater/gwinfo/. Last accessed: December 21, 2017.

Legislative Analyst’s Office. 2017. Overview of the Sustainable Groundwater Management Act. Viewed online at: http://www.lao.ca.gov/handouts/resources/2017/Overview-Sustainable-Groundwater-Management-Act-031617.pdf

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 6: Change in Groundwater Storage

This indicator assesses the change in available groundwater storage. Through analysis of subsidence, recharge rates, and extraction rates, the change in groundwater storage can be estimated throughout the state. However, data are lacking pending further collection under SGMA requirements. Additional potential data sources include CASGEM, the State Water Board, and NASA's JPL groundwater data.

The target outcome for this indicator would show no change or an increase in groundwater storage available.

Scale:	Regional
Data Sources:	DWR SGMA; NASA JPL; CASGEM; State Water Board
Data Availability:	Type III
Metric:	Groundwater storage (acre-feet)
Screening Status:	**Basic**

4.92 Importance and Screening Considerations

Over pumping groundwater not only leads to an immediate depleted supply of groundwater, but can also effect aquifer's abilities to store water in the future. Decades of over pumping groundwater have irreversibly altered layers of clay beneath California's Central Valley, which has permanently reduced aquifer storage capacity.

This indicator was considered Basic level during the screening process. The screening status has been changed to Basic (Future), based on a lack of available data. Data may be developed through SGMA in individual basins' Groundwater Sustainability Plans. Decrease in groundwater storage impacts groundwater supply reliability, relating directly to the intended outcome.

Representative of Outcome:	Medium-High
Data Viability:	Medium-High
Cost:	Medium-High
Potential Longevity:	High
Supportive of Decision Making:	High

4.93 Initial Data and Results

No initial data are presented as changes in groundwater storage are not currently tracked at a state level. A potential description of methodology is presented below.

4.94 Recommendations

This indicator is considered a Basic (Future) level indicator. Additional data are required to develop a methodology for this indicator. Potentially, this indicator would attempt to highlight basins impacted by decreased groundwater storage. Combining this indicator with, or considering this indicator in conjunction with, *HE 4, Groundwater Basins with Stable or Recovering Groundwater Levels,* or *HE 5,* *Groundwater Extraction and Subsidence Rates* may provide a more detailed picture of the health of groundwater basins throughout California.

This indicator should be further developed following the development of Groundwater Sustainability Plans under SGMA requirements, which may provide the necessary data.

4.95 References

National Aeronautics and Space Administration. California Institute of Technology, Jet Propulsion Laboratory. Viewed online at: https://www.jpl.nasa.gov/. Last accessed: December 21, 2017.

California Department of Water Resources. SGMA Public Portal. Viewed online at: http://www.water.ca.gov/groundwater/sgm/. Last accessed: December 12, 2017.

California Department of Water Resources. “Groundwater Information Center.” CASGEM Public Portal. Viewed online at: http://water.ca.gov/groundwater/gwinfo/. Last accessed: December 21, 2017.

Legislative Analyst’s Office. 2017. Overview of the Sustainable Groundwater Management Act. Viewed online at: http://www.lao.ca.gov/handouts/resources/2017/Overview-Sustainable-Groundwater-Management-Act-031617.pdf

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 7: Percentage of Groundwater Basin Areas in Compliance with SGMA

This indicator assesses the groundwater basins in compliance with SGMA requirements, including actions required by Groundwater Sustainability Agencies (GSA) and the requirements for Groundwater Management Plans (GMP)/Groundwater Sustainability Plans (GSP).

SGMA requires groundwater-dependent regions to halt overdraft and bring basins into balanced levels of pumping and recharge. SGMA helps define sustainable groundwater management. Basins were sorted into four priority categories – high, medium, low, and very low. Compliance with SGMA is mandatory for high and medium basins, although low and very low priority basins may elect to participate. Through a multi-phase process, local agencies must form GSAs. These GSAs must then adopt and implement GSPs that fulfill basic requirements. DWR has launched the Sustainable Groundwater Management Program to implement the law and provide ongoing support to local agencies around the state.

The target outcome for this indicator is for all groundwater basins, in their entirety, to be in compliance with their respective requirements under SGMA. Basins without requirements are not included.

Scale:	Statewide
Data Sources:	DWR SGMA Portal
Data Availability:	Type III
Metric:	Areas in compliance with SGMA
Screening Status:	**Basic**

4.96 Importance and Screening Considerations

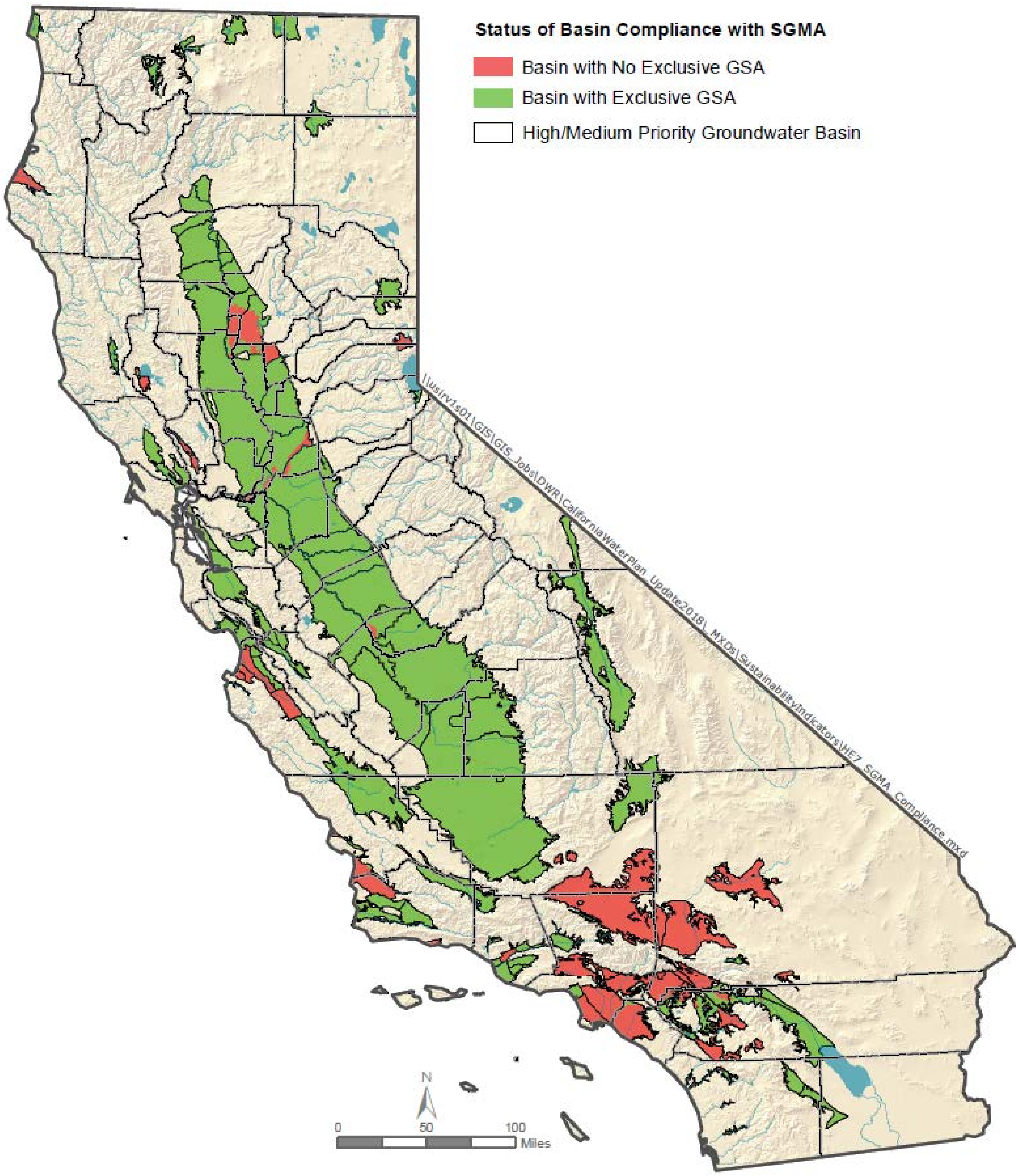
Groundwater is the primary, and in some cases sole, source of water for many communities in California. SGMA is evidence that California recognizes groundwater is a vital resource for the state that must be managed sustainably. SGMA implementation will help direct efforts to monitor and regulate groundwater use in the state. Some regions have developed GMPs under other sections of California legislation and in advance of SGMA requirements. However, GSAs have formed throughout the state in high and medium priority basins and are developing GSPs, as currently required by SGMA.

This indicator is considered a Basic level indicator. This indicator is easy to measure, simple to understand, and clear on actions to be taken statewide.

Representative of Outcome:	Medium-High
Data Viability:	High
Cost:	Low
Potential Longevity:	High
Supportive of Decision Making:	Medium

4.97 Initial Data and Results

Current requirements under SGMA state that by June 30, 2017, local agencies must establish GSAs in all high and medium priority basins. These GSAs must be exclusive; exclusive GSAs do not have overlapping boundaries. Although GMPs exist for many of these basins, no GSPs are required under SGMA in any basin until January 31, 2020. GSAs have been formed across the state in most high and medium groundwater basins as well as in basins with lower priority. Small areas remain unmanaged. The high and medium priority basins in compliance are shown in Figure 4-24.



Source: "GSA Map" SGMA Public Portal. California Department of Water Resources. December 12, 2017.

Figure 4-24. Current Progress of Exclusive Groundwater Sustainability Agency Formation in High and Medium Priority Basins

Table 4-12 lists the basins with a substantial portion of the high or medium priority groundwater basin being unmanaged, as shown in the figure above in red. Substantial is considered here as over 10 percent of a groundwater basin's total area.

Table 4-12. Unmanaged Areas of Groundwater Basins

Groundwater Basin	Unmanaged Area of Basin (%)	Location of Basin
8-2.04	100%	Upper Santa Ana Valley
4-11.04	100%	Coastal Plain Of Los Angeles
5-21.60	100%	Sacramento Valley
8-2.06	100%	Upper Santa Ana Valley
1-10	100%	Eel River Valley
2-2.01	100%	Napa-Sonoma Valley
3-16	100%	Goleta
3-4.04	100%	Salinas Valley
3-4.08	100%	Salinas Valley
4-23	100%	Raymond
5-15	100%	Big Valley
5-27	100%	Cummings Valley
5-28	100%	Tehachapi Valley West
6-40	100%	Lower Mojave River Valley
6-42	100%	Upper Mojave River Valley
6-43	100%	El Mirage Valley
6-67	100%	Martis Valley
7-12	100%	Warren Valley
8-2.02	100%	Upper Santa Ana Valley
9-4	100%	Santa Margarita Valley
4-11.03	100%	Coastal Plain Of Los Angeles
9-5	100%	Temecula Valley
3-4.01	100%	Salinas Valley
4-12	99%	San Fernando Valley
6-44	97%	Antelope Valley
4-13	97%	San Gabriel Valley
8-1	96%	Coastal Plain Of Orange County
8-2.01	95%	Upper Santa Ana Valley
3-4.10	94%	Salinas Valley
3-12	88%	Santa Maria
4-4.04	87%	Santa Clara River Valley
5-14	69%	Scotts Valley
8-2.03	69%	Upper Santa Ana Valley
3-8	66%	Los Osos Valley
5-21.58	55%	Sacramento Valley
5-21.59	52%	Sacramento Valley
8-5	49%	San Jacinto
8-2.08	25%	Upper Santa Ana Valley
5-21.65	17%	Sacramento Valley

Regions with no exclusive GSA may be working towards defining boundaries to remove overlaps of multiple GSAs. However, basins not managed by one or more GSAs that cover the entire basin, as of June 20, 2017, face additional requirements for monitoring extraction rates. The first GSPs will be required for basins in critical overdraft starting January 31, 2020.

4.98 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework will continue to develop. Monitoring the progress of agencies through the SGMA framework allows decision makers to see how local groundwater management is occurring.

Future methodology would involve gathering data from DWR’s SGMA Portal for information on each GSA and it plan’s compliance, and then correlating this information with the basin area covered by the GSA. SGMA establishes the requirements to be used to check whether plans are in compliance.

4.99 References

California Department of Water Resources. “GSA Map.” SGMA Public Portal. Viewed online at: http://water.ca.gov/groundwater/sgm/gsa_map.cfm. Last accessed: December 12, 2017.

Legislative Analyst’s Office. 2017. Overview of the Sustainable Groundwater Management Act. Viewed online at: http://www.lao.ca.gov/handouts/resources/2017/Overview-Sustainable-Groundwater-Management-Act-031617.pdf

State Water Resources Control Board. “Unmanaged Area Identification.” State Water Board SGMA. Viewed online at: https://waterboards.maps.arcgis.com/apps/MapJournal/index.html?appid=3ca8bf4bbd6e40aaa561b7ed06821f72. Last accessed: December 12, 2017.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 8: Contaminated Groundwater Wells

This indicator assesses the number of groundwater wells throughout the state that are contaminated. Groundwater is the primary, and in some cases sole, source of water for many communities in California.

A groundwater well's depth from the surface, quality for drinking water, and chance of being polluted vary from place to place. Groundwater may contain some natural contaminants or dissolved elements such as arsenic or radon. Human activities, such as improper use of fertilizers or chemical spills, can also contaminant groundwater. Both natural contamination and human related activities can lead to unacceptable drinking water quality and an increase in the cost of treatment required.

This indicator is similar to an archived indicator, *PHS: Number of People and Percent of Population Relying on Contaminated Groundwater for Domestic Water Supply*, which was archived due to the overlap of the two indicators.

The target outcome for this indicator is that all groundwater wells meet drinking water quality standards.

Scale:	Regional
Data Sources:	State Water Board; GAMA; DWR CASGEM
Data Availability:	Type II
Metric:	Percent of wells out of compliance
Screening Status:	**Basic**

4.100 Importance and Screening Considerations

On average, about 30 percent of Californian's drinking water comes from groundwater. In years of drought when surface water is scarce, there is a greater dependence on groundwater. Nearly 21 million people live in communities that rely on contaminated groundwater as part of their supply. Of those communities, 75 percent do not have a surface water supply and must rely solely on contaminated groundwater. For almost 5 percent of the state's population, a private groundwater well is the sole source of drinking water. Groundwater can be contaminated by natural causes or human activities, such as agricultural or industrial processes. Contamination of groundwater threatens not both public health and economic health. An increase in required groundwater treatment, rehabilitation of a contaminated well, or development of a new well all come at a cost and can increase the cost of water to end users.

This indicator is considered a Basic level indicator. Available data cover only a portion of potentially contaminated groundwater wells, as information on private wells is incomplete. Private domestic well owners are encouraged to test well water quality regularly, but this is not required or recorded by the State. As such, there are significant data gaps in information on the water quality of private wells. Gathering additional data would come at a relatively high cost, as sampling and analyses to determine if any one well meets all drinking water quality standards may take significant effort. Another obstacle for this indicator is the potential variation over time of groundwater quality, potentially necessitating frequent sampling. However, where data are available, it is easy to determine if a well exceeds contaminant limits.

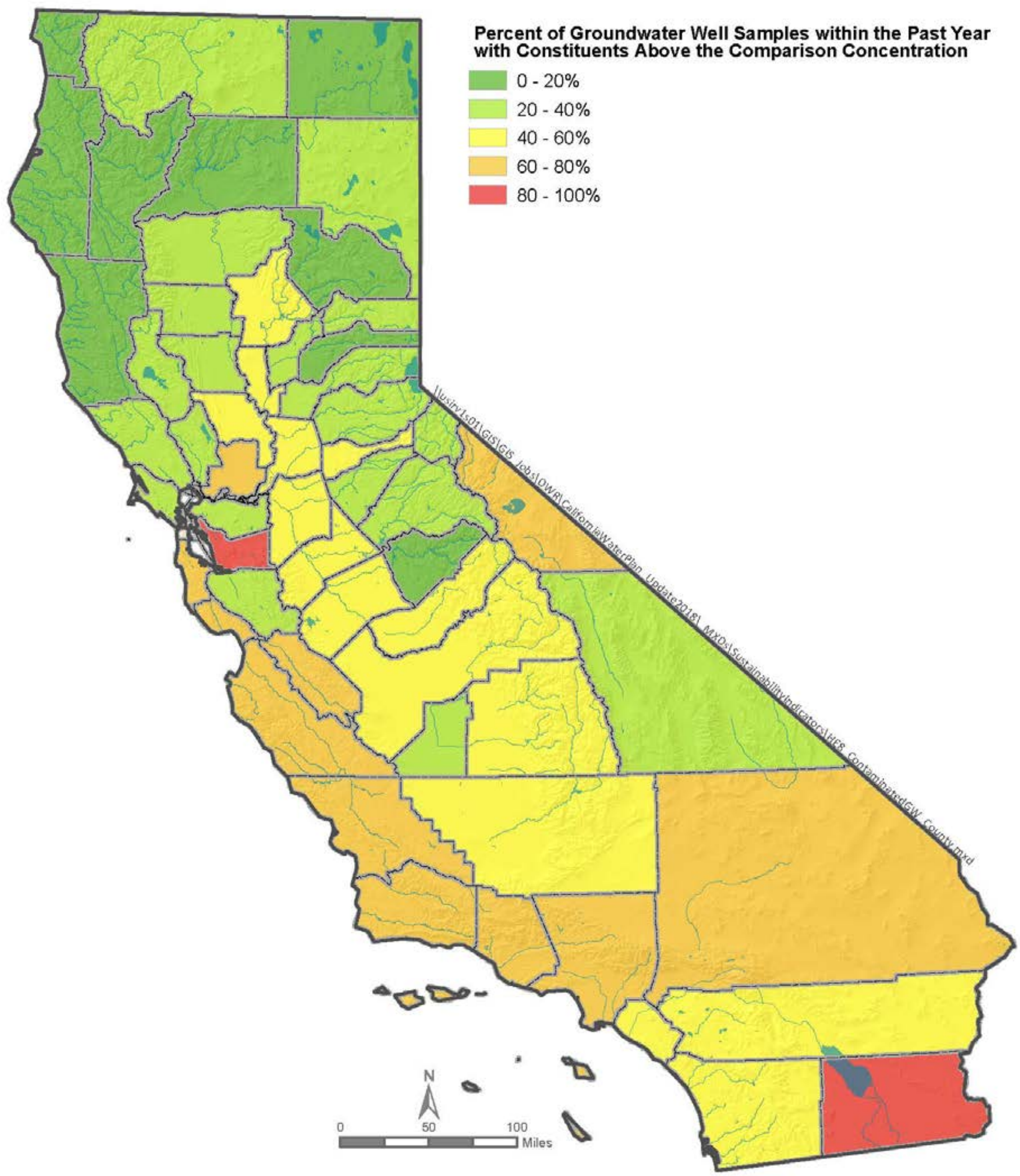
This indicator is measured as a percentage instead of a total count so that an increase in sampling does not necessarily correlate with diminished results.

Representative of Outcome:	Medium-High
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

4.101 Initial Data and Results

The State Water Board is required to monitor public water systems that rely on contaminated groundwater sources and report this information to the Legislature. The State Water Board created the GAMA Program to monitor and assess groundwater quality across the state. The GeoTracker GAMA tool combines groundwater information from multiple datasets and visually displays the data on a map. For this analysis, all samples taken in the previous year across all datasets available in this tool were analyzed. Samples that found constituents above the GeoTracker GAMA's comparison concentrations were compared to the total number of samples taken. The percentages were then summarized by county. Figure 4-25 shows the results of this analysis. San Francisco County did not have any recorded samples from the previous year in the GeoTracker GAMA database at the time of analysis. It is important to reiterate that there are data missing in every county due to the small number of private wells that have been sampled.

The data collected for this indicator only represent communities that are more reliant on groundwater than surface water. In addition, the data only cover a portion of the population's exposure to contaminated groundwater because information from private wells is expensive to collect. Private well data are not regulated at the State level, but private domestic well owners are encouraged to test well water quality regularly.



Source: GeoTracker GAMA. State Water Resources Control Board. February 8, 2018.

Figure 4-25. Wells Where Contaminated Groundwater Has Been Detected (Feb 2017–Jan 2018)

4.102 Recommendations

This indicator is considered a Basic level indicator. More data are needed to strengthen the accuracy of this indicator. California does not require sampling of private wells after installation, so individual owners may or may not conduct water quality testing. GAMA's Domestic Well Project helps bridge the gap in information between public and private wells, but there is considerable progress still to be made.

GAMA's goals include improving comprehensive groundwater water quality monitoring, and making this data publicly available. As these goals are recognized, comprehensive comparison of well water quality to drinking water standards could be made and the number of groundwater wells not meeting those standards could be better quantified. By expanding this program to a comprehensive statewide reach, a holistic picture of domestic groundwater well quality could be assessed.

Another potential source to increase the viability of this indicator is SGMA. As SGMA implementation continues to play an increased role in groundwater management, more data on groundwater quality should be available. It is important to note that not all groundwater wells are used for drinking water, so not all wells need to or should be required to meet the stringent drinking water requirements and doing so could be economically detrimental. Water quality should be matched to the beneficial use of the water.

This indicator differs from the archived indicator *PHS: Number of People and Percent of Population Relying on Contaminated Groundwater for Domestic Water Supply* in that it assesses many water contaminant limits, not only those for drinking water. Different groundwater uses require different levels of treatment and have varying effects on the local economy.

While the GAMA Domestic Well Project collects data on contaminated groundwater wells, these data have not been developed to the same extent for all counties. Additional funding is needed for this program to continue making progress.

As SGMA continues to play a role in groundwater management, more data on groundwater quality will be available into the future. Data from SGMA may potentially change the preferred methodology for this indicator.

4.103 References

State Water Resources Control Board. 2013. Communities that Rely on a Contaminated Groundwater Source for Drinking Water. Viewed online at: https://www.waterboards.ca.gov/gama/ab2222/docs/ab2222.pdf

State Water Resources Control Board. 2015. Safe Drinking Water Plan for California. Viewed online at: https://www.waterboards.ca.gov/publications_forms/publications/legislative/docs/2015/sdwp.pdf

State Water Resources Control Board. Groundwater Ambient Monitoring and Assessment Program. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/gama/. Last accessed: February 8, 2018.

U.S. Department of the Interior, U.S. Geologic Survey. "Groundwater Ambient Monitoring and Assessment Program." California Water Science Center. Viewed online at: https://ca.water.usgs.gov/projects/gama/. Last accessed: February 8, 2018.

State Water Resources Control Board. GeoTracker GAMA. Viewed online at: http://geotracker.waterboards.ca.gov/gama/. Last accessed: February 8, 2018.

State Water Resources Control Board. 2015. A Guide for Private Domestic Well Owners. Viewed online at: https://www.waterboards.ca.gov/gama/docs/wellowner_guide.pdf

Healthy Economy

Intended Outcome: Consideration of economic risks and rewards on floodplains, rivers, and coastal areas.

HE 9: Socioeconomic Vulnerability to Sea Level Rise Impacts

This indicator assesses the socioeconomic vulnerability of coastal area acreage at risk of sea level rise. Coastal California is experiencing the early impacts of rising sea levels, including more extensive coastal flooding during storms, periodic tidal flooding, and increased coastal erosion. Some coastal areas may be more prepared to respond to sea level rise impacts than others due to differences in socioeconomic variables.

The target outcome for this indicator is that all coastal areas show low socioeconomic vulnerability to sea level rise impacts. Low socioeconomic vulnerability indicates an area has relatively more capacity to prepare for, respond to, and recover from hazards than areas that show high socioeconomic vulnerability.

Scale:	Regional
Data Sources:	National Oceanic and Atmospheric Administration (NOAA); California Ocean Protection Council
Data Availability:	Type I
Metric:	Social Vulnerability Index and acreage of coastal land impacted by sea level rise
Screening Status:	**Basic**

4.104 Importance and Screening Considerations

Global sea-level rise attributed to climate change will have far-reaching consequences for California, which has about 1,100-miles of open coastline, many additional miles of estuarine shorelines, and high concentrations of people and development along the coast. If sea levels continue to rise, hundreds of miles of already developed land and other economic assets are at risk from future flooding, inundation, and coastal retreat.

This indicator is considered a Basic level indicator. It reflects the goal associated with the intended outcome and is representative of economic risks in coastal areas. This indicator may inform future economic decisions associated with land development in coastal regions.

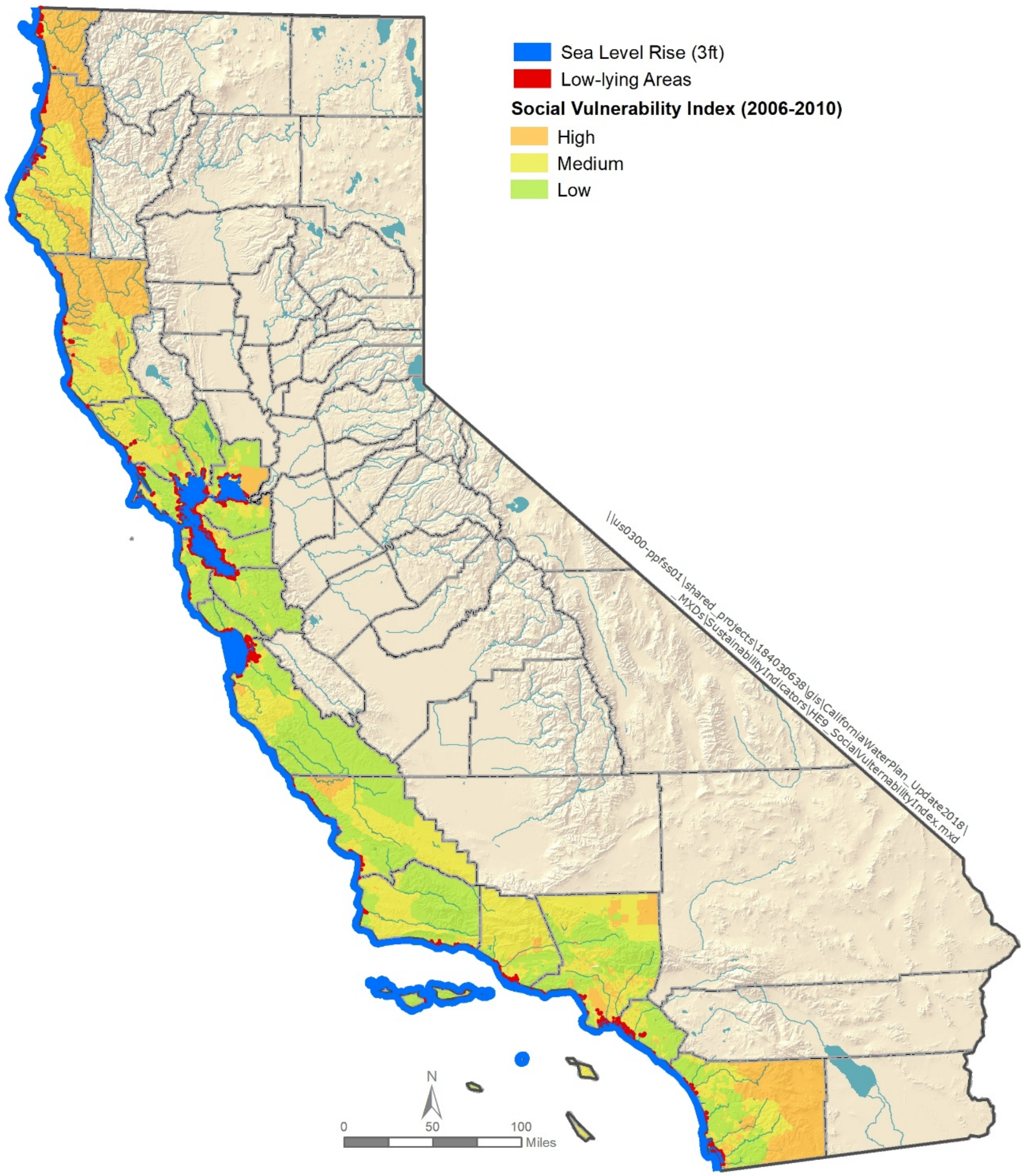
Representative of Outcome:	High
Data Viability:	Medium-High
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	High

4.105 Initial Data and Results

Data mapped from NOAA’s Sea Level Rise Viewer were used to develop Figure 4-26. Sea Level Rise Viewer data are updated as new elevation data are collected by a wide range of agencies. The mapping tool helps visualize community-level impacts from coastal flooding or sea level rise (up to 6 feet above average high tides). For the purposes of this indicator, the 3 feet above average high tides sea level rise scenario was mapped, as well as the hydrologically “unconnected” low lying areas that may also flood from a 3 feet sea level rise scenario.

The maps in the data viewer are derived from source elevation data that meet or exceed FEMA mapping specifications for the National Flood Insurance Program, which consider 0.6 feet root mean square error for low relief terrain and 1.2 feet for high relief terrain. The data also include future flooding impacts on socioeconomic vulnerability, which will assess the potential impact that sea level rise can have on vulnerable people and businesses along the coast of California.

The Hazards and Vulnerability Research Institute at the University of South Carolina’s Social Vulnerability Index shows areas of human vulnerability to hazards and is based on population attributes from Census 2010 and the built environment. The index synthesizes 29 socioeconomic variables, helping illustrate the geographic variation in social vulnerability. Examples of socioeconomic variables used to process the Social Vulnerability Index score include family structure, language barriers, vehicle availability, medical disabilities, healthcare access, wealth, race and social status, elderly residents, and service industry employment. The socioeconomic index score suggests a county’s ability to prepare for, respond to, and recover from hazards. Index scores are relative – high scores in the top 20 percent of the United States denote the most vulnerable areas and low scores in the bottom 20 percent of the United States denote the least vulnerable areas.



Source: Sea Level Rise Viewer. National Oceanic and Atmospheric Administration. February 9, 2018.

Figure 4-26. Coastal Areas at Risk of Sea Level Rise Evaluated with the Social Vulnerability Index of the Coastal Areas

As demonstrated in Figure 4-26, some areas along the coast have a relatively lower capacity for preparedness and response (indicated by a high Social Vulnerability Index score) to most effectively reduce pre-existing vulnerability to environmental hazards, such as flooding from sea level rise. In general, the areas that are most impacted by sea-level rise issues and coastal flooding exhibit low to medium vulnerability to the impacts of environmental hazards, as shown in Table 4-13. This indicates areas most impacted by flooding from sea-level rise are relatively more prepared than other areas exhibiting low capacity for preparedness and response to environmental hazards. Approximately 16.5 percent of the acreage at risk of sea level rise impacts are correlated with areas showing high vulnerability and lower capacity for preparedness and response to impacts.

Table 4-13. Acreage of Coastal Areas Vulnerable to Sea Level Rise Impacts

Social Vulnerability Index	Acreage of Land at Risk of Sea Level Rise (acres)	Percentage of Land at Risk of Sea Level Rise
High (most vulnerable)	52,726	16.5%
Medium	180,812	56.6%
Low (least vulnerable)	85,638	26.8%

Source: Sea Level Rise Viewer. National Oceanic and Atmospheric Administration. February 9, 2018.

4.106 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework will continue to develop. In order to more adequately consider the economic risks associated with sea level rise, information on both land use types and assets at risk are needed to more fully understand a county's potential risk and its ability to prepare or respond to sea level rise impacts.

The California Coastal Commission currently summarizes county level snapshots in the 2016 Statewide Sea Level Rise Vulnerability Synthesis report. *HE 10 Areas Covered by Local Coastal Program Vulnerability Assessments Updated for Sea Level Rise* evaluates some information from the report, including the status of the sea level rise vulnerability assessments. Additional information referenced in the report that could help support this indicator includes coastal zone resources categorized as ports and harbors, whether coastal zone resources are publicly owned/accessible, public access coastal areas, and coastal zone wetlands as well as ocean economy represented as an ocean sector's gross domestic product (GDP). However, the data provided in each county snapshot are not georeferenced. In the future, georeferencing the information already collected in the county snapshots, specifically the coastal zone resources, would benefit the evaluation of this indicator. Representing the county percent GDP of State Ocean Sector GDP on the map already developed for this indicator or on a separate map should also be considered for inclusion.

4.107 References

California Ocean Science Trust. 2017. Rising Seas in California: An Update on Sea-Level Rise Science. Prepared by: California Ocean Protection Council Science Advisory Team Working Group. Viewed online at: http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf

National Oceanic and Atmospheric Administration. Sea Level Rise Viewer. Viewed online at: http://bit.ly/2Etz45E. Last accessed: February 9, 2018.

Hazards & Vulnerability Research Institute. “SoVI® - Social Vulnerability Index for the United States – 2010-2014.” University of South Carolina. Viewed online at: http://artsandsciences.sc.edu/geog/hvri/sovi%C2%AE-0 . Last accessed: February 8, 2018.

Healthy Economy

Intended Outcome: Consideration of economic risks and rewards on floodplains, rivers, and coastal areas.

HE 10: Areas Covered by Local Coastal Program Vulnerability Assessments Updated for Sea Level Rise

This indicator assesses the acreage of land vulnerable to sea level rise covered and not covered by Local Coastal Program (LCP) Vulnerability Assessments updated for sea level rise. LCPs have been developed by local governments with the help of the California Coastal Commission, so that local governments can permit development at the local level consistent with the policies of the Coastal Act.

The target outcome for this indicator is that all areas at risk of sea level rise will have LCP Vulnerability Assessments updated for sea level rise. This will help ensure effective planning and permitting of development in California's coastal zone.

Scale:	Regional
Data Sources:	California Coastal Commission
Data Availability:	Type II
Metric:	Status of LCP Vulnerability Assessments
Screening Status:	**Basic**

4.108 Importance and Screening Considerations

Many aspects of the coastal economy, as well as California's broader economy, are at risk from sea level rise, including coastal-related tourism, beach and ocean recreational activities, transfer of goods and services through ports and transportation networks, coastal agriculture, and commercial fishing and aquaculture facilities. As many economic opportunities are at stake, California's coastal communities must make adaptation to sea level rise a priority through Vulnerability Assessments in order to minimize damage and losses.

Rising sea levels of up to 1.4 meters by 2100 will have significant impacts on California's coastline. While bays and estuaries are expected to experience the most significant impacts in the coming century, changes will also be realized far inland from the shoreline zone. These changes will lead to consequences for sovereign public trust lands, resources, and assets, and may lead to significant economic impacts.

This indicator is considered a Basic level indicator. Although this indicator is more relevant in coastal regions, sea level rise issues could have major implications on California's economy statewide. Evaluation of this indicator may require compiling data from multiple sources and entities, but would be very supportive of decision making for policies regarding sea level rise issues.

Representative of Outcome:	Medium
Data Viability:	High
Cost:	Low-Medium
Potential Longevity:	High
Supportive of Decision Making:	Medium-High

4.109 Initial Data and Results

The California Coastal Commission released the Statewide Sea Level Rise Vulnerability Synthesis report in December 2016. The report presents key statewide findings on vulnerability to inform sea level rise planning and preparedness, as well as county-level snapshots which describe sea level rise vulnerability at a county scale and local planning efforts underway. The California Coastal Commission works with local governments to develop LCPs. The LCPs provide the legally-controlling local land use policies and zoning to address statewide coastal resource management issues such as sea level rise.

Some of the key findings from the 2016 report include the following:

- The ocean economy makes up a significant portion of California’s total economy.
- The largest coastal zone populations vulnerable to flooding from a 100-year storm plus 55 inches sea level rise are Los Angeles, Orange, and San Diego counties.
- Many of the vulnerability assessments did not account for the full range of social impacts linked to sea level rise. Vulnerability to hazards from sea level rise will have a disproportionate impact on communities with the least capacity to adapt.
- Despite many miles of existing armoring, erosion will continue to threaten existing developed areas in vulnerable communities, and this threat will increase with rising sea level.
- Public access and recreational assets are threatened by sea level rise in every county.
- Many communities have not yet addressed the vulnerability of their sandy beaches to rising sea levels.
- Sea level rise poses significant threats to agricultural resources where it can cause an increase in flooding an inundation of low-lying agricultural land, saltwater intrusion into agricultural water supplies, and/or a decrease in the amount of freshwater available for agricultural uses.
- LCP policies to address new development, known vulnerabilities, general hazard response, and future specific adaptation methods provide the mechanism to develop resilience to sea level rise. Communities should begin planning so that actions now do not preclude future adaptation options.

Figure 4-27 provides a visual representation of the status of each LCP Vulnerability Assessment in the coastal zone. There are three broad descriptions the California Coastal Commission uses to track if an LCP has been updated for sea level rise: (1) "in progress’ means that the jurisdiction has grant or other ongoing work to address the impacts of climate change; (2) ‘in part’ means the LCP has mentioned sea level rise to some extent; and (3) ‘no’ means the LCP has no mention of sea level rise. Those broad descriptions are translated into the Figure 4-27 key to specify the status of each LCP Vulnerability Assessment. In general, most of the counties subject to sea level rise impacts are covered by vulnerability assessments either updated for sea level rise or mention sea level rise. However, the northern coastal counties have either no vulnerability assessments or the assessments have not been updated for sea level rise.

Source: California Coastal Commission. Sea Level Rise Vulnerability Synthesis. April 17, 2018.

Figure 4-27. Status of Local Coastal Programs Sea Level Rise Vulnerability Assessments Coastal Areas at Risk of Sea Level Rise

4.110 Recommendations

As the implementation of LCP Vulnerability Assessments gains more traction and funding, more coastal communities and counties should have vulnerability assessments updated for sea level rise. In the future, a centralized database through the California Coastal Commission where LCPs can report on the status of Vulnerability Assessments should be developed outside of the Sea Level Rise Vulnerability Synthesis report.

4.111 References

California Coastal Commission. 2016. Statewide Sea Level Rise Vulnerability Synthesis. Viewed online at: https://documents.coastal.ca.gov/assets/climate/slr/vulnerability/FINAL_Statewide_Report.pdf

California Coastal Commission. 2015. Sea Level Rise Policy Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits. Viewed online at: https://documents.coastal.ca.gov/assets/slr/guidance/August2015/0_Full_Adopted_Sea_Level_Rise_Policy_Guidance.pdf

Healthy Economy

Intended Outcome: More benefits from economic activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)

HE 11: Regional Trend in Cost of Water for Municipal and Industrial, and Agricultural Purposes; Cost Compared to State Average for these Same Supplies

This indicator assesses the regional trend in the cost of water for municipal, industrial, and agricultural water use and then further compare the regional costs to the state average. While not inherently a positive or negative sign, increases or decreases in the regional cost of water compared to the statewide average cost of water, could indicate regional economic and water resource issues in California.

Scale:	Regional
Data Sources:	California Public Utilities Commission
Data Availability:	Type II
Metric:	Cost of water to end user ($/AF or $/gallon)
Screening Status:	**Watershed**

4.112 Importance and Screening Considerations

Regional trends in the cost of water can be indicative of the economic health of a region. These rates may vary regionally. For instance, southern California faces higher costs to convey water from available sources to distance population centers. Water costs may lead to high rates, which in turn can be associated with fewer rate-payers and a potential loss in industrial or agricultural activity.

This indicator is considered a Basic level indicator because the data would be very representative of the intended outcome of identifying the impact of water on economic activities. Comparing to state averages helps adjust for market influencers out of a region’s control, such as a statewide drought, and would provide a region-specific snapshot of economic health and encourage investigation into local market indicators. Ultimately, tracking the cost of water for different purposes and comparing the relative trends to other regions would be useful for regional decision makers and planners. However, viable data sources have yet to be developed.

Representative of Outcome:	Medium-High
Data Viability:	Medium
Cost:	Medium-High
Potential Longevity:	High
Supportive of Decision Making:	Medium

4.113 Initial Data and Results

No initial data are presented. A potential description of methodology is presented below.

4.114 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework will continue to develop. The cost of water can face many outside influences, including water availability, demand levels, and energy costs.

The methodology for this indicator would involve gathering data from local utilities or other entities within a region to determine the average cost of water for municipal, agricultural, and industrial purposes. No centralized, official source of statewide water rate data currently exists. While rates from individual water service providers are available online, this information is not currently tracked or compiled on a statewide basis.

The regional cost of water can be indicative of several different economic drivers, especially when compared with other regions in the state. A regional upward trend could indicate recent investments for infrastructure upgrades to provide future benefits or a lack of supply, such as in dry water years. A regional trend downward could indicate a water supply surplus, which could be indicative of a wet water year. While no target outcome is evident, this indicator would show the regional trends and provide insight into whether regional response to factors such as climate, population, regulatory, or industrial changes are successfully being addressed and negative effects being mitigated in order to foster a healthy economy.

4.115 References

Public Policy Institute of California. “California's Water Market.” Public Policy Institute of California. Viewed online at: http://www.ppic.org/publication/californias-water-market/. Last accessed: February 9, 2018.

Hanak, Ellen and Elizabeth Stryjewski. 2012. California’s Water Market, By the Numbers: Update 2012. Public Policy Institute of California. Viewed online at: http://www.ppic.org/content/pubs/report/R_1112EHR.pdf

Healthy Economy

Intended Outcome: More benefits from economic activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)

HE 12: Volume of Water Transferred on the Open Market; Cost of Water on the Transfer Market

This indicator assesses the volume of water transferred on the open market and the associated cost, to evaluate general trends in water transfers. Water transfers involve a change in the place of water use, from the water's historic point of diversion and/or use, to a new location and/or use. Water may be transferred for a variety of purposes, including agricultural, municipal, environmental, and industrial uses.

For the purpose of this indicator, water transferred is considered water that is physically transferred resulting from a trade from one entity to another, through the means of short or long-term leases and sales of water rights. The cost of water is considered the price that the buyer paid, per acre-foot of water.

The target outcome for this indicator is showing an economical open water market that supports flexible allocation and water use in California.

Scale:	Statewide
Data Sources:	State Water Board; DWR; Water Agencies
Data Availability:	Type III
Metric:	Volume of water transfers vs. cost of transfer water
Screening Status:	**Basic**

4.116 Importance and Screening Considerations

The ability to transfer water on the open market adds flexibility to the state's water supply – helping to address conditions of temporary shortage and to accommodate longer-term changes in demand patterns. Historically, water transfers in California were primarily executed to meet dry-year demands rather than to obtain a primary water supply for agricultural or municipal development. Water transfer demand and completed transfers have increased over time, and consumptive use of water in California has increased. This trend may have an impact on the cost of water transferred on the open market.

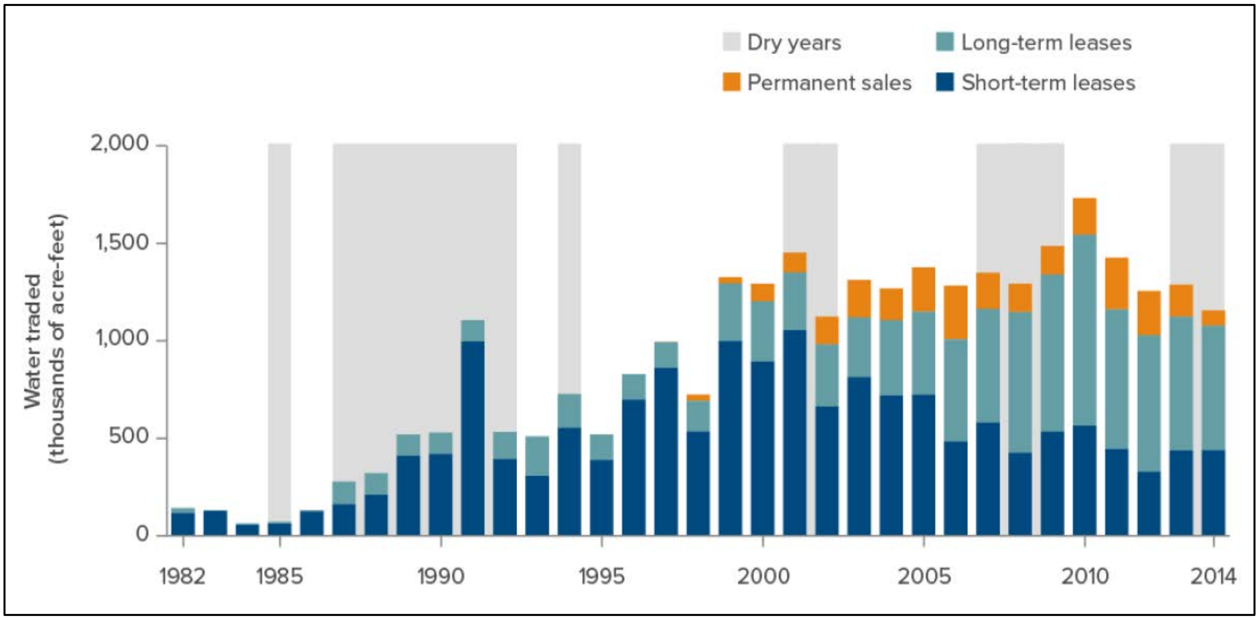
This indicator is considered a Basic level indicator. The data for this indicator are useful at a state level to track the overall value of transferred water over time and to determine a willingness to pay for water for various uses. A majority of the available market information is derived from State agencies with jurisdiction over these transfers, including the State Water Board and DWR.

Representative of Outcome:	Medium
Data Viability:	Medium-High
Cost	Medium
Potential Longevity:	High
Supportive of Decision Making:	Medium

4.117 Initial Data and Results

Consistent public data are not currently available for this indicator. Considerable work would be required to compile and analyze the data to provide sufficient information for this indicator. The Public Policy

Institute of California (PPIC) has released reports characterizing the California water market that could be used as a step toward the development of this indicator. Reproduced from PPIC's most recent report, Figure 4-28 shows the volume of water transferred on the water market from 1982 through 2014. PPIC gathered information from a variety of sources including the State Water Board, DWR, Reclamation, CALFED Bay Delta Program, records from the CVP and SWP, and the Colorado River Project, as well as directly from other entities, agencies, and sources. The results were then analyzed and adjusted to accurately represent the water actually transferred on the open market. The cost of water was not included in the analysis and would be essential to include for the development of this indicator. A potential description of future methodology is presented in the Recommendations section.



Source: E. Hanak and E. Stryjewski. California's Water Market Fact Sheet (PPIC, 2016)

Note: The figure shows water traded between entities that are not members of the same water district or wholesale agency. It excludes volumes committed under long-term lease and permanent-sale contracts that were not physically transferred because of hydrologic conditions or other factors (in 2014, roughly 800,000 acre-feet). Dry years are those classified as critical or dry for the Sacramento Valley.

Figure 4-28. Volume of Water Transferred on the California Water Market 1982-2014

4.118 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework will continue to develop. An active transfer market has existed in California for a number of years and can be an effective water management tool to provide much-needed flexibility. However, there is currently no official centralized source for information regarding the volume and cost of water transferred. It is recommended that this be developed.

The proposed methodology for this indicator would be to compile and centralize information from State Water Board, DWR, and other water sellers and buyers on the volume of water transferred annually coupled with the cost of the water transferred, on an annual basis. As described above, a characterization of the California water market has previously been done by PPIC, and its methodology would serve as a model for data acquisition and analysis. However, additional information on the cost of the water transferred would need to be collected and tracked over time to inform this indicator.

4.119 References

Public Policy Institute of California. “California's Water Market.” Public Policy Institute of California. Viewed online at: http://www.ppic.org/publication/californias-water-market/. Last accessed: February 9, 2018.

Hanak, Ellen and Elizabeth Stryjewski. 2012. California’s Water Market, By the Numbers: Update 2012. Public Policy Institute of California. Viewed online at: http://www.ppic.org/content/pubs/report/R_1112EHR.pdf

Hanak, Ellen and Elizabeth Stryjewski. 2012. California’s Water Market, By the Numbers: Update 2012: Technical Appendices. Public Policy Institute of California. Viewed online at: http://www.ppic.org/content/pubs/other/1112EHR_appendix.pdf

Healthy Economy

Intended Outcome: More benefits from economic activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)

HE 13: Percent of Average Annual Power Demand Satisfied by Hydropower

This indicator assesses the percent of the statewide average annual power demand is satisfied by hydropower, or hydroelectric power, in California. Currently, hydroelectric power provides about 15 percent of California's power annually. The amount of hydroelectric power produced varies each year and is largely dependent on rainfall.

Approximately 400 hydroelectric power plants produce electricity in California, often as part of multipurpose dams that also provide water supply, flood control, and/or recreation. The larger hydroelectric power plants on dams in California are operated by Reclamation and DWR. Many smaller hydroelectric power plants are operated by utilities, such as Pacific Gas and Electric Company.

Scale:	Statewide
Data Sources:	California Energy Commission; Reclamation; DWR
Data Availability:	Type I
Metric:	Annual hydroelectric power demand (megawatts)
Screening Status:	**Basic**

4.120 Importance and Screening Considerations

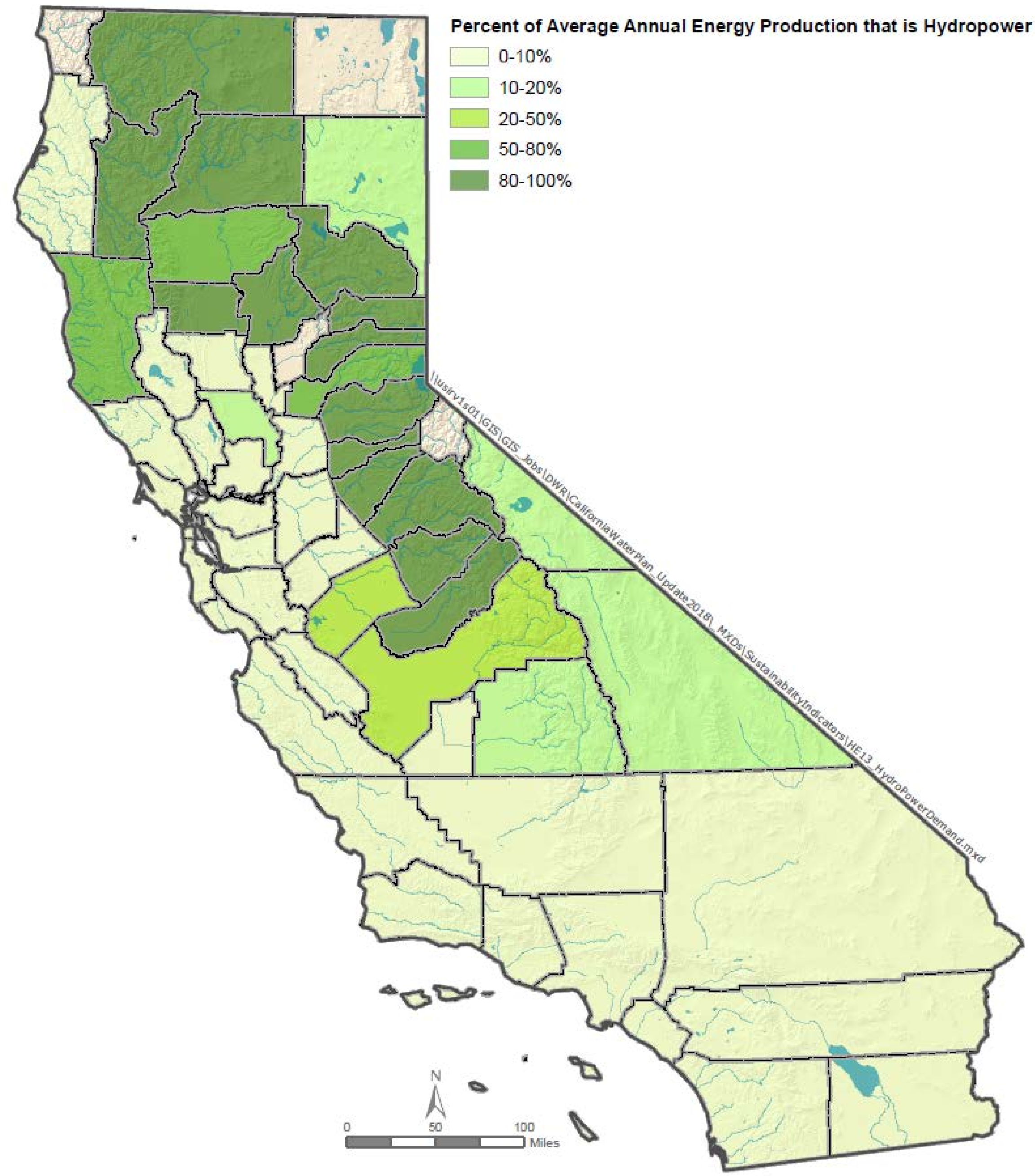
Hydroelectric power benefits include near-zero emissions and a relatively low production cost. The amount of hydroelectric power generated is dependent on rainfall, snowpack, and storage, so this indicator could be indicative of greater issues, such as climate change. Long-term trends leading to changes in precipitation patterns or decreased snowpack or storage would lead to decreased hydroelectric power benefits.

This indicator is considered a Basic indicator. Although, not directly representative of benefits from economic activities, this indicator could be a useful representation of the water-energy nexus statewide. This indicator is easy to apply and understand, and data are readily available. The amount of hydroelectric power produced varies each year and is largely dependent on snow, storage, and rainfall in upper watersheds, so long-term trends would reveal the effects of climate change or varying hydrologic conditions. The data are readily available, but may be held by multiple entities.

Representative of Outcome:	Medium
Data Viability:	High
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

4.121 Initial Data and Results

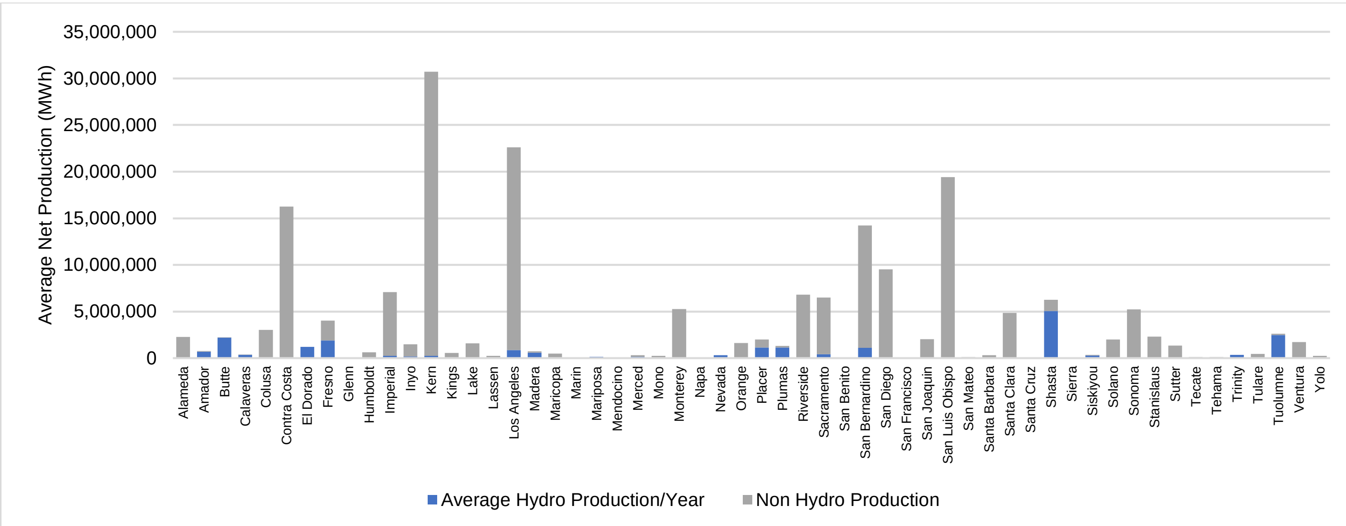
Average annual hydroelectric power production by county were compiled for a five-year period (2013-2016), as collected by the California Energy Commission. Data include both wet years and drought conditions. Figure 4-29 shows the percent of each county's hydroelectric power production that comes from hydropower. Northern California, with more reservoir locations and higher levels of annual precipitation, produces larger amounts of hydroelectric power for the state.



Source: "Energy Maps of California." California Energy Commission. December 20, 2017.

Figure 4-29. Average Hydroelectric Power Percent of Total Annual Power Production from 2013 to 2016

Figure 4-30 shows the total energy production by county, highlighting the portion that is hydroelectric power. Although certain counties have a high percentage of hydroelectric power, the overall amount of hydroelectric power produced annually across the state was about 30 percent on average from 2013 to 2016.



Source: "Energy Maps of California." California Energy Commission. December 20, 2017.

Figure 4-30. Energy Production by County, Annual Average (2013-2016)

4.122 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework will continue to develop.

The methodology for developing this indicator will involve compiling annual hydropower production data from all the facilities in the state. Analysis of future periods could be compared to find long-term trends in hydropower generation.

Consideration should be given to indicators better suited for this intended outcome. This indicator does not provide a broad overview of increased economic benefit to multiple economic sectors, despite its current status as the only indicator under its intended outcome.

4.123 References

Water Education Foundation. "Hydroelectric Power." Water Education Foundation. Viewed online at: http://www.watereducation.org/aquapedia/hydroelectric-power. Last accessed: December 20, 2017.

California Energy Commission. "Energy Maps of California." California Energy Commission. Viewed online at: http://www.energy.ca.gov/maps/. Last accessed: December 20, 2017.

Healthy Economy

Intended Outcome: Reduced likelihood or occurrence of significant social disruption following a disaster.

HE 14: Value of Assets within Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year

This indicator assesses the value of assets (built infrastructure) with equal to or greater than 1 percent of flooding in any given year, representing 100-year floodplains, throughout the state. The target outcome for this indicator is to show an increasing trend towards increased and appropriate levels of flood protection.

Scale:	Statewide
Data Sources:	DWR; U.S. Census Bureau; FEMA; Cal OES
Data Availability:	Type I
Metric:	Value ($)
Screening Status:	**Basic**

4.124 Importance and Screening Considerations

California has experienced destructive flood events throughout its history, and all areas of the state are subject to at least one form of flooding. Every county in California was declared a Federal disaster area at least once for a flooding event in the last 20 years. Most recently, due to heavy storms in January 2017, 34 of California's 58 counties were included in the Federal disaster declaration. The number of Californians and the value of assets exposed to flooding is likely to continue to increase because of increasing population and development in floodplains.

Estimates suggest structures valued at $575 billion and crops valued at $7.5 billion are located in areas that have at least a 1 in 500 chance of flooding in any given year. These estimates do not include the impacts of future development, population changes, climate change, or costs due to loss of major infrastructure and critical facilities.

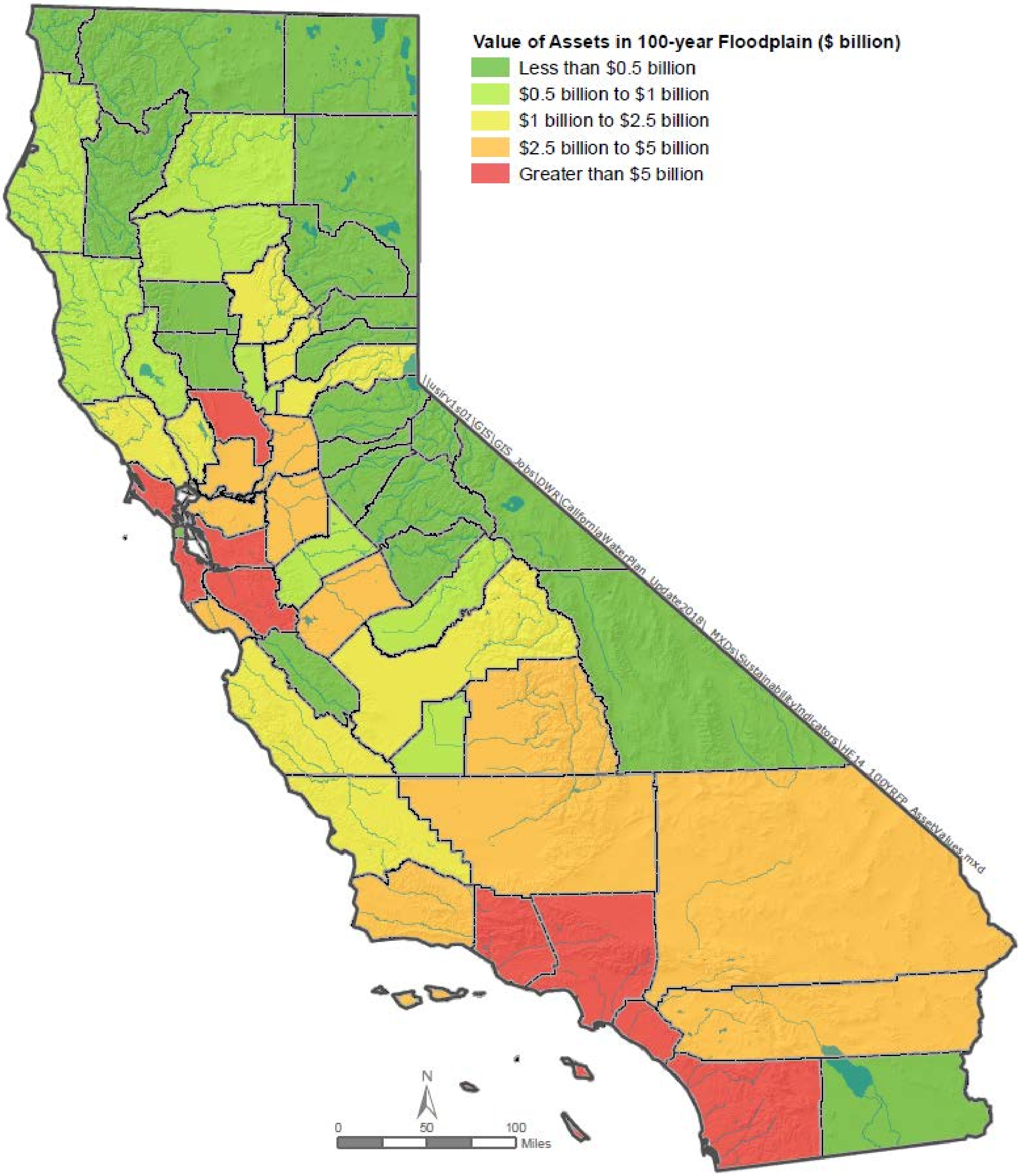
This indicator is considered a Basic level indicator. Determining the value of assets in 100-year floodplains would be supportive of decision making, particularly in combination with indicators related to public safety. Although this indicator is not directly tied to the intended outcome, evaluation of the data would indicate vulnerability to and potential for significant social disruption in different areas around the state.

During initial indicator development, some feedback related to reflecting State requirements for 200-year floodplains in the Central Valley. However, the majority of State and Federal agencies collect data for 100-year floodplains. Data are available from DWR to assess the 200-year floodplains in the Central Valley but not in the rest of the state. Therefore, this indicator was formulated and initially evaluated for 100-year floodplains to achieve as complete statewide coverage as possible.

Representative of Outcome:	Medium-High
Data Viability:	Medium-High
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.125 Initial Data and Results

The SFMPP conducted an in-depth analysis in November 2013 of flood exposure risks throughout California. The methodology used floodplain extents from FEMA and the 2012 CVFPP floodplains along with asset information from the Hazus and ParcelQuest databases. Results are presented for 100-year floodplains to achieve as complete statewide coverage as possible. Figure 4-31 shows the value of exposed assets by county in 100-year floodplains. The total value of exposed assets statewide in the 100-year floodplains was estimated at $142 billion. The value of agricultural lands was 4 percent of this total. Santa Clara, San Mateo, and Orange counties had the highest value of structures exposed to flood risk, each with exposed asset values over $10 billion. San Joaquin, Fresno, Kern, King, and Merced counties each have over $350 million in crops exposed to flood risk.



Source: Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

Figure 4-31. Value of Exposed Assets, Including Structures and Contents and Agricultural Crops, in the 100-Year Floodplains

4.126 Recommendations

Flood disasters are an unfortunate reality in California. This indicator helps provide decision and policy makers with an outlook to measure what investments or actions may help manage flood disasters and reduce the impacts of flooding. Investments or actions made now will help prevent spending billions more to recover from the effects of this inevitable future flooding.

The results of this indicator should provide the State with a useful way to indicate how much infrastructure is already built and continues to be built in floodplains statewide. Currently, the results may show upward or downward trends in the value of assets in floodplains. This could help inform State investments in flood risk mitigation and/or identify the need for voluntary or regulatory controls. However, the future methodology should account for analyses of assets outside appropriate levels of protection rather than considering a single level of protection for all assets. For example, 200-year floodplains are a State requirement in the Central Valley and could be used for that area. This would better account for both the state’s vulnerability to flooding and the potential for social disruption post-flooding.

The future methodology for the indicator should assess the exposure of different classes of assets in the varying floodplains. Crops may only require a 100-year level of protection, while highly urbanized areas may require a 200-year or 500-year level of protection. Future analysis should account for this variation. In addition, floodplain data from the multiple State and Federal agencies should be compiled and reconciled to provide the most recent floodplain extents. In some areas of the state, additional surveying should be conducted to update floodplain data.

In future updates, data should be considered on a per capita or per acre value of assets to indicate where exposed assets are most concentrated.

4.127 References

California Department of Water Resources and U.S. Army Corps of Engineers. 2013. California’s Flood Future Highlights. Viewed online at: https://www.water.ca.gov/LegacyFiles/sfmp/resources/ca_flood_future_highlight.pdf

California Department of Water Resources. 2016. Statewide Flood Management Planning Program Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

California Department of Water Resources. “Central Valley Flood Protection Plan.” California Department of Water Resources. Viewed online at: www.water.ca.gov/cvfmp. Last accessed: February 6, 2018.

Opportunities for Enriching Experience

Intended Outcome: Preserved or enhanced culturally or historically significant sites and communities, including continued and enhanced access to water and land used for sacred ceremonies or cultural practices

OEE 1: Number of Historically and Culturally Significant Sites at Risk of Flooding or Sea Level Rise

This indicator assesses the number of qualified historical buildings, historical sites, and tribal lands with equal to or greater than a 1 percent risk of flooding in any given year. This indicator also includes historical and cultural resources at risk of flooding from sea level rise, of greater relevance in coastal regions throughout California.

This indicator is meant to show geographically where there are historically and culturally significant sites at risk of flooding or sea level rise. The target outcome for this indicator would be zero historically and culturally significant sites at risk of flooding or sea level rise.

Scale:	Statewide
Data Sources:	National Register of Historic Places (NRHP); NOAA; CVFPP
Data Availability:	Type II
Metric:	Number of historical and cultural resources
Screening Status:	**Basic**

4.128 Importance and Screening Considerations

California is rich with historical and cultural resources that represent the contributions and collective human experiences of a diversified population spanning thousands of years. Preserving and protecting these historical and cultural resources continues to enhance the quality of life for many Californians as they provide continuity with the state’s history.

This indicator is considered a Basic level indicator. There is information on historical resources in California through the NRHP and tribal lands can be accessed from the DWR Water Plan database. The NRHP is the nation’s official list of buildings, structures, objects, sites, and districts worthy of preservation because of their significance in American history, architecture, archeology, engineering, and culture. Historical resources will remain protected by the State, but the State is unable to control flood events or flooding due to sea level rise. This indicator will be indicative of the policies or regulations that may need to be developed to better protect California’s historical and cultural sites as climate change and flood events continue to threaten those sites.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Low-Medium
Potential Longevity:	High
Supportive of Decision Making:	Medium-High

4.129 Initial Data and Results

The initial data to develop this indicator were gathered from multiple entities including 100-year floodplain extents developed for the CVFPP, NOAA sea level rise data, and the NRHP. Tribal lands data were gathered from DWR's Water Plan database. As shown in Figure 4-32, each historical resource registered on the NRHP and tribal lands in California were assessed based on the corresponding location in the 100-year floodplain extents developed for the CVFPP or the extent of sea level rise. For the purposes of this indicator, the 3 feet above average high tides NOAA sea level rise scenario was evaluated, as well as the hydrologically "unconnected" low lying areas that may also flood from a 3-foot sea level rise scenario.

Sources: "National Register for Historical Places." National Park Service. December 14, 2017.
Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.
Sea Level Rise Viewer. National Oceanic and Atmospheric Administration. February 9, 2018.

Figure 4-32. Number of Historically and Culturally Significant Sites at Risk of Flooding or Sea Level Rise Impacts

As demonstrated in Table 4-14, almost 16 percent of California's registered historical and cultural resources (including buildings, structures, districts, and sites) are at risk of sea level rise impacts and flooding. Sea level rise poses less of a risk to California's historical resources than the 100-year floodplain extent, particularly in the Central Valley (as shown in Figure 4-32) where more sites are at risk of flooding when compared to the rest of the state.

Table 4-14. California Qualified Historical and Cultural Resources at Risk of Sea Level Rise Impacts and Flooding

Risk	Number of Historical and Cultural Resources	Percent of Historical and Cultural Resources
Sea Level Rise	145	5.6%
100-year Floodplain	261	10.1%
Total (Statewide)	2,584	15.7%

Sources: "National Register for Historical Places." National Park Service. December 14, 2017.
Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.
Sea Level Rise Viewer. National Oceanic and Atmospheric Administration. February 9, 2018.

4.130 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

Significant investments have been made in the state's flood protection system, including levees and bypasses. Flooding occurs in all regions of the state in different forms and at different times. The analysis of how many historical and cultural sites are at risk of flooding and sea level rise will provide information where more enhanced flood protection may be needed to protect California's historical and cultural sites.

It is recommended to focus this indicator on historical buildings, historical sites, and tribal lands, excluding the assessment of recreational areas. Recreational areas and historical sites serve different purposes for the state of California. The evaluation of recreational areas is already considered under a different set of indicators, including *OEE 2*, *Change in Natural Area* and *OEE 6*, *Change in Visitor Days at Water Related Park Lands*. Although CDFW-classified lands evaluated in *OEE 2* are not all recreational areas, the open space or natural areas would support enriching experience for Californians.

4.131 References

California Department of Water Resources. "Central Valley Flood Protection Plan." California Department of Water Resources. Viewed online at: www.water.ca.gov/cvfmp. Last accessed: February 6, 2018.

National Oceanic and Atmospheric Administration. Sea Level Rise Viewer. Viewed online at: http://bit.ly/2Etz45E. Last accessed: February 9, 2018.

U.S. Department of the Interior, National Park Service. "National Register of Historical Places." National Park Service. Viewed online at: https://www.nps.gov/nr/. Last accessed: December 14, 2017.

Opportunities for Enriching Experience

Intended Outcome: Preserved and increased natural areas with aesthetic or intrinsic value (including viewshed)

OEE 2: Change in Natural Area

This composite indicator assesses the change in acreage of natural areas including open space, lands in conservation for habitat and other conservation purposes, and lands protected under the California Land Conservation Act of 1965 (LCA or Williamson Act) enrollment.

The LCA enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. The act serves as an important tool to allow landowners to resist development pressures. Outside of agricultural lands, CDFW is responsible for over 1,100,000 acres of fish and wildlife habitat, managed through 749 properties throughout the state. These properties provide habitat for a rich diversity of fish, wildlife, and plant species and comprise habitats from every major ecosystem in the state. These properties also provide many opportunities for the public to hunt, fish, view wildlife, and learn about nature.

Additional work is needed to explore appropriate target outcomes for this indicator. The target outcome for this indicator could (1) focus on maintaining a trend (increase in natural acreage of no less than 1% averaged over a 10-year period, or maintenance of current natural land area over time with no net decreases over a 10-year period), or (2) establish a specific target (achieving a certain number of acres of natural land area in the State over the next 50 years). The intended outcome associated with this indicator is “preserved and increased natural areas with aesthetic or intrinsic value,” which may make a trend-based outcome more appropriate.

Scale:	Statewide
Data Sources:	CDFW; California Department of Conservation
Data Availability:	Type I-III
Metric:	Acreage
Screening Status:	**Basic**

4.132 Importance and Screening Considerations

Open spaces, such as parks, playgrounds, and natural areas, can provide many health, cultural, recreational, and economic benefits to communities. In addition, California’s open spaces and natural areas provide habitat for thousands of species of plants and animals, many found only in this state. They can also provide important water management functions, supporting water quality, flood management, and groundwater recharge. As the State’s population continues to increase, development is a threat to the preservation of natural areas.

This indicator is considered a Basic level indicator. The initial data and results evaluation is limited to data from CDFW and California Department of Conservation. The data from CDFW provides a comprehensive evaluation of CDFW owned and operated natural areas and conservation easements, while the data from the California Department of Conservation on LCA enrollment focuses on the evaluation of agricultural lands conserved. There may be data available from other sources, including California Coastal Commission, California Department of Parks and Recreation, California State Lands Commission, Federal Lands, and local parks, to provide a more complete dataset to represent this composite indicator. This indicator would help assess policies enforced by the LCA and provide information appropriate for making policy decisions related to natural areas.

Representative of Outcome:	High
Data Viability:	Medium-High
Cost:	Low-Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.133 Initial Data and Results

The initial data and results for this indicator are represented by the acreage of land enrolled under the LCA and the acreage of lands under conservation designated by CDFW.

The LCA is a California State statue administered by local governments. The California Department of Conservation releases an annual status report that details the acreage of land in each county that is enrolled under the LCA program. Enrollment statistics are submitted annually as part of the Open Space Subvention application process. From the 2016 Status Report, 52 counties out of 58 counties in California have executed contracts under the LCA program. In addition to LCA contracts, areas can enroll land as Farmland Security Zones. There are 25 counties that have enrolled land under the Farmland Security Zones program.

Table 4-15 presents the statewide reported acreage of lands enrolled under the LCA program for the 2014 and 2015 years, which are the most recent available data sets. Overall enrollment in the LCA program increased slightly from 2014 to 2015.

Table 4-15. Statewide Reported Acreage under the Land Conservation Act and Farmland Security Zones

Statewide Reported Acreage (Acres)		
Category	2014	2015
Prime	4,627,349	4,591,784
Non-Prime	9,064,550	9,278,691
Prime – Farmland Security Zone	797,275	786,538
Non-Prime – Farmland Security Zone	80,396	79,817
Other – Farmland Security Zone	61,289	57,613
Total	**14,630,859**	**14,794,443**

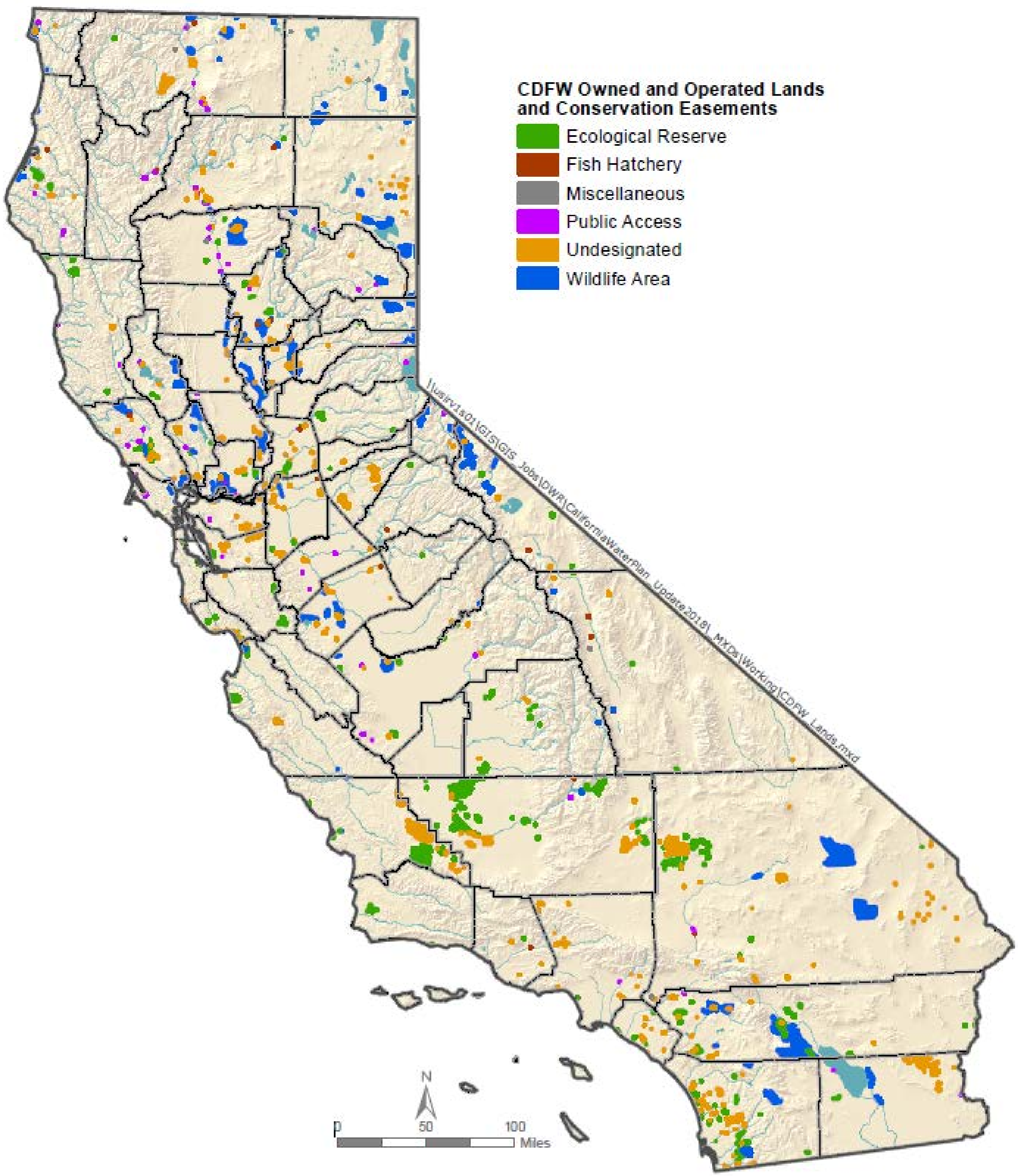
Source: The California Land Conservation Act of 1965 2016 Status Report. California Department of Conservation. 2016.

For non-agricultural lands, CDFW inventories the acreage of lands classified as wildlife areas, ecological reserves, undesignated lands, public access, fish hatcheries, or miscellaneous lands. Table 4-16 presents the number of properties and the total acreage of each classified type of land. Figure 4-33 geographically represents these lands.

Table 4-16. California Department of Fish and Wildlife Classification of Lands

Classification	Number of Properties	Total Acreage
Wildlife Areas	111	709,508
Ecological Reserves	136	228,906
Undesignated Lands	315	222,768
Public Access	127	4,080
Fish Hatcheries	21	833
Miscellaneous Lands	39	105
Total	749	1,166,201

Source: "CDFW Lands Inventory Fact Sheet." California Department of Fish and Wildlife. January 26, 2018.



Sources: "CDFW Lands Inventory Fact Sheet." California Department of Fish and Wildlife. January 26, 2018.

Figure 4-33. California Department of Fish and Wildlife Owned and Operated Lands and Conservation Easements (as of January 2018)

Some counties throughout the state have more CDFW owned and operated lands and conservation easements than others, which is likely influenced by the natural terrain and geography of each county. Table 4-17 presents the top 10 counties that have the highest percentage of lands in conservation classified by CDFW.

Table 4-17. Top 10 Counties in the State that have the Highest Percentage of Lands Classified by California Department of Fish and Wildlife

County	Percent of Land Classified by California Department of Fish and Wildlife
Napa	6.87%
Yuba	5.69%
Solano	4.82%
Yolo	4.45%
Butte	4.17%
Marin	3.77%
Riverside	3.20%
San Luis Obispo	3.13%
Sierra	2.86%
Sacramento	2.81%

Source: "CDFW Lands Inventory Fact Sheet." California Department of Fish and Wildlife. January 26, 2018.

4.134 Recommendations

This indicator is a composite indicator. In order for natural area to be completely evaluated, data are needed from multiple sources including, but not limited to, California Coastal Commission, California Department of Conservation, CDFW, California Department of Parks and Recreation, California State Lands Commission, Federal Lands, and local parks. However, each entity may not maintain all the information on acreage of open space and natural lands conserved or maintained. Presently, this indicator only assesses lands enrolled in the LCA program and CDFW classified lands. Although local governments are not mandated to participate in the LCA and this may create potential data gaps, the California Department of Conservation releases a status report that details the acreage of land in each county that is enrolled under the LCA. Similarly, CDFW maintains a database of the acreage of classified lands.

In the future, data outside the CDFW classified lands and LCA program enrollment should be considered to create a more complete and comprehensive evaluation of natural areas in California. A map should be developed that not only includes CDFW classified lands, but also would include lands enrolled under the LCA program and other natural areas assessed under the additional sources mentioned above. There is potential overlap of natural areas, so displaying one map with all the different natural area types may not be feasible.

4.135 References

California Department of Fish and Wildlife. "CDFW Lands Inventory Fact Sheet." California Department of Fish and Wildlife. Viewed online at: https://www.wildlife.ca.gov/Lands/Inventory. Last accessed: January 26, 2018.

California Department of Conservation. 2016. The California Land Conservation Act of 1965 2016 Status Report. Viewed online at: http://www.conservation.ca.gov/dlrp/lca/stats_reports/Documents/2016%20LCA%20Status%20Report.pdf

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced access to resources that support education and learning

OEE 3: Number of School Districts Using Water and Environmental Curriculum in K-12 Programs

This indicator assesses the number of school districts that incorporate water-related curriculum in kindergarten through grade 12 programs. DWR is working towards implementing water-related curriculum in school districts statewide. DWR Water Education and Outreach Branch works to educate the public about water issues through educator workshops, special events, and other outreach activities. The Water Education Program assists California's formal and informal educators by supporting professional development for K-12 educators, providing materials such as worksheets, posters, and workbooks, and attending educational events throughout the state.

The target outcome for this indicator would show the majority or all of the school districts implementing water-related curriculum in their K-12 grades.

Scale:	Statewide
Data Sources:	California Department of Education; DWR Project WET; Water Education Foundation
Data Availability:	Type II
Metric:	Number of School Districts
Screening Status:	**Basic**

4.136 Importance and Screening Considerations

This indicator could provide information on where water and environmental studies are incorporated into grade school curriculum. This allows young students to develop foundations in science curriculum based on their state's water resources. These foundations may lead students to make decisions to pursue water resource management careers or impact individual knowledge of the significance of water in California.

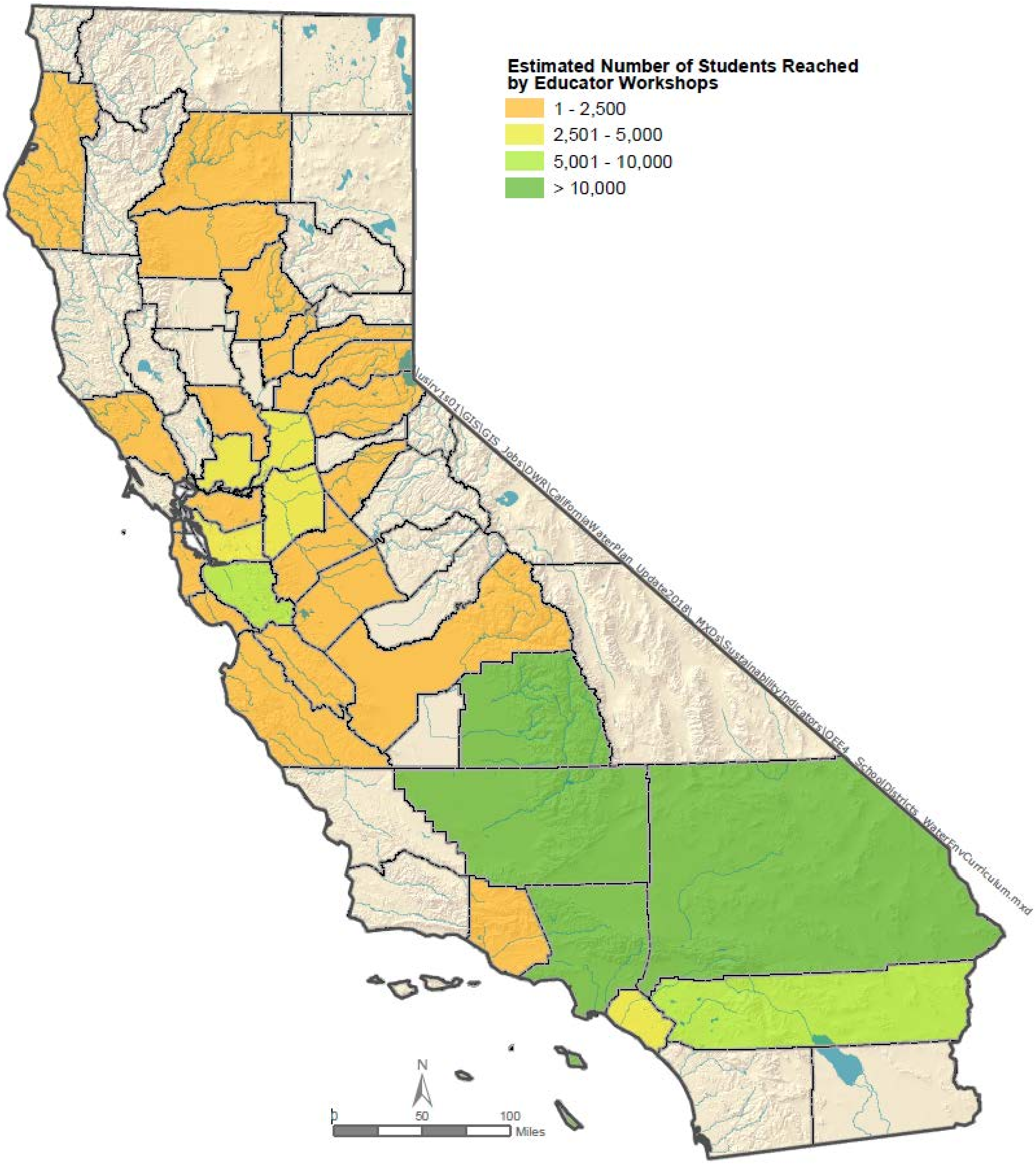
This indicator is considered Basic level. This indicator is easy to understand and would be easy for different regions and watersheds throughout the state to develop. Information on public school curriculum could be gathered from the California Department of Education. In addition, the DWR Public Affairs Office Water Education Branch collects data on the estimated number of students reached through their outreach events.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	High

4.137 Initial Data and Results

While a comprehensive data source is lacking, initial data on students reached through DWR's Public Affairs Office Water Education Branch in 2016 are presented in Figure 4-34. The estimated number of students reached represents the estimated impact of educators who attended various programs and events through the School Education Program Workshops, the Floodplain & Climate Divisions Workshops, DWR Water Education Committee Member and California State Water Contractors Sponsored Workshops, the CEEF Institute, the Delta Studies Institute, and the Salmonid Workshop.

These workshops are concentrated in certain areas of California. For example, the Bay Area, Los Angeles, and the southern Central Valley have had a high number of local workshops for educators, while other areas of the state have had little outreach through DWR workshops. Therefore, the majority of K-12 students that have been reached are within those areas or in neighboring counties.



Source: Schultz K. Feb. 5, 2018.

Figure 4-34. Estimated Number of Students Reached by California Department of Water Resources Educator Workshops

4.138 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

Future water plan updates should consider the number of students reached by county as a percentage of student populations per county.

Additional data from a wider range of program would be necessary to continue developing this indicator and providing a more comprehensive picture of where water and environmental curriculum is used to teach students. This should include accessing curriculum for private schools or smaller school districts throughout the state. Local programs to bring water and environmental curriculum to classrooms are not captured using the current data sources. Additional sources would need to be developed. Development of future data sources should be considered by DWR's Water Education Branch.

4.139 References

Schultz K, Water education specialist, Water Education Branch, California Department of Water Resources, Sacramento (CA). Feb. 5, 2018 – email correspondence with Marshall P, Principal Engineer, Stantec, Sacramento (CA).

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced access to resources that support education and learning

OEE 4: Number of Students Enrolled in Water and Environmental Resources Management Programs Within the UC and CSU Systems

This indicator assesses the number of students enrolled in water and environmental resources management programs within the UC and California State University (CSU) systems. Campuses throughout the CSU and UC system educate students and prepare them for careers in various industries and fields related to water and natural resources. The target outcome for this indicator would show stable or growing numbers of both Bachelor's and post-graduate awards across all UC and CSU schools in water-related or natural resource programs.

Scale:	Statewide
Data Sources:	National Center for Education Statistics (NCES)
Data Availability:	Type I
Metric:	Number of students enrolled in water-related programs
Screening Status:	**Basic**

4.140 Importance and Screening Considerations

Educational programs related to water and environmental resources management in California is vital to filling future technical, policy, or leadership roles associated with water resources management in California. High enrollment rates in higher-education programs associated with water and environmental resources management would indicate continued access to water-related resources that support education throughout the state.

This indicator is considered a Basic level indicator. Data and statistics on enrollment of students in water-related or natural resource programs are easily accessible through a centralized National Center of Education Statistics database. The evaluation of this indicator may be more applicable at a state than a local level due to the locations of the UC and CSU schools.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

4.141 Initial Data and Results

The initial methodology for this indicator involved using information from the centralized NCES database to track trends in education related to water and natural resource programs in UC and CSU schools. Available data include the number of awards presented to students in program categories and majors by universities. Initial data on the number of awards conferred for the 2015-2016 academic year, the most current data, for Californian 4-year public universities are shown in Figure 4-35. Awards were counted for all programs in NCES's Natural Resources and Conservation category as well as for the Environmental Engineering and Hydrology and Resources Science majors. Total awards include certificates, Bachelor's degrees, Master's degrees, and Doctorate degrees. The number of students enrolled in these programs represent low percentages of total university enrollment.

Source: College Navigator. National Center for Education Statistics. October 30, 2017.

Figure 4-35. Number of Awards from Water and Environmental Resources Management Programs in University of California and California State University Systems and Four-year Public Universities

While the number of students enrolled in water and environmental resources management programs is low at individual schools, a spread of programs is available throughout the state, often centered on urbanized areas.

4.142 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. Trends would need to be tracked by gathering data on the number of students currently enrolled in a water or natural resource related major or program over time.

4.143 References

National Center for Education Statistics. College Navigator. Viewed online at: https://nces.ed.gov/collegenavigator. Last accessed: October 30, 2017.

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced access to resources that support education and learning

OEE 5: Number of Water Agencies that Have Educational Programs for Customers

This indicator assesses the number of water agencies that offer educational programs for their customers. Many water districts and agencies throughout California are actively involved in educating their customers on the importance of water quality, water use efficiency. Some programs are implemented in local school districts, while other programs are more community oriented and focus on raising awareness of water efficiency programs and activities.

The target outcome for this indicator would be that every water agency or district is performing some sort of community education or outreach program to inform their customers of relevant water issues or topics.

Scale:	Statewide
Data Sources:	Local Water Agencies
Data Availability:	Type II
Metric:	Number of Water Agencies
Screening Status:	**Basic (Future)**

4.144 Importance and Screening Process

Water agencies and districts should promote discussion and educational activities for regional water use efficiency issues. By promoting educational programs for customers, water agencies and districts can provide focus on community participation around regional water policy issues, clearly communicate regional water policy issues to key constituent groups, and provide opportunity for participation and collaboration with other relevant member agencies.

This indicator is considered a Basic (Future) level indicator. This indicator will provide interpretation of the intended outcome on a watershed scale, as most water agencies and districts are focused on a more regional level, rather than statewide. However, no centralized data source currently exists.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	High

4.145 Initial Data and Results

No initial data are presented. Recommendations to gather data from existing highly dispersed sources or to build a centralized database are presented below.

4.146 Recommendations

This indicator is considered a Basic (Future) level indicator, so the guidelines and framework for measuring the indicator will continue to develop. Individuals should develop an understanding of water resources systems, especially at a local level. Conservation and efficiency efforts are typically enforced on a local or regional level, so water agencies and districts are the appropriate parties to promote education on various water topics.

The methodology for this indicator would involve gathering information from water districts and agencies on what community education programs they offer. The community education programs promoted by water agencies in school districts should also be considered as part of this indicator.

Currently, no data have been collected for this indicator. A full list of water agencies or districts is not available, although partial lists exist as part of membership in the Association of California Water Agencies or as a utility regulated by the California Public Utilities Commission. This indicator may also need to consider urban water suppliers that submit Urban Water Management Plans and public water systems. Once a list of agencies has been established, then information on the community education programs offered by each would need to be gathered. This effort would require a set of criteria to qualify programs or materials. Agencies, districts, systems, and suppliers could potentially be surveyed to provide information for this indicator.

4.147 References

California Public Utilities Commission. “Water Division.” California Public Utilities Commission. Viewed online at: http://www.cpuc.ca.gov/water/. Last accessed: January 26, 2018.

California Water Association. “Regulated Water Utilities in California.” California Water Association. Viewed online at: http://www.calwaterassn.com/about-cwa/regulated-water-utilities-in-california/. Last accessed: January 26, 2018.

Association of California Water Agencies. “Member Directory.” Association of California Water Agencies. Viewed online at: https://www.acwa.com/about/members-associates-affiliates/. Last accessed: January 26, 2018.

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces

OEE 6: Change in Visitor Days at Water Related Park Lands

This indicator assesses the change in visitor days at water related park lands, including all local, State, and Federal parks. Park lands can help provide health, inspiration, and education to the people of California by creating opportunities for high-quality outdoor recreation. The target outcome for this indicator would be no change or an increase in visitor days at park lands throughout California over time.

Scale:	Statewide
Data Sources:	California Department of Parks and Recreation
Data Availability:	Type III
Metric:	Change in number of visitor days
Screening Status:	**Basic**

4.148 Importance and Screening Considerations

California boasts a high diversity of State and National Parks. Some of the most notable National Parks include Yosemite, Sequoia, and Joshua Tree National Parks. The State Park System over 340 miles of coastline as well as 970 miles of lake and river frontage. These parks provide opportunity for visitors to enjoy water-related recreational activities.

Tracking visitation data for these parks can help quantify if recreational opportunities are accessible and attractive to visitors. Data are collected annually by the State Park System and the National Park System. Local parks may not have the same level of data.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

4.149 Initial Data and Results

Initial data were drawn from visitation reports produced by the National and State Park Systems.

The following locations were included in this analysis as water-related park lands in the National Park System: Golden Gate National Recreation Area (NRA), San Francisco National Historic Place (NHP), Point Reyes National Seashore, Fort Point National Historical Site, Muir Woods National Monument (NM), Cabrillo NM, Santa Monica NRA, Whiskeytown NRA, Redwoods National Park, Channel Islands National Park, Rose the Riveter WWII Home Front, Part Chicago Naval Magazine NM. These locations are either along the coast, or inland with a major water feature. Table 4-18 shows the number of visitors to each of these locations in 2015 and 2016.

The State Park System provides waterfront footage for all parks as part of its Annual Statistical Report. Visitors to parks with waterfront footage in each State Park System District are shown in Table 4-19.

Table 4-18. Visitors to Water-Related National Parks in 2015 and 2016

Park Name	2015	2016
Golden Gate NRA	14,888,537	15,638,777
San Francisco Maritime NHP	4,173,014	4,334,752
Point Reyes NS	2,501,106	2,438,442
Fort Point NHS	1,610,466	2,264,154
Muir Woods NM	1,099,923	1,123,121
Cabrillo NM	981,825	959,145
Santa Monica Mountains NRA	797,126	906,606
Whiskeytown NRA	843,845	875,565
Redwood NP	527,143	536,297
Channel Islands NP	324,816	364,807
Rosie The Riveter WWII Home Front	56,362	64,425
Port Chicago Naval Magazine NM	963	1,942

Source: "Reports." National Park Service Visitor Use Statistics. January 30, 2018.

Key:
NHP = National Historic Place
NM = National Monument
NRA = National Recreation Area

Table 4-19. Number of Visitors During 2015-2016 Fiscal Year to California State Parks with Waterfront Footage

State Park System District	Number of Visitors to Parks with Water	Number of Parks with Water not Tracking Visitors	Number of Parks with Water
Angeles	1,736,711	5	10
Bay Area	1,792,628	4	11
Capital	-	0	0
Central Valley	1,181,570	1	9
Channel Coast	2,054,459	2	9
Colorado Desert	495,645	0	3
Gold Fields	1,836,075	4	8
Inland Empire	507,833	0	1
Monterey	5,021,482	1	16
North Coast Redwoods	2,136,194	1	19
Northern Buttes	1,740,341	2	11
Oceano Dunes	2,050,235	0	2
Ocotillo Wells	-	0	0
Orange Coast	9,051,173	1	7
San Andreas	-	0	0
San Diego Coast	8,887,729	2	10
San Luis Obispo Coast	3,146,764	1	7
Santa Cruz	7,805,344	4	21
Sierra	1,919,800	2	11
Sonoma-Mendocino Coast	7,430,157	0	18
Tehachapi	860,592	0	2
Twin Cities	-	0	0

Source: Statistical Report 2015-2016 Fiscal Year. California State Parks. 2016.

4.150 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop. Further work to develop a visual representation of this indicator may show trends in what regions of the state are most affected by impacts from changing climactic conditions on recreational opportunities. An effective way to visually represent this indicator would be a statewide map that would show the percent change by location over a number of years.

If data on local parks are desired, a central database for these parks to provide visitation data to would need to be developed. However, collecting visitation data may remain a problematic aspect of this indicator. Therefore, identifying key locations where trends in hydrologic conditions are most evident through visitation rates may be most useful to guide decision makers.

Therefore, future methodology should establish key locations across the state to track visitation or a set of criteria to determine what parks are included in “Water Related Park Lands.” Additional types of recreational areas may also need to be considered through this indicator, potentially including snow-related or hunting-related recreation. Both these types of recreation, while potentially not covered within park systems, are often impacted by hydrological conditions.

4.151 References

California State Parks. 2016. Statistical Report 2015-16 Fiscal Year. Planning, Recreation and Support Section Marketing and Business Development Office. Viewed online at: https://www.parks.ca.gov/pages/795/files/15-16%20Statistical%20Report%20FINAL%20ONLINE.pdf

U.S. Department of the Interior, National Park Service. “Reports.” National Park Service Visitor Use Statistics. Viewed online at: https://irma.nps.gov/Stats/Reports/Home. Last accessed: January 30, 2018.

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5 Advanced Sustainability Indicators

This section provides summaries of each sustainability indicator that was considered Advanced level as a result of the screening process. Table 5-1 lists all 7 indicators that will not be used for the 2018 pilot studies but should be considered for use in future California Water Plan updates. Prior to use in future California Water Plan updates, the descriptions and targets of these indicators (and potentially the indicators themselves) would need to be revisited and revised to ensure they would be consistent with policies and regulations at the time of their incorporation.

Each assessment of the Advanced sustainability indicators provides the description, importance, insight on the screening process, recommendations, and any references that were utilized. The indicators are divided by each societal value (Public Health and Safety, Ecosystem Vitality, Healthy Economy, and Opportunities for Enriching Experiences) and then further divided by their corresponding intended outcome. Some of the intended outcomes didn't have any indicators that were considered Advanced.

Table 5-1. Comprehensive List of Intended Outcomes and Each Associated Indicator that are Advanced Level

Ref No.	Public Health and Safety
A reliable water supply for domestic needs, sanitation, and fire suppression.	
1	Water Supply Vulnerability to Wildland Fires
2	Percent of Urban Fire Water Systems that Pass 5-year Mandated Inspections
Ecosystem Vitality	
Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.	
3	Deviation from Unimpaired Flows
4	California Integrated Assessment of Watershed Health
5	Number of Fish Rescues to Fish Kills and Fisheries Closed to Recreational and Commercial Activity
6	Forest Health
Achieved designated beneficial uses for water bodies throughout the state	
7	Number of Fish Consumption Advisories
Healthy Economy	
Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.	
8	Real Cost of Water to End User
9	Watershed Drought Response Capacity Index
Opportunities for Enriching Experiences	
Continued and enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces.	
10	Average Distance to Water-Related Recreational Resources

Public Health and Safety

Intended Outcome: A reliable water supply for domestic needs, sanitation, and fire suppression.

PHS: Water Supply Vulnerability to Wildland Fires

This indicator would assess the threat and vulnerability of water supply or water supply systems to wildland fires in California. California is made up of wildfire-prone and fire-adapted landscapes. Natural wildfire has supported ecosystem health and is critical to maintaining the structure and function of ecosystems. However, wildfire poses a significant threat to life, public health, infrastructure and other property, and natural resources.

This composite indicator could take into account multiple factors defined by California Department of Forestry and Fire Protection's (CalFire) Fire and Resource Assessment Program (FRAP), including fire trends, fire threats, fire security, historical wildfire activity, post-fire erosion threat levels, and Fire Return Interval Departure (FRID). The FRAP is required by the California legislature to produce periodic assessments of the forests and rangelands of California.

Scale:	Regional
Potential Data Sources:	CalFire FRAP
Data Availability:	Type II
Metric:	Threat-asset data from FRAP
Screening Status:	**Advanced**

5.1 Importance and Screening Results

California is recognized as one of the most fire-prone landscapes in the world. Research indicates trends of increased fire severity, increases in human infrastructure at risk, and climate change increasing hazards and risk associated with vegetation fires. However, the innate complexities of varying ecosystems and landscapes throughout California make it difficult for statewide and even regional generalizations to capture viable data for water supply vulnerability to wildland fires in California. This indicator is considered Advanced because its future development is directly dependent on the status and advancement of the FRAP indicator assessment.

Representative of Outcome:	Medium
Data Viability:	High
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

5.2 Recommendations

Future work with the CalFire FRAP team could help direct data collection towards analyzing local threatened water supply systems. Current data on threats to water quality focus on prioritizing watersheds with high storage, high post-fire erosion potential, along with other indications of risk of post-fire water quality impacts.

In addition, determining the potential link of this indicator to the economic vitality indicators may help in developing a future methodology for its analysis.

5.3 References

California Department of Forestry and Fire Protection. 2010. Fire and Resource Assessment Program (FRAP): 2010 Assessment. Viewed online at: http://frap.fire.ca.gov/data/assessment2010/pdfs/california_forest_assessment_nov22.pdf

Public Health and Safety

Intended Outcome: A reliable water supply for domestic needs, sanitation, and fire suppression.

PHS: Percent of Urban Fire Water Systems that Pass 5-year Mandated Inspections

This indicator would assess the percent of urban fire water systems that pass 5-year mandated inspections. These inspections assess the ability of water supply systems to provide fire suppression during emergency situations.

The Office of the State Fire Marshal regulates and enforces the State-mandated inspections, supporting CalFire. The mission of the State Fire Marshal is to protect life and property through the development and application of fire prevention engineering, education and enforcement.

Scale:	Regional
Potential Data Sources:	CalFire; Office of the State Fire Marshal; local municipalities and agencies
Data Availability:	Type III or IV
Metric:	Percent of Urban Fire Water Systems
Screening Status:	**Advanced**

5.4 Importance and Screening Results

The percent of local municipalities and agencies passing the mandated inspections for urban fire water systems would provide an indication on the need for additional water supply to protect a community from fire. However, this indicator is considered Advanced and should be viewed as a placeholder for a future indicator that would potentially better address urban fire protection. Currently, while the State Fire Marshall provides regulation and enforcement of the inspection mandate, no centralized database exists Data may only be available at a local level through multiple entities. In addition, the inspection considers a variety of factors, including a lack of maintenance on fire prevention devices, and not only the availability of sufficient water.

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium-High
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

5.5 Recommendations

Future development of an indicator for urban fire protection is required. This indicator may focus on areas at risk of wildland fires rather than the state as a whole. Communities at risk from wildfire are provided through FRAP as Wildland Urban Interface spatial data. The ability to urban areas to withstand wildland fires plays an important role in protection public health and safety. Currently, the lack of available data prevents this indicator from being used to represent its intended outcome.

5.6 References

California Department of Forestry and Fire Protection. 2010. Fire and Resource Assessment Program (FRAP): 2010 Assessment. Viewed online at: http://frap.fire.ca.gov/data/assessment2010/pdfs/california_forest_assessment_nov22.pdf

California Department of Forestry and Fire Protection. "FRAP Projects." California Department of Forestry and Fire Protection. Viewed online at: http://frap.fire.ca.gov/projects/wui/index. Last accessed: December 14, 2017.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV: California Integrated Assessment of Watershed Health

This indicator would identify healthy watersheds and characterize relative watershed health across the state to guide future protection initiatives. This indicator would draw from previous work by the U.S. EPA to develop composite indices as part of the U.S. EPA's California Integrated Assessment of Watershed Health.

For the purpose of this indicator, a healthy watershed is defined as having the structure and function in place to support healthy aquatic ecosystems. The target outcome for this indicator could include a healthy watershed condition, stream health, and minimal vulnerability to future degradation.

Scale:	Statewide
Potential Data Sources:	U.S. EPA
Data Availability:	Type II
Metric:	Composite Indicator
Screening Status:	**Advanced**

5.7 Importance and Screening Results

Healthy waters are a vital part of California's identity and economy. The state's high-quality streams, lakes, and wetlands provide a variety of benefits including supporting key ecological functions. Continued effort to protect existing high-quality waters throughout California can support the effectiveness of current efforts to restore impaired waters and prevent costly restoration in the future.

During the screening process, this indicator was determined to be an Advanced indicator. Although previously developed by the U.S. EPA, additional work and data collection would need accomplished to apply the indicator at a more refined scale throughout the state, potentially down to a watershed scale.

Future assessment would involve a systems approach that views watersheds and their aquatic ecosystems as dynamic and interconnected systems in the landscape connected by surface and ground water and natural vegetative corridors. Watershed health would be quantified across the state at the subwatershed scale from existing statewide geospatial datasets and from predictive models derived from field monitoring data collected as part of existing statewide assessment programs. This information would be further synthesized into indices that describe watershed condition, stream health, and vulnerability to future degradation.

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	High

5.8 Recommendations

This indicator is Advanced level, so framework and guidelines will continue to develop, potentially in parallel with the future development of U.S. EPA's California Integrated Assessment of Watershed Health. There are three main goals established by the California Integrated Assessment:

1. Integrate multi-disciplinary data to both identify healthy watersheds and characterize the relative health of watersheds across the state
2. Make watershed health data and information readily available to a variety of State, Federal, and local programs for watershed protection planning
3. Encourage inter-agency partnerships and collaboration to build upon previous efforts to assess watershed health and protect healthy watersheds

As part of the last two goals, additional collaboration with the U.S. EPA is recommended to further develop this indicator in the future. For example, the current report recommends placing the data layers used in the initial analysis into publicly available GIS files.

5.9 References

U.S. Environmental Protection Agency. 2013. California Integrated Assessment of Watershed Health. Prepared by: The Cadmus Group, Inc. Viewed online at: https://www.epa.gov/sites/production/files/2015-11/documents/ca_hw_report_111213_0.pdf

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV: Deviation from Unimpaired Flows

This indicator would provide an assessment of what instream flows would be without factors that impair natural flows, such as reservoir regulation or hydrologic conditions. Flow standards and objectives help protect habitat and migratory signals for native fish species. This indicator may be more relevant in regions or watersheds that contain water bodies heavily regulated by reservoir operations, such as the San Joaquin region.

Scale:	Regional
Potential Data Sources:	State Water Board; DWR; USGS
Data Availability:	Type II
Metric:	Percentage of unimpaired flows
Screening Status:	**Advanced**

5.10 Importance and Screening Results

Currently, many of California's streams do not have adequate flows or seasonal variability of flows to support and protect fisheries and other ecological processes. Decreasing deviation from unimpaired flows through changes in reservoir regulation could help partially restore the natural functions of certain streams and rivers in California.

Currently, most reservoirs do not provide environmental flows. However, with new and updated flow standards and objectives for the San Joaquin River and southern Delta set by the State Water Board, the State continues to develop methods to improve environmental conditions even on impaired streams. Monitoring the deviation from expected unimpaired flows could show progress in meeting standards and objectives in applicable watersheds.

The viability of current data is unknown. This indicator may be highly variable and dependent on hydrologic condition. Therefore, this indicator was determined to be an Advanced indicator during the screening process.

Representative of Outcome:	Medium
Data Viability:	High
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

5.11 Recommendations

This indicator is Advanced level and will not be included as a sustainability indicator for the 2018 CWP Update. In the future, the methodology for assessing this indicator could be developed by comparing actual to models of unimpaired flows during periods particularly important to ecosystem functions. This indicator may only apply to certain watersheds in the state.

5.12 References

State Water Resources Control Board. “Development of Flow Objectives (Phase 4 of Bay-Delta Effort).” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/flow_objectives/index.shtml. Last accessed: December 14, 2017.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

Number of Fish Rescues to Fish Kills and Fisheries Closed to Recreational and Commercial Activity

This indicator assesses the number of fish rescues and fisheries closed to recreational and commercial activity. Fish rescues and closures may occur when stream or water body conditions, such as inadequate flow or temperature, are unable to support fish populations. When large releases are made from dams, fish may require rescue to avoid stranding in side-channel habitat. For example, the high flows from Oroville Dam's broken spillway (2017) were rapidly decreased and fish rescues were required to prevent stranding of native fish species, such as Chinook salmon. CDFW oversees all fisheries closures and fish rescues and continues to work with DWR, Reclamation, and other dam operators to regulate release patterns and minimize the risk of stranding.

However, CDFW does not currently store historical data on fish rescues, kills, and fisheries closed to recreational and commercial activity. Therefore, although this indicator was considered Basic during the initial screening process, it has been moved to an Advanced indicator

The target outcome of this indicator is pending, but would be based on the data collected to evaluate the indicator. A likely target outcome to consider would be a high fish rescue to fish kill ratio and zero fisheries closed to recreational and commercial activity.

Scale:	Regional
Data Sources:	CDFW
Data Availability:	Type III
Metric:	Ratio of fish rescues to fish kills and fisheries closures
Screening Status:	**Watershed**

5.13 Importance and Screening Considerations

Fish species in California waterways have generally declined over time in response to changing habitat and flows. Fish are vital to maintaining the health of California waterways because they store a large proportion of ecosystem nutrients in their tissues, transport nutrients farther than other aquatic animals, and excrete nutrients that are readily available to primary producers. Ecosystems that depend on fish may be negatively impacted when large populations of fish are killed from stranding or other poor water quality issues, such as inadequate water temperatures.

This indicator was considered Watershed level, but is currently classified as an Advanced indicator based on the data that was found during further indicator development. This indicator may not be as relevant in areas throughout Southern California, but it could be a good indicator of ecological functions in coastal watersheds, the Delta, and portions of Northern California and the Central Valley. However, this indicator scored relatively low in the data viability, potential longevity, and supportive of decision making categories. Multiple agencies may hold information on this indicator, but no comprehensive, easily accessible database current exists that records historical fish rescues or fishery closures. In addition, this indicator may not present enough information to be supportive of decision making or to provide a statewide assessment of functioning ecosystems.

Representative of Outcome:	Low-Medium
Data Viability:	Low
Cost:	High
Potential Longevity:	Low-Medium
Supportive of Decision Making:	Low-Medium

5.14 Initial Data and Results

Due to lack of a centralized database or historical data on fish rescues and fishery closures, there are no data or results to evaluate the indicator at this time. Further refinements to this indicator and a potential methodology are presented below.

5.15 Recommendations

This indicator is considered an Advanced level indicator. Once data is better developed, further work should be considered to determine the fish rescue to fish kill ratio and occurrences of fisheries closed to recreational and commercial activity.

In April 2016, the CDFW adopted regulations which grant CDFW authority to temporarily close fisheries experiencing degraded environmental conditions that may affect fish populations or their habitat within waters of the state. CDFW has developed a set of triggers to guide fishing closure and reopening decisions that are based on the most current monitoring information available. At present, only current inland fishery closures are posted on the CDFW site. In the future, a historical database should be developed for inland fishery closures as the adopted regulations continue to be enforced. For coastal and commercial fisheries, there are no available data for fish rescues or closures.

For future CWP updates, a geocoded map with watersheds color coded by the ratio of fish rescues to fish kills per watershed as the base that highlights the locations of fishery closures over the last five years, would be an appropriate way to visually represent this indicator. To obtain data, the CDFW would need to track their historical fish closures and track the number of fish rescues and kills caused by drought, inadequate reservoir operations, or other adverse conditions.

5.16 References

California Department of Fish and Wildlife. Fish and Games Commission. Viewed online at: http://www.fgc.ca.gov/. Last accessed: February 12, 2018.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

Forest Health

This indicator would combine multiple sets of data to assess the acreage of healthy forests in California. Healthy forests would be managed to improve heterogeneity in tree size and species, limit fuel loads and conditions that cause unmanageable wildfires, preserve snowpack, and increase runoff into watersheds.

The target outcome of this indicator is pending, but would be based on the determination of what factors are most indicative of a healthy managed forest that results in these stated outcomes.

Scale:	Regional
Data Sources:	Sierra Nevada Conservancy,
Data Availability:	Type IV
Metric:	To be determined.
Screening Status:	**Advanced**

5.17 Importance and Screening Considerations

Historically, many forests in California are adapted to frequent, low intensity fires. Current forest conditions, especially in low and middle elevation forests, are the result of fire suppression programs in the past century. These forests adapted to frequent, low intensity fires. In dry forest types, this legacy of fire suppression has resulted in dense, homogenous forests. These forests have high water demands and fuel loads. Catastrophic fires result when these fuel loads burn.

Efforts led by the Sierra Nevada Conservancy are working to develop an overall forest health indicator and determine what data must be developed to apply it on a large scale throughout the Sierra Nevada. These efforts could potentially be expanded to other Californian forests. However, data sets related to forest health are currently limited to individual studies. Therefore, this indicator is considered an Advanced indicator, despite its ability to support decision making. This indicator may not be relevant in desert, rural, or agricultural areas of the state. The indicator may be adapted for and potentially be applied to chaparral areas of the state, which have also faced fire suppression in the past century.

Representative of Outcome:	High
Data Viability:	Low
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	High

5.18 Initial Data and Results

No consensus is available on the best indicator of a healthy forest. Therefore, no data or results are presented for this indicator at this time.

5.19 Recommendations

This indicator is considered an Advanced level indicator. A collection of agencies are developing indicators for forest health. Once additional consensus is reached and centralized data is available, further work could allow a forest health indicator to be applied statewide.

5.20 References

Boisramé, Gabrielle; Thompson, Sally; Collins, Brandon; Stephens, Scott. 2017. Managed wildfire effects on forest resilience and water in the Sierra Nevada. Ecosystems. 20(4): 717-732. https://doi.org/10.1007/s10021-016-0048-1.

Sierra Nevada Adaptive Management Project. 2015. Appendix E: Water Team Final Report. Viewed online at: http://snamp.cnr.berkeley.edu/static/documents/2016/01/25/E_Water_quantity_and_quality_chapter_Final_Dec_14_2015compressed.pdf. Last accessed: May 4, 2018.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

Number of Fish Consumption Advisories

This indicator assesses the number of fish consumption advisories statewide. This indicator is similar to *PHS 6: Potential for Consumption of Mercury-Contaminated Fish,* but this indicator evaluates consumption advisories rather than the potential for consumption.

Fish consumption advisories are prompted by the OEHHA. The OEHHA provides recommendation on how often you can safely eat certain types of fish from water bodies in California. Most advisories are issued because of mercury in fish. The target outcome for this indicator would be zero fish advisories are required in the state. However, a statewide advisory is currently enacted across all state water bodies. Therefore, although this indicator was considered Basic during the initial screening process, it has been moved to an Advanced indicator. Unless site-specific advisories have been established for all water bodies, analyzing this indicator will not produce useful information to analyze the progress of policy decisions. Currently, this indicator showing increases in fish advisories would indicate additional data was analyzed by OEHHA, rather than an increase in polluted water bodies.

Scale:	Statewide
Data Sources:	OEHHA
Data Availability:	Type I
Metric:	Number of Fish Advisories
Screening Status:	**Advanced**

5.21 Importance and Screening Considerations

Fishing is a popular activity enjoyed by many Californians throughout the state, however fish may contain pollutants that can harm human health if consumed too often at high concentrations. The most common chemicals found in California fish are mercury and polychlorinated biphenlyls, and sometimes dichloro-diphenyl-trichloroethane and dieldrin, which are common constituents of concern in California water bodies. Fish consumption advisories issued by OEHAA help lower the risk associated with consuming contaminated fish by providing the public with information on safe eating guidelines on both statewide and site-specific levels.

This indicator was considered Basic level, but is currently classified as an Advanced indicator based on the data that was found during further indicator development. California's OEHHA already keeps information on fish advisories throughout the state. This indicator is easy to understand by various decision makers and data are easy to access statewide. This indicator reflects ecosystem vitality, but can also represent public health and safety concerns.

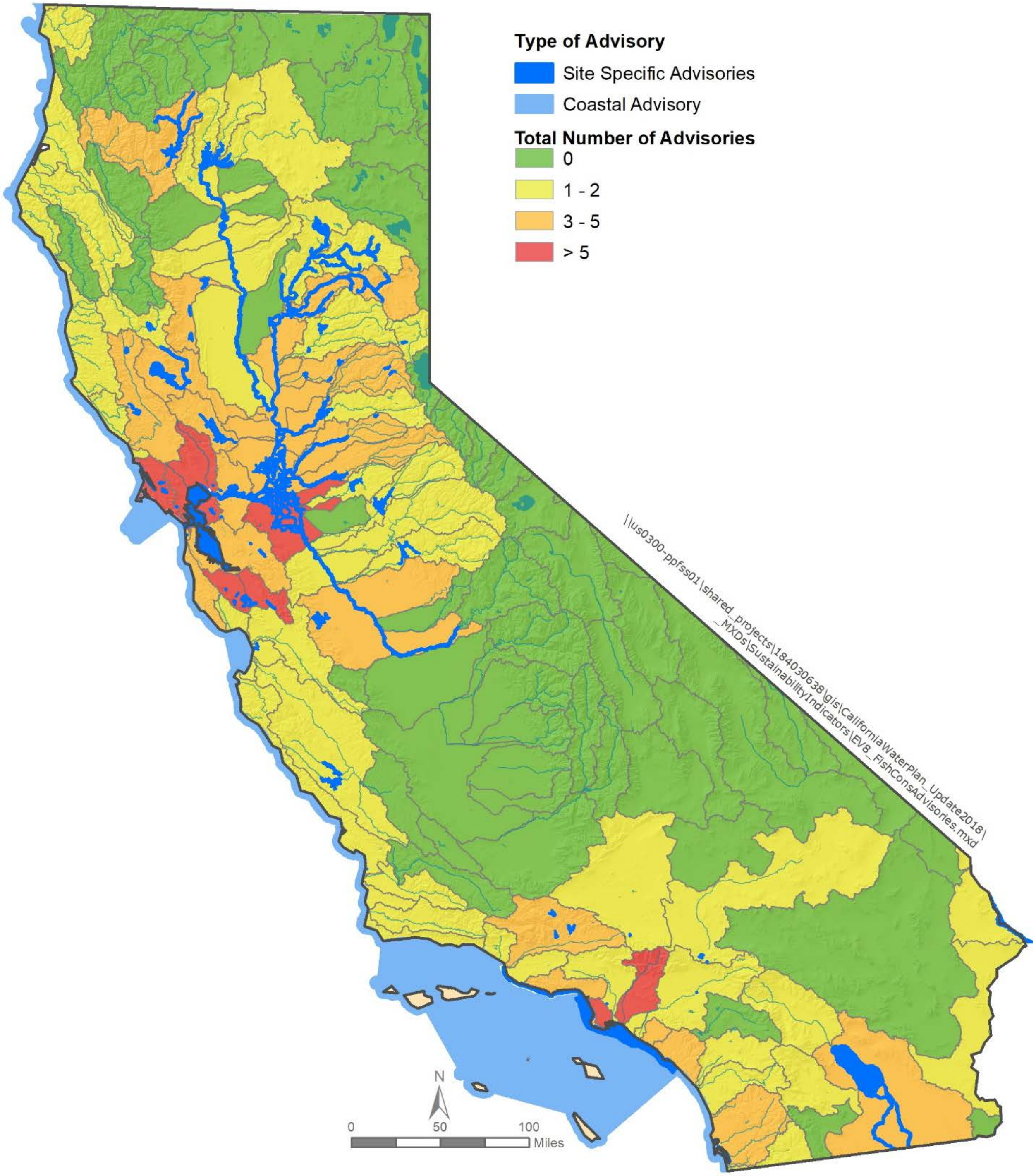
However, since OEHHA considers all water bodies under a statewide advisory, the potential trends in the data will not produce useful information on the outcome. Until a statewide advisory is broken down into site specific advisories, this indicator will not be supportive of decision making.

Representative of Outcome:	High
Data Viability:	Medium-High
Cost:	Low-Medium
Potential Longevity:	Medium
Supportive of Decision Making:	High

5.22 Recommendations

This indicator is considered an Advanced level indicator. Once data is better developed, further work should be considered to determine the rate in which fish advisories are being issued and redacted. OEHHA should continue to provide advisories for water bodies as further analysis continues at individual sites. In addition, OEHHA should develop a collective shapefile download for all advisories, rather than individual downloads for recent advisories, to allow for an easier analysis of all fish consumption advisories throughout the state.

Although this indicator has been classified as an Advanced level indicator, initial data on the current set of site-specific advisory locations and their enacted dates were downloaded from OEHHA’s website. The OEHHA provides GIS files for certain advisories. For advisories where no GIS file was provided for download, additional sources were used to supplement OEHHA’s data. The total number of advisories per watershed was calculated. Both the location of the individual advisories and the number per watershed are displayed in Figure 4-36. Although these advisories vary in severity, areas with higher populations have watersheds with more advisories. Ninety-four site specific advisories have been added by OEHHA since 1987.



Source: “Fish Advisories.” Office of Environmental Health Hazard Assessment. November 14, 2017.
Figure 4-36. Number of Fish Consumption Advisories

5.23 References

Office of Environmental Health Hazard Assessment. “Fish Advisories.” Office of Environmental Health Hazard Assessment. Viewed online at: https://oehha.ca.gov/fish/advisories. Last accessed: November 14, 2017.

State Water Resources Control Board. “Statewide Mercury Provisions.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/mercury/. Last accessed: January 23, 2018.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.

HE: Real Cost of Water to End User

This indicator would help assess the real cost of water to end users. Factors included in the real cost of water to end users include treatment costs, conveyance costs, and costs for infrastructure development, improvement, and rehabilitation. The target outcome for this indicator is that the real cost of water to end users represents a fair and economical cost, similar to the cost to actually produce the water.

Scale:	Statewide
Potential Data Sources:	DWR; SWP Billings
Data Availability:	Type III
Metric:	Real Cost of Water ($)
Screening Status:	**Advanced**

5.24 Importance and Screening Results

While the economic value of water is difficult to determine, regardless of its final purpose, the real cost of water to its end users would be indicative of changes in water’s affordability in California. Much of the state’s water supply, wastewater, and flood control infrastructure is aging. Rehabilitation and maintenance often includes improvements to meet increasingly high standards for water quality and infrastructure safety. Climate change and water shortages can also drive changes in the real cost of water.

The screening process determined this indicator is an Advanced indicator. No current methodology exists to evaluate the real cost of water to end users. Different regions, systems, and stakeholders consider different factors in calculating the real cost of water. Therefore, without an established framework, this indicator cannot yet be fully developed.

Representative of Outcome:	High
Data Viability:	Medium
Cost:	High
Potential Longevity:	Medium-High
Supportive of Decision Making:	Medium-High

5.25 Recommendations

This indicator is Advanced level, so framework and guidelines will continue to develop once more reliable data or methodologies exist. The methodology for this indicator would be developed to consider the total costs involved to secure, transport, treat, and deliver water supplies to end users. This indicator may need to be evaluated by region to note trends in the cost of water regionally and statewide.

5.26 References

None.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.

HE: Watershed Drought Response Capacity Index

This indicator would develop a watershed drought response capacity index to assess and rank watersheds based on their vulnerability to a multi-year drought. This new index would consider the following aspects of each watershed:

- Population reliant on water supply sources
- Water supply assets (regional and imported)
- Operational Flexibility
- Carryover storage capacity in surface and groundwater supplies

Each watershed faces unique drought conditions and has varying capacity to respond to multi-year droughts. A composite index would support statewide comparison of watersheds.

Scale:	Regional
Potential Data Sources:	Local and State entities
Data Availability:	Type IV
Metric:	Composite index
Screening Status:	**Advanced**

5.27 Importance and Screening Results

The 2012-2016 drought conditions in California underscored both the importance of water use efficiency and the need to achieve greater resilience in the face of varying hydrologic conditions. The period from 2012 through 2014 are on record as California's driest three consecutive years with respect to statewide precipitation. During this multiyear drought, many communities were unable to provide stable, safe water supplies to their residents for household uses. Assessing the vulnerability of watersheds to multi-year droughts would help the state assess what areas require additional development of resilience against drought conditions.

Since no index has been developed and data availability is unknown, the screening process placed this indicator on an Advanced level. However, an index considering population, water supply, operational flexibility, and carryover storage capacity would be representative of the intended outcome and highly supportive of decision making.

Representative of Outcome:	Medium-High
Data Viability:	Medium
Cost:	High
Potential Longevity:	High
Supportive of Decision Making:	High

5.28 Recommendations

Methodology for this indicator should be developed as data becomes more widely available. The methodology should focus on developing a widely applicable index value to compare the vulnerability of individual watersheds' and regions' water supply to multi-year droughts.

5.29 References

State Water Resources Control Board. "Drought Preparedness, Water Conservation and Water Supply Emergency Response." State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/DroughtPreparedness.shtml. Last accessed: December 14, 2017.

Opportunities for Enriching Experiences

Intended Outcome: Continued and enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces.

OEE: Average Distance to Water-related Recreational Resources

This indicator would assess the average distance to water-related recreational resources to help determine the accessibility to water-related resources throughout California. Data for this indicator would be developed using maps or location assessments provide by California Department of Parks and Recreation coupled with the average distance from the center of mass of populations to water-related parks.

Scale:	Statewide
Potential Data Sources:	California Department of Parks and Recreation
Data Availability:	Type III
Metric:	Distance (miles) from population centers
Screening Status:	**Advanced**

5.30 Importance and Screening Results

Although there are ample water-related State lands and parks throughout California, inaccessibility due to the amount of travel required to access these State lands and parks may prevent all Californians from enjoying these spaces.

This indicator was considered Advanced during the screening process, because while it would be fairly representative of its outcome and supportive of decision making, significant data and methodology development would be required.

Representative of Outcome:	Medium
Data Viability:	Low-Medium
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

5.31 Recommendations

This indicator is Advanced level and should be considered a future indicator. Methodology for this indicator may be similar to how city and county recreational assessments evaluate the need for investments in community recreational facilities. This indicator would assess several factors such as the effect of distance on visitor use days or overall accessibility of the water-related resources.

5.32 References

None

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6 Archived Sustainability Indicators

This section provides a brief description of each sustainability indicator that was archived during the planning process. Table 6-1 lists the 40 indicators that were archived during the planning process for each intended outcome. Indicators were archived for several reasons, with the most common reasons including lack of access to viable data, overlap with other indicators, or the indicator was not representative of the intended outcome.

Each description provides insight on the screening process and why each indicator was chosen to be archived instead of included as an indicator to use in the 2018 pilot studies or future California Water Plan Updates.

Table 6-1. Comprehensive List of Archived Indicators that will not be Considered as Sustainability Indicators for Future California Water Plans

Ref No.	Public Health and Safety
A reliable water supply for domestic needs, sanitation, and fire suppression.	
1	Number of Dry Water Supply Wells
2	Number of Water Bottles Distributed
3	Number of Private Water Supply Wells
4	Number of People and Percent of Population Relying on Contaminated Groundwater for Domestic Water Supply
5	Number of Native American Tribal Communities without Access to Reliable Water Supplies
Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents.	
6	Mercury Levels in Fish Consumed by Humans
7	Number of Small Systems on Fractured Groundwater Sources
Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)	
8	Number of Days per Year that CVP and SWP Facilities Experience Unplanned Service Outages
9	Population in Floodplains with Equal to or Greater than 0.2 Percent Chance of Flooding in any Given Year
Ecosystem Vitality	
Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness	
10	Water Temperature, Chemistry, and Pollutant/Nutrient Concentrations and Dynamics
11	Water Quantity and Availability for Environmental Purposes

Table 6-1. Comprehensive List of Archived Indicators that will not be Considered as Sustainability Indicators for Future California Water Plans (contd.)

Ref No.	Public Health and Safety
Healthy Economy	
Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.	
12	Changed is Water Use of Water Bodies
13	Percent of Communities Showing a Neutral (or excess) Water Balance in their Approved UWMP/AWMPs
14	Drought Carryover Storage in Reservoirs
15	Groundwater Levels and Quality
16	Groundwater Wells that do not Meet Drinking Water Quality Standards
17	Water Available for Groundwater Recharge
18	Value of Agriculture Production per Acre Foot delivered
19	Number of Acres Under Production Experiencing Water Stress
Consideration of economic risks and rewards of floodplains, rivers, and coastal areas.	
20	Number of Sea-Level Rise Preparedness Assessments Completed per Assembly Bill 691
21	Economic Value of Lands Held in Conservation and Open Space
22	Improvement to Flood Safety
More benefits from economic activities, including from reduced costs to provide a given level of service (including transaction and permitting costs).	
23	Public and Legislative Support for Water Measures
24	Comparison of Water Rates and Household Income to the National Average Rates
25	Compare Gross Domestic Product to Gallons per Capita per Day
26	Number of Water Facilities that are Beyond Design Life
27	Book Value of Assets in Water Infrastructure and Replacement Costs
28	FERC Licenses and Number of Renewals (50 Year Licenses)
29	Land Use Changes - Agricultural/Urban/Industrial/Open Space
30	Water Transfers (water moving from higher to valued users)
31	Social Safety (water used for industry instead of agriculture)
32	[Gross Domestic Product]/[Consumptive Use]
33	Consumer Price Index vs. Aggregated Cost of Service (all agencies)
34	Change in End Use (agriculture, urban, industrial, open space) Mapped
35	Five Year Rolling Average of Hydropower Generation vs. Total Generated
Reduced likelihood or occurrence of significant social disruption following a disaster.	
36	Number (cumulative) of Water-Related Emergency Declarations Over Time
37	Lost Business Income from Water-Related Emergency Declarations

Table 6-1. Comprehensive List of Archived Indicators that will not be Considered as Sustainability Indicators for Future California Water Plans (contd.)

Ref No.	Public Health and Safety
Opportunities for Enriching Experiences	
Preserved or enhanced culturally or historically significant sites and communities, including continued and enhanced access to water and land used for sacred ceremonies or cultural practices.	
38	Number of Qualified Historical Buildings or Places at Risk of Losing Reliable Water Supplies
Preserved and increased natural areas with aesthetic or intrinsic value (including viewshed).	
39	Statewide Open Space
40	Conserved Lands Adjacent to California Waterways (acreage)
41	Land Conservation Williamson Act Enrollment (acreage)
Continued and enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces.	
42	Number of Communities Without Access to Water-Related State Lands, Parks, or Resources
43	Change in Water Bodies that Allow Contact Recreation
44	Change in Miles of Boatable (Recreational) Waterways

Key:
AWMP = Agricultural Water Management Plan
FERC = Federal Energy Regulatory Commission
UWMP = Urban Water Management Plan

Public Health and Safety

Intended Outcome: A reliable water supply for domestic needs, sanitation, and fire suppression

PHS: Number of Dry Water Supply Wells

This indicator would assess the number of water supply wells that are dry.

Screening Process

Representative of Outcome:	Low
Data Viability:	Low
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- Good indicator in some watersheds that have a strong dependence on groundwater, but not reflective on a statewide scale.
- Data are collected by dispersed entities.
- Data are less accessible for rural areas.

PHS: Number of Water Bottles Distributed

This indicator would assess the number of water bottles distributed in communities or areas where access to reliable water supply is challenging. Lack of access to adequate water supplies to meet basic domestic needs can be caused by a variety of underlying conditions, including drought, poor water quality, affordability, insufficient infrastructure, and others. In some cases, bottled or tanked water must be transported into these communities to meet basic needs.

Screening Process

Representative of Outcome:	Low
Data Viability:	Medium
Cost:	Low
Potential Longevity:	Low
Supportive of Decision Making:	High

This indicator was archived for the following reasons:

- This indicator would not show trends because it is event driven.
- Water bottles are typically distributed during certain timeframes when public health and safety is facing a direct threat, such as during drought or wildfire events.

- There are limited data available and when there are data, it would require significant coordination between multiple entities in different sectors (churches verses local municipalities).

PHS: Number of Private Water Supply Wells

This indicator would assess the number of private water supply wells in California. Up to 2 million California residents are served either by domestic private wells or by water systems serving fewer than 15 service connections. Private domestic well owners are responsible for maintaining their well and are encouraged to test their well water quality, but there are no current State regulations on private wells.

Screening Process

Representative of Outcome:	Low
Data Viability:	Medium
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- The number of private water supply wells is neither good nor bad for the intended outcome.
- It is hard to determine the amount of water that is actually supplied by private wells due to lack of regulations.
- Some wells that would be considered in the evaluation of this indicator may not be active or may supply very little water.
- Data are not available for the water quality or quantity from private water supply wells.

PHS: Number of People and Percent of Population Relying on Contaminated Groundwater for Domestic Water Supply

This indicator would assess the percent of the population reliant on contaminated groundwater for domestic water supply purposes, targeting zero percentage of the population relying on contaminated groundwater. For this indicator, a population that relies on contaminated groundwater was initially defined as a public water system that draws water from a contaminated groundwater source prior to any treatment. Most contamination is removed during the treatment processes. However, private domestic wells, without the same regulations for monitoring and treatment, remain at risk.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium-High
Potential Longevity:	Medium
Supportive of Decision Making:	High

This indicator was archived for the following reasons:

- Although considered as a Watershed indicator after the initial screening process, information on groundwater contamination was condensed into *HE 7, Contaminated Groundwater Wells.*

- The initial methodology for evaluating this indicator was based on the State Water Board's report, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water*. The report only analyzed data from groundwater sampled directly from a well or groundwater sampled at a point between the well and a treatment system. This methodology was considered less applicable than considering all contaminated groundwater wells in the State.

PHS: Number of Native American Tribal Communities without Access to Reliable Water Supplies

This indicator would assess the number of tribes and tribal communities without access to reliable and safe water supplies. A positive trend for this indicator is a decrease in the number of tribal communities without access to reliable water supply. The target outcome for this indicator would be that all Native American Tribal Communities have access to reliable water supplies.

The 1988 amendments to the IHCIA require the IHS to maintain inventories of sanitation deficiencies for new and existing American Indian and Alaskan Native homes and communities. Data from IHS have previously been used to determine the number of homes with certain IHS Deficiency Levels in Update 2013.

Screening Process

Representative of Outcome:	High
Data Viability:	Medium - High
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	High

This indicator was archived for the following reasons:

- Although considered as a Basic indicator after the initial screening process, information specific to Native American Tribal Communities was combined into *PHS 1, Population and Percentage of Population with Reliable Domestic Water Supplies*, and *PHS 2, Population and Percentage of Population without Access to Reliable Sanitation.*

- Originally, this indicator was found to be highly representative of its target outcome, as having reliable access to safe drinking water is a direct indicator of public health and safety. Extensive data exist in the IHS STARS database, and these data are readily compiled for analysis of this indicator. This indicator, supportive of decision making, shows California how well the water supply is managed for tribal communities and whether or not changes to management practices and/or policies need to be made.

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS: Mercury Levels in Fish Consumed by Humans

This indicator would assess the levels of mercury in fish consumed by humans in California. Mercury is considered a toxic substance in the human body and is also included as a constituent of concern for many water bodies on the 303(d) impaired water bodies list. The Clean Water Act Section 303(d) List is a list of impaired and threatened waters (streams, river segments, lakes) that have identified the pollutants causing the impairment.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	Low-Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- Another indicator has been identified *(PHS 6, Potential for Consumption of Mercury-Contaminated Fish*) and further assessed that is more representative of the intended outcome. This indicator was eliminated so the evaluation of mercury concentrations was already represented.

PHS: Number of Small Systems on Fractured Rock Groundwater Sources

This indicator would assess the number of water systems on fractured rock groundwater sources. Groundwater contamination by microbiological contaminants may be a concern when water wells are improperly sealed, or when there is release of sewage or seepage directly into groundwater.

Screening Process

Representative of Outcome:	Low
Data Viability:	Low-Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Low

This indicator was archived for the following reasons:

- This indicator would only apply to communities who rely on groundwater sources.

- This indicator may only be indicative in rural communities.

- The assessment of this indicator would only provide the potential for the impact on the groundwater sources.

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

No indicators considered during the planning process were archived for this intended outcome.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS: Number of Days per Year that CVP and SWP Facilities Experience Unplanned Service Outages

This indicator would assess the number of days per year that CVP and SWP facilities experience unplanned service outages. CVP and SWP facilities support water supplies for a variety of purposes. The CVP and SWP play major roles in California's water supply and water storage system. Many regions in California rely heavily on water from the CVP and SWP systems. The CVP extends from the Trinity Dam in the Cascade Range south along the San Luis Canal and Friant-Kern Canal, including several major dams along the western Sierra Nevada. Major features of the SWP include Oroville Dam, San Luis Reservoir (a shared facility with the CVP), and the California Aqueduct. Both these projects serve many purposes including providing water storage and delivery for domestic, agricultural, and industrial needs; providing flood protection; generating hydropower; and supporting recreational opportunities.

6.1 Screening Consideration

This indicator is considered a Basic level indicator. The SWP collects data on outages through its Operations Control Office. The Annual Report of Operations for the SWP provides monthly and end-of-year status of its water and power operations. The report also provides data on SWP service outages. A similar report does not exist for CVP facilities.

Representative of Outcome:	Medium
Data Viability:	High
Cost:	Medium-High
Potential Longevity:	High
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- Although initial data was collected, no information was available to link unplanned service outage data to decreases in deliveries. Redundant systems in place often prevent health and safety impacts during outages.

- Initial data were provided for the SWP through personal communications with DWR's Outage Management Branch. These data covered "Noteworthy Forced Outages" throughout the SWP system during the 2017 calendar year. In total, 125 forced outages lasting over 24 hours occurred in 2017 for a total of 34,840 combined hours of lost operations in pumps and generators at various facilities. Thirty-three of these lasted over three days.

- No data is publicly available for the CVP.

6.2 Recommendations

This indicator is considered a Basic level indicator, so the guidelines and framework for measuring the indicator will continue to develop.

Further work should be done to determine the impact of unplanned service outages on deliveries to accurately represent this indicator’s intended outcome. In addition, data collection on the CVP through coordination with Reclamation is necessary to fully characterize both major water delivery systems.

6.3 References

California Department of Water Resources. “State Water Project Annual Report of Operations.” Last accessed: February 6, 2018.

U.S. Department of the Interior, Bureau of Reclamation. “Central Valley Operations Office.” U.S. Department of the Interior, Bureau of Reclamation. Viewed online at: https://www.usbr.gov/mp/cvo/index.html. Last accessed: February 15, 2018.

PHS: Population in Floodplains with Equal to or Greater than 0.2 Percent Chance of Flooding in any Given Year

This indicator would assess the population that lives in floodplains with equal to or greater than a 0.2 percent chance of flooding in any given year throughout the state. During initial indicator development, some feedback related to reflecting more frequent flooding events (i.e., 2 percent change of flooding in any given year, or 50-year floodplains). As the state is experiencing increasingly intense and more frequent extreme events (droughts and floods), and no State of Federal agencies currently develop or maintain 50-year floodplain maps, this indicator was formulated for 500-year floodplains.

6.4 Screening Considerations

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Low
Potential Longevity:	High
Supportive of Decision Making:	High

This indicator was archived for the following reasons:

- Due to the similarity in subject and methodology, this indicator was incorporated into *PHS 10, Population within Floodplains with Equal to or Greater than 1 Percent Change of Flooding in any Given Year*.

Ecosystem Vitality

Intended Outcome: Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.

EV: Water Temperature, Chemistry, and Pollutant/Nutrient Concentrations and Dynamics

This indicator would assess several criteria related to water quality including water temperature, chemistry, and pollutant/nutrient concentrations. Specifically, this indicator would assess water bodies on a case by case basis by utilizing the constituents listed on the Clean Water Act Section 303(d) List for each water body.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- Although measurable characteristics of systems are indicators of overall ecological health, the assessment of whether they're good or bad is dependent on specific biological processes.
- Ecosystems require different water temperatures and chemistry to thrive, which would make this indicator difficult to assess on a statewide scale.
- Other indicators have been identified as Basic in the Ecosystem Vitality Sustainability Outlook assessment that would capture overall watershed ecological health more effectively,

EV: Water Quantity and Availability for Environmental Purposes

This indicator assesses the amount of water available for environmental purposes. Water for environmental purposes would include water for refuge water supply, instream flow standards, water temperature and flow requirements, and timing of flows. Water availability and quantity are dependent on each other and on water rights, so this indicator would be a composite indicator of water quantity, timing, and quality. The CDFW helps set and enforce instream flow standards and ensure refuge water supplies are allocated throughout the state.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium-High
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- Water availability and quantity are dependent on each other and on water rights, so this indicator would be considered a composite indicator that would require evaluation of water quantity, timing, and quality.
- The data are highly dependent on regulatory requirements and water rights.
- There is no existing comprehensive data set to assess this indicator.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California

No indicators considered during the planning process were archived for this intended outcome.

Ecosystem Vitality

Intended Outcome: Achieved designated beneficial uses for water bodies throughout the state.

No indicators considered during the planning process were archived for this intended outcome.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.

HE: Changes in Water Use of Water Bodies

This indicator would assess the change in water use of water bodies throughout the state, which would be indicative of evolving water demands based on economic needs. Water, like any resource, will move to the highest value purpose. For example, a reservoir that was once considered for agricultural needs could be converted to a municipal water supply as a result of urban population growth nearby. Each purpose would define a different baseline for water use, which would have different impacts to California's economy. This assessment could also be indicative of demographics.

Screening Process

Representative of Outcome:	Low
Data Viability:	Medium
Cost:	Low
Potential Longevity:	Low
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- Although it would be indicative of the ability of California's water system to remain flexible based on economic or demographic needs, the accessibility of data may be difficult with respect to tracing the amount of water that is used for agricultural purposes.
- Difficulties would arise when trying to obtain data from all agricultural communities throughout the state, which would produce significant data gaps.

HE: Percent of Communities Showing a Neutral (or excess) Water Balance in their Approved Urban Water Management Plan and/or Agricultural Water Management Plan

This indicator would assess the number or percentage of communities that show a neutral or excess water balance in their approved UWMPs or their Agricultural Water Management Plans (AWMP). Based on the supply provided by urban water suppliers or agricultural water suppliers, DWR requires suppliers to develop and submit either a UWMP or AWMP that meets requirements identified in the California Water Code. For the purposes of this indicator, an excess water balance would show an excess in water supply.

Screening Process

Representative of Outcome:	Low
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Low
Supportive of Decision Making:	Low

This indicator was archived for the following reasons:

- Not all urban or agricultural water suppliers are required to submit UWMPs or AWMPs, so there would be significant data gaps statewide and regionally.
- Not all regions throughout the state have water budgets, such as areas that rely heavily on groundwater.

HE: Drought Carryover Storage in Reservoirs

This indicator would assess the drought carryover storage in reservoirs throughout California. Carryover storage is defined as the water stored as spills at the end of one year that is carried over to the next.

Screening Process

Representative of Outcome:	Medium
Data Viability:	High
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- Carryover storage is dependent on operational agreements and regulatory factors that may or may not be indicative of problems associated with water supply reliability.
- Carryover storage is highly dependent on hydrologic conditions, which would make the data hard to assess long term.
- An indicator that would be more focused on water availability during an emergency response would be more representative of the intended outcome.

HE: Groundwater Levels and Quality

This indicator would assess groundwater levels and quality throughout California's groundwater basins. SGMA requires locally managed groundwater sustainability agencies to implement sustainability plans requiring the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

Screening Process

Representative of Outcome:	Low
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- Data viability is not an issue with groundwater levels and quality, but some of the data associated with this indicator would overlap with other indicators that would be more representative of the outcome.

HE: Water Available for Groundwater Recharge

Groundwater aquifers can act as underground reservoirs that can accommodate excess water and ease the pressure on our surface water reservoirs that can accommodate excess water during wet years. Groundwater recharge can either occur naturally or artificially.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	Low-Medium
Cost:	Medium-High
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- Currently, groundwater basins do not collect this type of data year to year.

- There are other indicators developed that achieve a similar evaluation and are more representative of the intended outcome.

HE: Value of Agriculture Production per Acre Foot Water Delivered

This indicator would assess the value of the agriculture production per acre foot of water delivered to agricultural crops. California's agriculture is a diverse and dynamic sector of the state's economy. This sector is also a significant consumer of California's water and energy.

Screening Process

Representative of Outcome:	Low
Data Viability:	Low
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- There are a variety of crops produced throughout California, so the evaluation would need to either evaluate all types of crops or pick several crops that would be representative of a range of values.
- This presents multiple challenges, such as determining which crops best represent the value of agricultural production.
- This indicator is more relevant in agricultural regions in California and may not be representative statewide.

HE: Number of Acres under Production Experiencing Water Stress

This indicator would assess the acreage of agricultural production that is experiencing stress from inadequate water supply reliability. California's water system is often stretched and particularly in more rural communities where a lot of agricultural production occurs.

Screening Process

Representative of Outcome:	Medium-High
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- It would be difficult to gather viable data to adequately represent this indicator.
- There are multiple reasons agricultural production may experience water stress. Some agricultural landowners may have invested water supply that was lost due to lack of water storage during a particularly wet season while others may not be able to afford the adequate water supply required for their particular agricultural crop due to increased water rates.
- The results of this indicator would not be representative of the outcome because the assessment is unable to differentiate the stresses on water supply.

Healthy Economy

Intended Outcome: Consideration of economic risks and rewards on floodplains, rivers, and coastal areas.

HE: Number of Sea-Level Rise Preparedness Assessments Completed per Assembly Bill 691

This indicator would assess the number of Sea-Level Rise Preparedness Assessments completed throughout the state per Assembly Bill 691. Assembly Bill 691 requires trustees of granted lands with average annual gross public trust revenues exceeding $250,000 to submit a sea-level rise adaptation strategy assessment to the Commission by July 1, 2019.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	High
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- This indicator covers the same evaluation as *HE 9, Areas Covered by Local Coastal Program Vulnerability Assessments Updated for Sea Level Rise*.

HE: Economic Value of Lands Held in Conservation and Open Space

This indicator would assess the value of lands held in conservation and open space for ecosystem services to assess the overall economic value the conservation and open space lands provide the state.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Low-Medium
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- This indicator is covered through the evaluation of *OEE 2, Change in Natural Area*. However, *OEE 2* does not directly assess the economic value of the lands held in conservation and open space.

- This indicator was archived to eliminate repetitiveness.

HE: Improvement to Flood Safety

This indicator would assess the improvements to flood safety throughout the state including reduced flood insurance rates, home value changes, and the value of avoided recovery and clean-up costs.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	Low-Medium
Cost:	Medium-High
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- The data required to cover all aspects of flood safety would require extensive data compilation from multiple entities.
- The data, if available, would also be difficult to track down.
- Flood safety improvements are addressed in other indicators that are included in the indicator set (*PHS 9, Urban Population without State-Mandated Urban Level of Flood Protection; PHS 10, Population in Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year; and HE 14, Value of Assets within Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year*).

Healthy Economy

Intended Outcome: More benefits from economic activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)

HE: Public and Legislative Support for Water Measures

This indicator would assess the degree of public and legislative support for California water measures. Developing more reliable funding for environmental management, flood protection, and statewide data collection could help support California's economic vitality.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	Low-Medium
Cost:	Low
Potential Longevity:	Low-Medium
Supportive of Decision Making:	Low

This indicator was archived for the following reasons:

- There are no historical data sets to support the evaluation of this indicator and it would also be difficult to evaluate in the future.
- This indicator is not scientifically based. It's a measure of how supportive the public could be with moving projects forward, but would be biased with the existing economic situation.
- The outcome of the indicator wouldn't be definitive. It could be an indicator that the proponent of the water measure is a good communicator or it should indicate the water measure is good if everyone supports it.

HE: Comparison of Water Rates and Household Income to the National Average Rates

This indicator would assess the comparison between water rates and household incomes and further compare the state water rates to the national average rate. There are several different drivers associated with the cost of water, including energy costs and demand.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- There is broad variation associated with water rates in California, so it would be more useful to track local trends than compare rates against a state or national average.

- This indicator does not recognize that different regions face different water challenges that drive the cost of water.

HE: Compare Gross Domestic Product to Gallons per Capita per Day

This indicator would assess the relationship between the trend in the daily consumption of water per capita and the GDP. The GDP is one of the primary indicators used to gauge the health of a country's economy. It represents the total dollar value of all goods and services produced over a specific time period and reflects the size of the economy.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	High
Potential Longevity:	Low-Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- Water is not the only economic factor in economic productivity, so this indicator is not very representative of the intended outcome or societal value.

- This indicator may be useful in some regions whose economic activities rely on water supply, such as agricultural or industrial communities. However, this indicator would not be very representative on a statewide scale.

HE: Number of Water Facilities that are Beyond Design Life

This indicator would assess the number of water-related infrastructure facilities, such as water treatment plants, that are beyond design life. Much of California's water infrastructure is nearing the end of its useful life and approaching the age at which it needs to be replaced.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	Low
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- Data viability is an issue for this indicator.
- While this is a good indicator of the level of investment that may be needed into the future to maintain water supply reliability, it does not tie directly to the intended economic outcome

HE: Book Value of Assets in Water Infrastructure and Replacement Costs

This indicator would assess the book value of water infrastructure assets and the replacement costs associated with water infrastructure. The book value is calculated by taking the cost of the asset minus the accumulated depreciation.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	Low
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- The value of water infrastructure assets is not necessarily indicative of sustainable management.
- This indicator would be more useful in combination with other indicators or is captured by other indicators. For example, the cost of water is indicative of investments in facilities to provide sustainable water supply.

HE: FERC Licenses and Number of Renewals (50-year licenses)

This indicator would assess the number of Federal Energy Regulatory Commission (FERC) 50-year licenses currently issued in the state, including the number of renewals issued. FERC is an independent agency that regulates the interstate transmission of electricity, natural gas, and oil.

Screening Process

Representative of Outcome:	Low
Data Viability:	High
Cost:	High
Potential Longevity:	Low
Supportive of Decision Making:	Low

This indicator was archived for the following reasons:

- The number of licenses and renewals of power sources does not necessarily indicate a certainty of power generation over a license period.
- This indicator is not representative of the outcome and would not be supportive of decision making.

HE: Land use Changes – Agricultural/Urban/Industrial/Open Space

This indicator would assess land use changes, which would be correlated with a change in the end use of water. For example, if agricultural land is converted to urban land to support a new development due to a recent population boom, agricultural water demand would no longer be required. Instead, there would be a demand for urban water use.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Low

This indicator was archived for the following reason:

- There is no ideal land use distribution, so assessing a target outcome for this indicator would be difficult.

HE: Water Transfers (Water Moving to Higher Valued Uses)

This indicator would assess water transfers on the open market where water moves to a higher valued use. Water transfers involve a change in the place of water use, from the water's historic point of diversion and use, to a new location or water use. Water may be transferred on the market for a variety of purposes, including agricultural, municipal, environmental, and industrial uses. There are different types of water transfers and exchanges, which include temporary (up to one year), long-term (more than one year, but permanent) or permanent.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium-High
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- The wording of the indicator is too vague and would not provide a focused evaluation of the intended outcome.

- Another indicator (*HE 11, Volume of Water Transferred on the Open Market; Cost of Water on the Transfer Market*) has been identified that is a better representation of the intended outcome.

HE: Social Safety (Water used for Industry Instead of Agriculture)

This indicator would assess social safety through the evaluation of water use. Water tends to go to the highest economic use. The statewide water balance could be a good indicator of whether social safety is achieved by investigating the balance of industrial water use and agricultural water use.

Screening Process

Representative of Outcome:	Low
Data Viability:	Low
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Low

This indicator was archived for the following reasons:

- The data to assess this indicator are not viable. There are limited historical or spatial data throughout California.
- Food security within the state of California can’t necessarily be directly linked to food production in California.

HE: [Gross Domestic Product]/[Consumptive Use]

This indicator would assess the ratio of the GDP verses consumptive water use. The GDP is one of the primary indicators used to gauge the health of a country’s economy. It represents the total dollar value of all goods and services produced over a specific time period and reflects the size of the economy.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Low

This indicator was archived for the following reasons:

- Measuring GDP can be complicated, so obtaining viable data at the state level may be difficult.
- Water is not the only factor in economic productivity, so this indicator is not very representative of the intended outcome or societal value.

HE: Consumer Price Index vs. Aggregated Cost of Service

This indicator would assess the Consumer Price Index (CPI) versus the aggregated cost of services. The CPI is a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services. Aggregate cost of services are produced by averaging across all the costs of services related to consumer items.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium-High
Potential Longevity:	Medium
Supportive of Decision Making:	Low

This indicator was archived for the following reasons:

- There are likely data for urban water use through the U.S. Bureau of Labor Statistics, but data on agricultural water use may not exist.
- The CPI is designed to measure inflation for the urban population and may not accurately reflect populations living in more rural areas.
- The CPI surveys typically rely on the voluntary cooperation of many people and establishments throughout the state, which may result in some significant data gaps.

HE: Change in End Use (agriculture, urban, industrial, open space) Mapped

This indicator would assess the change in end use of water throughout the state. Although water may initially be a supply for agriculture, the end use could change to urban, industrial, or open space depending on where the demand is. Similar transfers could be made for water that was originally urban, industrial, or open space.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	Medium
Cost:	Low
Potential Longevity:	High
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- A change in the end use of water is neither good nor bad, so this indicator would not be very supportive of decision making.
- This indicator is archived for similar reasons as HE Land Use Changes – Agricultural/Urban/Industrial/Open Space.

HE: Five-year Rolling Average of Hydropower Generation vs. Total Generated

This indicator would assess the five-year rolling average of hydropower generations verses the total amount of energy generated statewide. Hydroelectric power is a major source of California's electricity. The amount of hydroelectricity produced varies each year, and is largely dependent on rainfall. A five-year rolling average would help normalize the variance caused by hydrologic effects.

Screening Process

Representative of Outcome:	Low-Medium
Data Viability:	High
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reason:

- The definition of this indicator is too vague, so it was replaced with *HE 12, Percent of Average Annual Power Demand Satisfied by Hydropower*, which is more specific and a better representation of the intended outcome.

Healthy Economy

Intended Outcome: Reduced likelihood or occurrence of significant social disruption following a disaster

HE: Number of Water-Related Emergency Declarations over Time

This indicator would assess the cumulative number of water-related emergency declarations over time. All emergency and major disaster declarations are made solely at the discretion of the President of the United States, when the President determines federal assistance is necessary.

Screening Process

Representative of Outcome:	Medium
Data Viability:	High
Cost:	Low
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reason:

- The data from this indicator would be potentially useful at a local or regional scale to consider trends, but the number of declarations themselves is not actionable or representative of the social disruption that would follow a disaster.

HE: Lost Business Income from Water-Related Emergency Declarations

This indicator would assess the lost business income due to water-related emergency declarations. Severe, prolonged droughts or even catastrophic events can have a negative financial impact on businesses that make it hard for them to return more quickly to normal operations. Disruption from water-related emergency declarations can lead to long-term impacts, such as a business's permanent inability to return to operations.

Screening Process

Representative of Outcome:	High
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- Although estimates have been collected for specific events in the past, data are not currently collected on lost business income due to water-related emergency declarations.

- Small businesses may be impacted more than larger businesses, which would make it less supportive of decision making when evaluating how to reduce the likelihood or occurrence of significant social disruption following a disaster.

Opportunities for Enriching Experience

Intended Outcome: Preserved or enhanced culturally or historically significant sites and communities, including continues and enhanced access to water and land used for sacred ceremonies or cultural practices

OEE: Number of Qualified Historical Buildings or Historic Places at Risk of Losing Reliable Water Supplies, or with Equal to or Greater than a 1 Percent Chance of Being Flooded in any Given Year

This indicator would assess what qualified historical buildings or places throughout California are at risk of losing reliable water supplies or are located in a 100-year floodplain. Most of California is vulnerable to floods and every county has been declared a flood disaster area multiple times. Therefore, it's not uncommon that many qualified historical buildings or places throughout California are impacted by the negative effects of flooding.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Low-Medium
Cost:	Medium
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- It would be difficult to track and estimate the water supply reliability to specific historical resources, which would make it difficult to provide a complete dataset for this indicator.

- There is not a current viable dataset and another indicator has been identified (*OEE 1, Number Historically and Culturally Significant Sites at Risk of Flooding or Sea Level Rise*) that provide a better representation of the intended outcome.

Opportunities for Enriching Experience

Intended Outcome: Preserved and increased natural areas with aesthetic or intrinsic value (including viewshed)

The following indicators were combined to form an indicator (*OEE 2, Change in Natural Area*) that is more representative of the intended outcome. Each indicator received a relatively low score in the screening process because by themselves there were not indicative of the outcome. Together, they are valuable in assessing the aesthetic and intrinsic value of natural areas throughout California.

OEE: Statewide Open Space

Scale:	Statewide
Potential Data Sources:	State Lands Commission; California Coastal Commission; California Department of Conservation
Data Availability:	Type II
Metric:	Acres of Open Space
Screening Status:	**Archive**

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Low
Potential Longevity:	High
Supportive of Decision Making:	Medium

OEE: Conserved Lands Adjacent to California Waterways (acreage)

Scale:	Statewide
Potential Data Sources:	Unknown
Data Availability:	Type III
Metric:	Acreage of conserved lands
Screening Status:	**Archive**

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Medium
Potential Longevity:	High
Supportive of Decision Making:	Medium

OEE: Land Conservation Williamson Act Enrollment (acreage)

Scale:	Statewide
Potential Data Sources:	California Department of Conservation; DWR
Data Availability:	Type I
Metric:	Acreage of land enrolled in Williamson Act
Screening Status:	**Archive**

Screening Process

Representative of Outcome:	Medium
Data Viability:	Medium
Cost:	Low
Potential Longevity:	High
Supportive of Decision Making:	Medium

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced access to resources that support education and learning

No indicators considered during the planning process were archived for this intended outcome.

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces

OEE: Number of Communities Without Access to Water-related State Lands, Parks, or Resources

This indicator would assess the number of communities without access to water-related State lands, parks or other outdoor spaces. Although there are ample water-related State lands and parks throughout California, they may be inaccessible by some communities due to traveling barriers, long distances, or funding issues.

Screening Process

Representative of Outcome:	High
Data Viability:	Low
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Medium

This indicator was archived for the following reasons:

- The indicator would need redefined to be more representative of the intended outcome.
- All communities have access to State and local parks, but people in the communities may not be able to go due to personal restrictions such as distance, travel barriers, weather conditions, or funding issues. The information required to evaluate this indicator is not scientifically based.

OEE: Change in Water Bodies that Allow Contact Recreation

This indicator would assess how many water bodies that allow contact recreation have needed to change their regulations and inhibit contact recreation. Water bodies in California serve multiple functions, including drinking water supply or as a recreational waterbody. Some recreational water bodies may need to create regulations to prohibit contact recreation due to water quality concerns or if the purpose of a waterbody, such as a reservoir, is switched to a drinking water source for cities or communities.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Low-Medium
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- Although this indicator would be representative on a statewide scale, there are too many non-related reasons why water contact is not allowed in some water bodies.
- A reservoir that serves as a drinking water source does not reflect poor water quality issues, which could be another reason for prohibiting water contact in a reservoir.

OEE: Change in miles of Boatable (recreational) Waterways

This indicator would assess the change in square miles of boatable waterways.

Screening Process

Representative of Outcome:	Medium
Data Viability:	Low-Medium
Cost:	High
Potential Longevity:	Medium
Supportive of Decision Making:	Low-Medium

This indicator was archived for the following reasons:

- Technically, all waterways are considered “boatable”, so there would be no change to assess from this indicator.
- This indicator would require rephrasing to avoid misinterpretation because the term “boatable” is too vague.

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7 Statewide Progress toward Sustainability Outlook

THIS SECTION IS CURRENTLY UNDER DEVELOPMENT

The intent of this section is to reflect the current status of the statewide evaluation of all Basic and Watershed Indicators to provide a preliminary assessment of California’s progress towards sustainability and highlight potential next steps/recommendations for continued development of the Sustainability Outlook.

The evaluation is meant to provide a common framework that can be applied to individual California regions and watersheds. In addition, DWR intends to show both (1) the current state of sustainability, and (2) trends to highlight areas where progress has been made and areas where additional efforts may be needed.

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8 References

Alarcon, Jose, et al. 2014. Californians Without Safe Water and Sanitation- California Water Plan Update 2013. California Department of Water Resources. Viewed online at: https://www.waterboards.ca.gov/rwqcb3/water_issues/programs/enviro_justice/ej_docs/2_20_15ca_wo_safewater_san.pdf

Association of California Water Agencies. “Member Directory.” Association of California Water Agencies. Viewed online at: https://www.acwa.com/about/members-associates-affiliates/. Last accessed: January 26, 2018.

American Water Works Association. 2016. Manual of Water Supply Practices -- M36 Water Audits and Loss Control Programs, 4th Edition. Denver: American Water Works Association.

Boisramé, Gabrielle; Thompson, Sally; Collins, Brandon; Stephens, Scott. 2017. Managed wildfire effects on forest resilience and water in the Sierra Nevada. Ecosystems. 20(4): 717-732. https://doi.org/10.1007/s10021-016-0048-1.

California Coastal Commission. 2015. Sea Level Rise Policy Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits. Viewed online at: https://documents.coastal.ca.gov/assets/slr/guidance/August2015/0_Full_Adopted_Sea_Level_Rise_Policy_Guidance.pdf

California Coastal Commission. 2016. Statewide Sea Level Rise Vulnerability Synthesis. Viewed online at: https://documents.coastal.ca.gov/assets/climate/slr/vulnerability/FINAL_Statewide_Report.pdf

California Department of Conservation. 2016. The California Land Conservation Act of 1965 2016 Status Report. Viewed online at: http://www.conservation.ca.gov/dlrp/lca/stats_reports/Documents/2016%20LCA%20Status%20Report.pdf

California Department of Finance. “Demographic Projections.” California Department of Finance. Viewed online at: http://www.dof.ca.gov/Forecasting/Demographics/Projections/. Last accessed: November 6, 2017.

California Department of Fish and Game. 2008. California Aquatic Invasive Species Management Plan. Viewed online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=3868

California Department of Fish and Wildlife. “California’s Invaders.” California Department of Fish and Game, Invasive Species Program. Viewed online at: https://www.wildlife.ca.gov/Conservation/Invasives/Species. Last accessed: February 7, 2018.

California Department of Fish and Wildlife. “CDFW Lands Inventory Fact Sheet.” California Department of Fish and Wildlife. Viewed online at: https://www.wildlife.ca.gov/Lands/Inventory. Last accessed: January 26, 2018.

California Department of Fish and Wildlife. Fish and Games Commission. Viewed online at: http://www.fgc.ca.gov/. Last accessed: February 12, 2018.

California Department of Food and Agriculture. California Department of Food and Agriculture. Viewed online at: https://www.cdfa.ca.gov/. Last accessed: February 2, 2018.

California Department of Forestry and Fire Protection. “FRAP Projects.” California Department of Forestry and Fire Protection. Viewed online at: http://frap.fire.ca.gov/projects/wui/index. Last accessed: December 14, 2017.

California Department of Forestry and Fire Protection. 2010. Fire and Resource Assessment Program (FRAP): 2010 Assessment. Viewed online at: http://frap.fire.ca.gov/data/assessment2010/pdfs/california_forest_assessment_nov22.pdf

California Department of Transportation. “CalTrans GIS Data.” Viewed online at: http://www.dot.ca.gov/hq/tsip/gis/datalibrary/. Last accessed: December 12, 2017.

California Department of Water Resources. “Best Available Maps.” California Department of Water Resources. Viewed online at: http://gis.bam.water.ca.gov/bam/. Last accessed: February 12, 2018.

California Department of Water Resources. “Central Valley Flood Protection Plan.” California Department of Water Resources. Viewed online at: www.water.ca.gov/cvfmp. Last accessed: February 6, 2018.

California Department of Water Resources. “Groundwater Information Center.” CASGEM Public Portal. Viewed online at: http://water.ca.gov/groundwater/gwinfo/. Last accessed: December 21, 2017.

California Department of Water Resources. “GSA Map.” SGMA Public Portal. Viewed online at: http://water.ca.gov/groundwater/sgm/gsa_map.cfm. Last accessed: December 12, 2017.

California Department of Water Resources. “Levee Flood Protection Zone.” California Department of Water Resources. Viewed online at: http://gis.lfpz.water.ca.gov/lfpz/. Last accessed: February 12, 2018.

California Department of Water Resources. “State Water Project Annual Report of Operations.” Last accessed: February 6, 2018.

California Department of Water Resources. “Submitted 2015 Urban Water Management Plans (UWMP) Data Exports.” Water Use Efficiency Data Public Portal. Viewed online at: https://wuedata.water.ca.gov/default.asp. Last accessed: January 10, 2018.

California Department of Water Resources. 2015. A Guidebook to Assist Agricultural Water Suppliers to Produce a 2015 Agricultural Water Management Plan. Viewed online at: https://www.water.ca.gov/LegacyFiles/waterconditions/docs/Approved-Final-2015-AWMP-Guidebook-June2015.pdf

California Department of Water Resources. 2016. Guidebook for Urban Water Suppliers- 2015 Urban Water Management Plans. Viewed online at: http://www.water.ca.gov/urbanwatermanagement/docs/2015/UWMP_Guidebook_Mar_2016_FINAL.pdf

California Department of Water Resources. 2013. Statewide Flood Management Planning Program Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

California Department of Water Resources. 2016. Water Audit Manual. Prepared by: Water Systems Optimization. Viewed online at: http://www.water.ca.gov/urbanwatermanagement/docs/2015/DWR%20Water%20Audit%20Manual%20FINAL.pdf

California Department of Water Resources. 2017. The State Water Project Draft Delivery Capability Report 2017. Viewed online at: https://msb.water.ca.gov/documents/86800/e00836f7-68f5-4f00-aeb8-450dc475436b

California Department of Water Resources. SGMA Public Portal. Viewed online at: http://www.water.ca.gov/groundwater/sgm/. Last accessed: December 12, 2017.

California Department of Water Resources and U.S. Army Corps of Engineers. 2013. California's Flood Future Highlights. Viewed online at: https://www.water.ca.gov/LegacyFiles/sfmp/resources/ca_flood_future_highlight.pdf

California Department of Water Resources. California State Water Project Overview. Viewed online at: http://wdl.water.ca.gov/swp/

California Energy Commission. "Energy Maps of California." California Energy Commission. Viewed online at: http://www.energy.ca.gov/maps/. Last accessed: December 20, 2017.

California Ocean Science Trust. 2017. Rising Seas in California: An Update on Sea-Level Rise Science. Prepared by: California Ocean Protection Council Science Advisory Team Working Group. Viewed online at: http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf

California Public Utilities Commission. "Water Division." California Public Utilities Commission. Viewed online at: http://www.cpuc.ca.gov/water/. Last accessed: January 26, 2018.

California State Parks. 2016. Statistical Report 2015-16 Fiscal Year. Planning, Recreation and Support Section Marketing and Business Development Office. Viewed online at: https://www.parks.ca.gov/pages/795/files/15-16%20Statistical%20Report%20FINAL%20ONLINE.pdf

California Urban Water Agencies. 2012. Water Supply Reliability Report. Viewed online at: http://www.cuwa.org/pubs/CUWA_WaterSupplyReliability.pdf

California Urban Water Agencies. 2017. Tackling California's Water Accessibility and Affordability Issues. Viewed online at: http://www.cuwa.org/pubs/2017_CUWA-Water-Affordability-Fact-Sheet.PDF

California Water Association. "Regulated Water Utilities in California." California Water Association. Viewed online at: http://www.calwaterassn.com/about-cwa/regulated-water-utilities-in-california/. Last accessed: January 26, 2018.

California Water Quality Monitoring Council. “Is it safe to swim in our waters?” My Water Quality. Viewed online at: http://www.mywaterquality.ca.gov/safe_to_swim/index.html. Last accessed: February 2, 2018.

California Water Quality Monitoring Council. “Where are harmful algal blooms occurring in California?” My Water Quality. Viewed online at: http://www.mywaterquality.ca.gov/habs/where/freshwater_events.html. Last accessed: February 6, 2018.

Center for Watershed Sciences, University of California, Davis. “Fish Data.” UC Davis PISCES. Viewed online at: https://pisces.ucdavis.edu/fish. Last accessed: January 30, 2018.

Fofonoff PW, Ruiz GM, Steves B, Simkanin C, & Carlton JT. 2018. California Non-native Estuarine and Marine Organisms (Cal-NEMO) System. Viewed online at: http://invasions.si.edu/nemesis/. Last accessed: April 24, 2018

Governor's Office of Emergency Services. “Local Hazard Mitigation Program - Local Mitigation Planning.” Cal OES. Viewed online at: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program. Last accessed: December 7, 2017.

Governor's Office of Emergency Services. 2015. 2014 - 2018 Strategic Plan Summary. Version 1. Viewed online at: http://www.caloes.ca.gov/NewsMediaSite/Documents/Cal%20OES%20Strategic%20Plan%20Summary%20Booklet%20(FINAL).pdf

Hanak, Ellen and Elizabeth Stryjewski. 2012. California’s Water Market, By the Numbers: Update 2012. Public Policy Institute of California. Viewed online at: http://www.ppic.org/content/pubs/report/R_1112EHR.pdf

Hanak, Ellen and Elizabeth Stryjewski. 2012. California’s Water Market, By the Numbers: Update 2012: Technical Appendices. Public Policy Institute of California. Viewed online at: http://www.ppic.org/content/pubs/other/1112EHR_appendix.pdf

Hazards & Vulnerability Research Institute. “SoVI® - Social Vulnerability Index for the United States – 2010-2014.” University of South Carolina. Viewed online at: http://artsandsciences.sc.edu/geog/hvri/sovi%C2%AE-0. Last accessed: February 8, 2018.

Heal the Bay. “Beach Grades.” Beach Report Card. Viewed online at: http://brc.healthebay.org/?st=CA&f=1. Last accessed: February 2, 2018.

Heal the Bay. 2017. Heal the Bay's 2016-17 Annual Beach Report Card.

Indian Health Service Sanitation Facilities Construction (SFC) Program. 2015. Public Law 86-121 Annual Report. Viewed online at: https://www.ihs.gov/dsfc/includes/themes/responsive2017/display_objects/documents/reports/SFCAnnualReport2015.pdf

Indian Health Service. “Sanitation Tracking and Reporting System.” Viewed online at: https://wstars.ihs.gov/. Last accessed: December 15, 2017.

Klasing, Susan, PhD and Robert Bordberg, PhD. 2017. Development of Fish Contaminant Goals and Advisory Tissue Levels (ATLs) for Common Contaminants in California Sport Fish. California Environmental Protection Agency. Viewed online at: https://oehha.ca.gov/media/downloads/fish/report/atlmhgandothers2008c.pdf

Legislative Analyst’s Office. 2017. Overview of the Sustainable Groundwater Management Act. Viewed online at: http://www.lao.ca.gov/handouts/resources/2017/Overview-Sustainable-Groundwater-Management-Act-031617.pdf

Moyle, P.B. 1976. Inland Fishes of California. University of California Press, Berkeley.

Moyle, PB, JE Williams, and E Wikramanayake. 1989. Fish species of special concern of California. California Department of Fish and Game, Sacramento.

Moyle, PB, RM Quiñones, JV Katz, and J Weaver. 2015. Fish Species of Special Concern in California. Third edition. University of California, Davis and California Department of Fish and Wildlife. Viewed online at: https://www.wildlife.ca.gov/Conservation/SSC/Fishes

Moyle, PB, RM Yoshiyama, JE Williams, and ED Wikramanayake. 1995. Fish species of special concern of California. Second edition. California Department of Fish and Game, Inland Fisheries Division. Rancho Cordova, CA.

National Aeronautics and Space Administration. California Institute of Technology, Jet Propulsion Laboratory. Viewed online at: https://www.jpl.nasa.gov/. Last accessed: December 21, 2017.

National Center for Education Statistics. College Navigator. Viewed online at: https://nces.ed.gov/collegenavigator. Last accessed: October 30, 2017.

National Oceanic and Atmospheric Administration. Sea Level Rise Viewer. Viewed online at: http://bit.ly/2Etz45E. Last accessed: February 9, 2018.

Natural Resource Agency. 2010. State of the State’s Wetlands: 10 Years of Challenges and Progress. Viewed online at: http://www.resources.ca.gov/docs/SOSW_report_with_cover_memo_10182010.pdf

Office of Environmental Health Hazard Assessment. “Fish Advisories.” Office of Environmental Health Hazard Assessment. Viewed online at: https://oehha.ca.gov/fish/advisories. Last accessed: November 14, 2017.

Public Policy Institute of California. “California's Water Market.” Public Policy Institute of California. Viewed online at: http://www.ppic.org/publication/californias-water-market/. Last accessed: February 9, 2018.

Rehn, Andrew C, Raphael Mazor, and Peter R Ode. 2015. The California Stream Condition Index (CSCI): A New Statewide Biological Scoring Tool for Assessing the Health of Freshwater Streams. Surface Water Ambient Monitoring Program. Viewed online at:

https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/csci_tech_memo.pdf

Santa Ana Watershed Project Authority. 2014. One Water One Watershed 2.0 Plan, Integrated Regional Watershed Management Plan for the Santa Ana River Watershed. Viewed online at: http://www.sawpa.org/owow-2-0-plan/

Schultz K, Water education specialist, Water Education Branch, California Department of Water Resources, Sacramento (CA). Feb. 5, 2018 – email correspondence with Marshall P, Principal Engineer, Stantec, Sacramento (CA).

Shilling, Fraser. 2014. California Water Sustainability Indicators Framework: Assessment at State and Regional Scale. Final Report. California Department of Water Resources. Prepared by: Department of Environmental Science and Policy at University of California, Davis. Viewed online at: https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Sustainability/Files/Publications/California-Water-Sustainability-Indicators-FrameworkAssessment-at-State-and-Region-Scales--Final-Rep.pdf\

Sierra Nevada Adaptive Management Project. 2015. Appendix E: Water Team Final Report. Viewed online at: http://snamp.cnr.berkeley.edu/static/documents/2016/01/25/E_Water_quantity_and_quality_chapter_Final_Dec_14_2015compressed.pdf. Last accessed: May 4, 2018.

State Water Resources Control Board. “Bioassessment Scores Map.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/csci_scores_map.shtml. Last accessed: December 1, 2017.

State Water Resources Control Board. “Development of Flow Objectives (Phase 4 of Bay-Delta Effort).” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/flow_objectives/index.shtml. Last accessed: December 14, 2017.

State Water Resources Control Board. “Drought Preparedness, Water Conservation and Water Supply Emergency Response.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/DroughtPreparedness.shtml. Last accessed: December 14, 2017.

State Water Resources Control Board. “eWRIMS - Electronic Water Rights Information Management System.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/. Last accessed: January 23, 2018.

State Water Resources Control Board. “Human Right to Water Portal.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/hr2w/index.html. Last accessed: January 29, 2018.

State Water Resources Control Board. “Impaired Water Bodies.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml. Last accessed: November 29, 2017.

State Water Resources Control Board. “Selected Drinking Water Program Publications.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Publications.shtml. Last accessed: November 2, 2017.

State Water Resources Control Board. “Statewide Mercury Provisions.” State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/mercury/. Last accessed: January 23, 2018.

State Water Resources Control Board. “The Integrated Report - 303(d) List of Water Quality Limited Segments and 305(b) Surface Water Quality Assessment.” Central Valley Regional Water Quality Control Board. Viewed online at: https://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/. Last accessed: November 28, 2017.

State Water Resources Control Board. “Unmanaged Area Identification.” State Water Board SGMA. Viewed online at: https://waterboards.maps.arcgis.com/apps/MapJournal/index.html?appid=3ca8bf4bbd6e40aaa561b7ed06821f72. Last accessed: December 12, 2017.

State Water Resources Control Board. “Water Loss Control.” Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/water_loss_control.html. Last accessed: February 8, 2019.

State Water Resources Control Board. 2012. Onsite Wastewater Treatment System Policy. Final Substitute Environmental Document. Viewed online at: https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2012/0032sed.pdf

State Water Resources Control Board. 2013. Communities that Rely on a Contaminated Groundwater Source for Drinking Water. Viewed online at: https://www.waterboards.ca.gov/gama/ab2222/docs/ab2222.pdf

State Water Resources Control Board. 2015. A Guide for Private Domestic Well Owners. Viewed online at: https://www.waterboards.ca.gov/gama/docs/wellowner_guide.pdf

State Water Resources Control Board. 2015. Safe Drinking Water Plan for California. Viewed online at: https://www.waterboards.ca.gov/publications_forms/publications/legislative/docs/2015/sdwp.pdf

State Water Resources Control Board. California Environmental Data Exchange Network (CEDEN). Viewed online at: http://www.ceden.org/. Last accessed: January 23, 2018.

State Water Resources Control Board. GeoTracker GAMA. Viewed online at: http://geotracker.waterboards.ca.gov/gama/. Last accessed: February 8, 2018.

State Water Resources Control Board. Groundwater Ambient Monitoring and Assessment Program. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/gama/. Last accessed: February 8, 2018.

Taylor, Mac. 2017. Managing Flood in California. Legislative Analyst's Office. Viewed online at: http://www.lao.ca.gov/reports/2017/3571/managing-floods-032217.pdf.

U.S. Census Bureau. "American Community Survey 5-Year Data (2009-2016)." Viewed online at: https://www.census.gov/data/developers/data-sets/acs-5year.html. Last accessed: January 10, 2018.

U.S. Census Bureau. "TIGER Products." Viewed online at: https://www.census.gov/geo/maps-data/data/tiger.html. Last accessed: December 12, 2017.

U.S. Department of Agriculture, U.S. Forest Service. "Download National Datasets." U.S. Department of Agriculture. Viewed online at: https://data.fs.usda.gov/geodata/edw/datasets.php. Last accessed: December 12, 2017.

U.S. Department of Homeland Security, Federal Emergency Management Agency. National Flood Hazard Layer.

U.S. Department of the Interior, Bureau of Reclamation. "Central Valley Operations Office." U.S. Department of the Interior, Bureau of Reclamation. Viewed online at: https://www.usbr.gov/mp/cvo/index.html. Last accessed: February 15, 2018.

U.S. Department of the Interior, Bureau of Reclamation. November 2015. "CVP Contract Water Delivery Information." Viewed online at: https://www.usbr.gov/mp/cvp-water/docs/cvp-water-deliveries.pdf. Last Accessed: May 10, 2018.

U.S. Department of the Interior, National Park Service. "National Register of Historical Places." National Park Service. Viewed online at: https://www.nps.gov/nr/. Last accessed: December 14, 2017.

U.S. Department of the Interior, National Park Service. "Reports." National Park Service Visitor Use Statistics. Viewed online at: https://irma.nps.gov/Stats/Reports/Home. Last accessed: January 30, 2018.

U.S. Department of the Interior, U.S. Geologic Survey. "Groundwater Ambient Monitoring and Assessment Program." California Water Science Center. Viewed online at: https://ca.water.usgs.gov/projects/gama/. Last accessed: February 8, 2018.

U.S. Department of the Interior, U.S. Geologic Survey. "Hydrography." Viewed online at: https://nhd.usgs.gov/. Last accessed: December 12, 2017.

U.S. Environmental Protection Agency. 2013. California Integrated Assessment of Watershed Health. Prepared by: The Cadmus Group, Inc. Viewed online at: https://www.epa.gov/sites/production/files/2015-11/documents/ca_hw_report_111213_0.pdf

U.S. Environmental Protection Agency. “Clean Water Act Section 303(d): Impaired Waters and Total Maximum Daily Loads (TMDLs).” U.S. EPA. Viewed online at: https://www.epa.gov/tmdl. Last accessed: November 28, 2017.

U.S. Fish and Wildlife Service. “National Wetlands Inventory Product Summary.” Viewed online at: https://www.fws.gov/wetlands/Data/Wetlands-Product-Summary.html. Last accessed: April 12, 2018.

U.S. Fish and Wildlife Service. 2018. “National Wetlands Inventory.” Viewed online at: https://www.fws.gov/wetlands/Data/Wetlands-Product-Summary.html. Last accessed: April 12, 2018.

U.S. Geological Survey. 2018. Nonindigenous Aquatic Species Database. Viewed online at: https://nas.er.usgs.gov/. Last accessed: April 24, 2018.

Water Education Foundation. “Hydroelectric Power.” Water Education Foundation. Viewed online at: http://www.watereducation.org/aquapedia/hydroelectric-power. Last accessed: December 20, 2017.

Water Foundation and Inland Empire Utilities Agency. 2017. Sustainable Water Management Profile.

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DEPARTMENT OF WATER RESOURCES • STATE OF CALIFORNIA

Sustainability Outlook Indicator Descriptions and Methodology

May 2019

Attachment 1 – Data Tables

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Prepared for

California Department of Water Resources

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About this Document

This attachment to the Sustainability Outlook Indicator Descriptions and Methodology provides the data behind the GIS maps and bar charts used within the main body of the appendix to analyze available indicator data.

Table of Contents

List of Tables

Abbreviations and Acronyms

GIS	Geographic Information System

Data Tables

The data tables presented below are organized by indicator. The **current** list of indicators is shown in Table A-1 and is subject to change as indicators are more fully developed. Indicators are grouped by societal value (Public Health and Safety, Ecosystem Vitality, Healthy Economy, and Opportunities for Enriching Experiences) and then further sorted by the corresponding intended outcome. In this table and throughout the document, Public Health and Safety is coded in red, Ecosystem Vitality in blue, Healthy Economy in green, and Opportunities for Enriching Experiences in yellow. Each intended outcome has several indicators. In some cases, while an indicator is presented under one corresponding outcome, it may provide insight into multiple outcomes.

The “ID” column provides a reference number for each indicator, which also includes its societal value, however the ordering does not denote importance or weighting.

The data tables within this document are organized by county (in alphabetical order) or by watershed (ordered geographically from northwest to southeast).

All basic and watershed indicators are presented; archived and advanced indicators are presented when data was examined within figures.

Table A-1. Comprehensive List of Intended Outcomes and Associated Basic and Watershed Indicators

Societal Value	ID	Indicator
Public Health and Safety		**Intended Outcome – A reliable water supply for domestic needs, sanitation, and fire suppression.**
	PHS 1	Population and Percentage of Population with Reliable Domestic Water Supplies
	PHS 2	Population and Percentage of Population without Access to Reliable Sanitation
		Intended Outcome – Reduced number of people exposed to waterborne health threats such as contaminants or infectious agents.
	PHS 3	Number of Public Water Systems Not in Compliance with Drinking Water Standards
	PHS 4	Percentage of Beaches with Safe Coliform Bacteria Levels
	PHS 5	Water Supplies Derived from 303(d) Impaired Water Bodies
	PHS 6	Potential for Consumption of Mercury-Contaminated Fish
		Intended Outcome – Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)
	PHS 7	Population Served by Local Hazard Mitigation Plans, Emergency Response Plans, or Equivalents
	PHS 8	Population Covered by Water Shortage Contingency Plans
	PHS 9	Urban Population without State-Mandated Urban Level of Flood Protection
	PHS 10	Population in Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year
Ecosystem Vitality		**Intended Outcome – Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.**
	EV 1	Native Fish Diversity Index
	EV 2	Non-Native Invasive Species Distribution and Status
		Intended Outcome – Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.
	EV 3	Acreage of Wetlands
	EV 4	Degree of Aquatic Fragmentation
	EV 5	Impaired Water Bodies – by Hydrologic Region
	EV 6	California Stream Condition Index
		Intended Outcome – Achieved designated beneficial uses for water bodies throughout the state.
	EV 7	Impaired Water Bodies – Count by Watershed
	EV 8	Number of Harmful Algae Blooms

Table A-1. Comprehensive List of Intended Outcomes and Associated Basic and Watershed Indicators (contd.)

Societal Value	ID	Indicator
Healthy Economy	**Intended Outcome – Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.**	
	HE 1	Delivery Reliability of SWP, CVP, and Colorado River Aqueduct Systems
	HE 2	Comparison of Actual Water use to Proposed Statewide Water Use Targets
	HE 3	Distribution System Leaks and Losses
	HE 4	Groundwater Basins with Stable or Recovering Groundwater Levels
	HE 5	Groundwater Extraction Rates and Subsidence Rates
	HE 6	Change in Groundwater Storage
	HE 7	Percentage of Groundwater Basin Areas in Compliance with SGMA
	HE 8	Contaminated Groundwater Wells
	Intended Outcome – Consideration of economic risks and rewards on floodplains, rivers, and coastal areas.	
	HE 9	Socioeconomic Vulnerability to Sea Level Rise Impacts
	HE 10	Areas Covered by Local Coastal Program Vulnerability Assessments Updated for Sea Level Rise
	Intended Outcome – More benefits from economics activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)	
	HE 11	Regional Trend in Cost of Water for Municipal and Industrial, Agricultural, and Other Purposes; Cost Compared to State Average for these Same Supplies
	HE 12	Volume of Water Transferred on the Open Market; Cost of Water on the Transfer Market
	HE 13	Percent of Average Annual Power Demand Satisfied by Hydropower
	Intended Outcome – Reduced likelihood or occurrence of significant social disruption following a disaster.	
	HE 14	Value of Assets within Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year
Opportunities for Enriching Experiences	**Intended Outcome – Preserved or enhanced culturally or historically significant sites and communities, including continued and enhanced access to water and land used for sacred ceremonies or cultural practices.**	
	OEE 1	Number of Historically and Culturally Significant Sites at Risk of Flooding or Sea Level Rise
	Intended Outcome – Preserved and increased natural areas with aesthetic or intrinsic value (including viewshed).	
	OEE 2	Change in Natural Area
	Intended Outcome – Continued and enhanced access to resources that support education and learning.	
	OEE 3	Number of School Districts Using Water and Environmental Curriculum in K through 12 Programs

Table A-1. Comprehensive List of Intended Outcomes and Associated Basic and Watershed Indicators (contd.)

Societal Value	ID	Indicator
Opportunities for Enriching Experiences (continued)	**Intended Outcome – Continued and enhanced access to resources that support education and learning.**	
	OEE 4	Number of Students Enrolled in Water and Environmental Resources Management Programs within the UC and CSU Systems
	OEE 5	Number of Water Agencies that Have Educational Programs for Customers
	Intended Outcome – Continued and enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces	
	OEE 6	Change in Visitor Days at Water Related Park Lands

Key:
CSU = California State University
CVP = Central Valley Project
EV = Ecosystem Vitality
HE = Healthy Economy
K = kindergarten
OEE = Opportunities for Enriching Experiences
PHS = Public Health and Safety
SGMA = Sustainable Groundwater Management Act
SWP = State Water Project
UC = University of California

Public Health and Safety

Intended Outcome: A reliable water supply for domestic needs, sanitation, and fire suppression.

PHS 1: Population and Percentage of Population with Reliable Domestic Water Supplies

No Geographic Information System (GIS) figures or charts included in main body.

Public Health and Safety

Intended Outcome: A reliable water supply for domestic needs, sanitation, and fire suppression.

PHS 2: Population and Percentage of Population Without Access to Reliable Sanitation

No GIS figures or charts included in main body.

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS 3: Number of Public Water Systems Not in Compliance with Drinking Water Standards

Table A-2 presents the data from Figure 4-1 in the main body.

Table A-2. Public Water System Maximum Contaminant Level Violations

County	1 Violation Population < 3000	1 Violation Population > 3000 and < 10000	1 Violation Population > 10000	2 - 9 Violation Population < 3000	2 - 9 Violation Population > 3000 and < 10000	2 - 9 Violation Population > 10000	10 - 24 Violation Population < 3000	10 - 24 Violation Population > 3000 and < 10000	10 - 24 Violation Population > 10000	Over 25 Violation Population < 3000	Over 25 Violation Population > 3000 and < 10000	Over 25 Violation Population > 10000
Alpine				1								
Amador	2	1	1	2								
Butte	1											
Calaveras	1											
Colusa							1					
Contra Costa							2					
Del Norte	1											
El Dorado	1			2								
Fresno	4			7		1	8			16	1	
Humboldt	3			2			2					
Imperial	5			1		1	1	2		1		
Inyo				1						1		
Kern	2			9			18		1	13	1	1
Kings					1	1	4		1			
Los Angeles				4	1	1						
Madera	1			4			11			8	1	
Marin	1			1			1					
Mariposa	1											
Mendocino				1								
Merced	1			1				1				
Mono				1			1			1		
Monterey				5			10			12		
Napa				2	1	1						
Nevada	1											
Plumas										2		
Riverside		1		3			2					

Table A-2. Public Water System Maximum Contaminant Level Violations (contd.)

County	1 Violation Population < 3000	1 Violation Population > 3000 and < 10000	1 Violation Population > 10000	2 - 9 Violation Population < 3000	2 - 9 Violation Population > 3000 and < 10000	2 - 9 Violation Population > 10000	10 - 24 Violation Population < 3000	10 - 24 Violation Population > 3000 and < 10000	10 - 24 Violation Population > 10000	Over 25 Violation Population < 3000	Over 25 Violation Population > 3000 and < 10000	Over 25 Violation Population > 10000
Sacramento		1		3			1			5		
San Benito				2			1					
San Bernardino	1			2		1	5			2		
San Diego				6			4			2		
San Joaquin	2						3					
San Luis Obispo	1						3					
San Mateo	2						3					
Santa Barbara	1											
Santa Clara	3		1									
Santa Cruz	1			1						2	1	
Shasta	3									1		
Solano		1										
Sonoma	1						1			3		
Stanislaus				6	1		5	2		1		
Sutter				1			4					
Tehama				1			3					
Trinity				2								
Tulare	2			2			11			8		1
Tuolumne	1											
Ventura	1											
Yolo	1			1								

Source: Human Right to Water Portal. State Water Board. January 18, 2018

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS 4: Percentage of Beaches with Safe Coliform Bacteria Levels

Tables A-3 and A-4 present the data from Figure 4-2 in the main body.

Table A-3. Percent of A+, A, and B Beach Grades Reported by Heal the Bay for California Beaches Representing Safe Coliform Bacteria Levels

County	Percent of Reported A+, A, and B Beach Grades
Del Norte	100
Humboldt	40
Mendocino	0
Sonoma	100
Marin	67
Contra Costa	67
San Francisco	33
Alameda	50
San Mateo	35
Santa Cruz	9
Monterey	88
San Luis Obispo	70
Santa Barbara	63
Ventura	80
Los Angeles	38
Orange	38
San Diego	60

Source: "Beach Grade." Heal the Bay. February 2, 2018.

Table A-4. Beach Grades Reported by Heal the Bay for California Beaches Representing Safe Coliform Bacteria Levels

County	Number of Beaches	No Sampling Results (Dry)	D or F Grades (Dry)	C Grades (Dry)	A+, A, or B Grades (Dry)	No Samplin g Results (Wet)	D or F Grades (Wet)	C Grades (Wet)	A+, A, or B Grades (Wet)
Del Norte	1	0	0	0	1	0	0	0	1
Humboldt	5	5	0	0	0	0	3	0	2
Mendocino	6	6	0	0	0	6	0	0	0
Sonoma	7	7	0	0	0	0	0	0	7
Marin	27	27	0	0	0	5	4	0	18
Contra Costa	3	3	0	0	0	1	0	0	2
San Francisco	18	3	5	1	9	3	4	5	6
Alameda	6	6	0	0	0	0	2	1	3
San Mateo	23	2	1	3	17	1	10	4	8
Santa Cruz	22	9	0	0	13	9	6	5	2
Monterey	8	8	0	0	0	0	0	1	7
San Luis Obispo	20	4	0	0	16	4	1	1	14
Santa Barbara	16	0	0	1	15	0	2	4	10
Ventura	40	22	0	0	18	1	3	4	32
Los Angeles	92	9	7	3	73	3	40	14	35
Orange	119	7	2	2	108	19	45	10	45
San Diego	72	21	4	0	47	16	9	4	43

Source: "Beach Grade." Heal the Bay. February 2, 2018.

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS 5: Water Supplies Derived From 303(d) Impaired Water Bodies

Table A-5 presents the data from Figure 4-3 in the main body.

Table A-5. Permitted Diversions from Impaired Water Bodies

County	0 - 10,000 GPD	10,000 - 1,000,000 GPD	> 1,000,000 GPD
Alameda	0	1	3
Alpine	0	1	2
Amador	1	0	2
Butte	9	13	19
Calaveras	0	0	2
Colusa	0	3	46
Contra Costa	4	10	73

Table A-5. Permitted Diversions from Impaired Water Bodies (contd.)

County	0 - 10,000 GPD	10,000 - 1,000,000 GPD	> 1,000,000 GPD
Del Norte	1	7	0
El Dorado	2	16	3
Fresno	6	4	14
Glenn	0	0	2
Humboldt	629	405	6
Imperial	1	0	0
Inyo	0	0	3
Kern	0	0	0
Kings	0	1	20
Lake	10	6	6
Lassen	8	5	34
Los Angeles	1	2	5
Madera	3	2	12
Marin	4	7	3
Mariposa	1	0	1
Mendocino	152	239	101
Merced	0	13	75
Modoc	7	28	41
Mono	15	6	22
Monterey	1	40	39
Napa	6	21	8
Nevada	8	14	15
Orange	0	8	8
Placer	7	13	10
Plumas	4	9	11
Riverside	0	0	0
Sacramento	43	76	258
San Benito	2	17	1
San Bernardino	1	1	9
San Diego	1	25	8
San Francisco	0	0	0
San Joaquin	102	105	374
San Luis Obispo	14	109	13
San Mateo	9	25	0
Santa Barbara	5	47	8
Santa Clara	3	1	1
Santa Cruz	11	17	0
Shasta	1	12	46
Sierra	4	4	2
Siskiyou	55	130	105
Solano	7	10	78
Sonoma	98	205	135
Stanislaus	3	7	50
Sutter	3	4	35
Tehama	6	6	2
Trinity	210	226	34
Tulare	11	10	50

Table A-5. Permitted Diversions from Impaired Water Bodies (contd.)

County	0 - 10,000 GPD	10,000 - 1,000,000 GPD	> 1,000,000 GPD
Tuolumne	3	3	2
Ventura	2	8	16
Yolo	10	37	128
Yuba	2	4	11

Sources: "Impaired Water Bodies – 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. April 11, 2018.
"eWRIMS - Electronic Water Rights Information Management System." State Water Resources Control Board. January 29, 2018.

Public Health and Safety

Intended Outcome: Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents

PHS 6: Potential for Consumption of Mercury-Contaminated Fish

Tables A-6 and A-7 present the data from Figure 4-4 in the main body.

Table A-6. Number of Monitoring Stations by County

County	Number of Monitoring Stations
Alameda	0
Alpine	0
Amador	1
Butte	9
Calaveras	0
Colusa	0
Contra Costa	4
Del Norte	1
El Dorado	2
Fresno	6
Glenn	0
Humboldt	629
Imperial	1
Inyo	0
Kern	0
Kings	0
Lake	10
Lassen	8
Los Angeles	1
Madera	3
Marin	4
Mariposa	1
Mendocino	152
Merced	0
Modoc	7
Mono	15
Monterey	1
Napa	6
Nevada	8
Orange	0
Placer	7
Plumas	4
Riverside	0
Sacramento	43
San Benito	2
San Bernardino	1
San Diego	1
San Francisco	0

Table A-6. Number of Monitoring Stations by County (contd.)

County	Number of Monitoring Stations
San Joaquin	102
San Luis Obispo	14
San Mateo	9
Santa Barbara	5
Santa Clara	3
Santa Cruz	11
Shasta	1
Sierra	4
Siskiyou	55
Solano	7
Sonoma	98
Stanislaus	3
Sutter	3
Tehama	6
Trinity	210
Tulare	11
Tuolumne	3
Ventura	2
Yolo	10
Yuba	2

Table A-7. Mercury Tissue Levels by Species and Monitoring Station

County	Station	Species	AvgPPB	MaxPPB
Alameda	Central Bay (6)-203CENTRL	Striped Bass	339	483
Alameda	Bethany Reservoir-543ADVBTR	Largemouth Bass	358	634
Butte	Feather River upstream Yuba City	Largemouth Bass	402	570
Butte	Feather River upstream Yuba City	Sacramento Sucker	463	463
Butte	Thermalito Afterbay	Clark's Grebe	365	836
Butte	Thermalito Afterbay	Largemouth Bass	414	666
Butte	Thermalito Afterbay	Western Grebe	315	734
Calaveras	(New) Hogan Reservoir-533ADVNHR	Channel Catfish	339	651
Calaveras	(New) Hogan Reservoir-533ADVNHR	Largemouth Bass	416	639
Calaveras	(New) Hogan Reservoir-533ADVNHR	Smallmouth Bass	590	779
Calaveras	Camanche Reservoir_531ADVCMR_FMP-531ADVCMR	Channel Catfish	354	711
Calaveras	Camanche Reservoir_531ADVCMR_FMP-531ADVCMR	Common Carp	401	694
Calaveras	Camanche Reservoir_531ADVCMR_FMP-531ADVCMR	Hardhead	433	525
Calaveras	Camanche Reservoir_531ADVCMR_FMP-531ADVCMR	Largemouth Bass	433	870
Calaveras	Lake Tulloch-534PTR113	Largemouth Bass	380	582
Calaveras	Tulloch Reservoir	Largemouth Bass	380	582
Colusa	Butte Creek at Colusa Highway-520ADVBUT	Channel Catfish	400	645
Colusa	Butte Creek at Colusa Highway-520ADVBUT	Common Carp	357	482
Colusa	Butte Creek at Colusa Highway-520ADVBUT	Largemouth Bass	551	947
Colusa	East Park Reservoir Southeast-522ADVEPS	Largemouth Bass	284	558
Colusa	East Park Reservoir West-522ADVEPW	Channel Catfish	267	549
Colusa	Sacramento River at Tisdale Boat Ramp AKA River Bend Marina-520ADVTIS	Striped Bass	525	717
Colusa	East Park Reservoir	Clark's Grebe	763	2599
Colusa	East Park Reservoir	Largemouth Bass	350	522
Colusa	East Park Reservoir	Western Grebe	672	2345
Contra Costa	San Pablo Bay (5)-206SNPBLO	Striped Bass	463	463
Contra Costa	Big Break-FMP-544INDBGB	Largemouth Bass	260	447

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Contra Costa	Frank's Tract-FMP-544INTFKT	Largemouth Bass	233	494
Contra Costa	Italian Slough-544ADVITS	Common Carp	329	459
El Dorado	American River, South Fork at Coloma	Sacramento Pikeminnow	1037	1380
Glenn	Sacramento River @ Hamilton City-504RESHMC	Hardhead	304	810
Glenn	Sacramento River @ Hamilton City-504RESHMC	Sacramento Pikeminnow	379	1150
Glenn	Sacramento River Near Hamilton (Scotty's Boat Landing)-504ADVSBL	Hardhead	297	553
Glenn	Sacramento River Near Hamilton (Scotty's Boat Landing)-504ADVSBL	Striped Bass	374	559
Glenn	Stony Gorge Reservoir South-522ADVSGS	Common Carp	339	512
Glenn	Black Butte Lake	Clark's Grebe	457	731
Glenn	Black Butte Lake	Smallmouth Bass	686	882
Glenn	Black Butte Lake	Western Grebe	371	531
Glenn	Stony Gorge Reservoir	Clark's Grebe	495	769
Glenn	Stony Gorge Reservoir	Largemouth Bass	323	826
Glenn	Stony Gorge Reservoir	Western Grebe	608	856
Lake	Indian Valley Reservoir North-513ADVIVN	Channel Catfish	436	911
Lake	Indian Valley Reservoir North-513ADVIVN	Common Carp	456	544
Lake	Indian Valley Reservoir North-513ADVIVN	Largemouth Bass	846	1140
Lake	Clear Lake	Clark's Grebe	1983	9549
Lake	Clear Lake	Largemouth Bass	830	1070
Lake	Clear Lake	Western Grebe	685	5475
Lassen	Eagle Lake	Clark's Grebe	1126	1126
Lassen	Eagle Lake	Western Grebe	249	666
Los Angeles	Castaic Lagoon	Largemouth Bass	211	542
Los Angeles	Castaic Lake	Channel Catfish	1000	1000
Los Angeles	Castaic Lake	Largemouth Bass	264	462
Los Angeles	Elderberry Forebay	Largemouth Bass	466	672
Los Angeles	Legg Lake	Largemouth Bass	230	645
Los Angeles	Malibou Lake	Largemouth Bass	117	500

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Los Angeles	Puddingstone Reservoir_BOG	Largemouth Bass	194	530
Los Angeles	Pyramid Lake	Largemouth Bass	442	1060
Los Angeles	Santa Fe Reservoir	Largemouth Bass	386	597
Los Angeles	Little Rock Reservoir	Common Carp	486	571
Los Angeles	Little Rock Reservoir	Largemouth Bass	456	903
Los Angeles	Little Rock Reservoir	White Catfish	453	734
Madera	Hensley Lake	Largemouth Bass	792	1350
Madera	Hensley Lake-539PHL083	Bluegill	389	456
Madera	Hensley Lake-539PHL085	Largemouth Bass	818	1350
Madera	Hensley Lake-539PHL086	White Catfish	588	588
Madera	Millerton Lake_540ADVMLL_FMP-540ADVMLL	Common Carp	302	513
Madera	Millerton Lake_540ADVMLL_FMP-540ADVMLL	Spotted Bass	267	510
Mariposa	Lake McClure	Largemouth Bass	786	1200
Mariposa	Lake McClure at Bagby-537ADVMBG	Largemouth Bass	849	1090
Mariposa	Lake McClure at Bagby-537ADVMBG	Spotted Bass	669	854
Mariposa	Lake McClure at Barrett Co-537ADVMBR	Channel Catfish	521	711
Mariposa	Lake McClure at Barrett Co-537ADVMBR	Largemouth Bass	742	1200
Mariposa	Lake McClure at Barrett Co-537ADVMBR	Spotted Bass	621	865
Mariposa	Lake McSwain	Largemouth Bass	675	878
Mariposa	Lake McSwain-537PLM116	Largemouth Bass	675	878
Mendocino	Lake Mendocino	Clark's Grebe	1066	1751
Mendocino	Lake Mendocino	Largemouth Bass	443	727
Mendocino	Lake Mendocino	Western Grebe	690	1275
Mendocino	Russian River Downstream of Ukiah STP	Sacramento Pikeminnow	438	2110
Merced	Merced River @ Hatfield State Park-535RESHSP	Largemouth Bass	337	944
Merced	Mud Slough @ HWY 140-541ADVMS4	Common Carp	466	749
Merced	O'Neill Forebay	Largemouth Bass	319	478
Merced	O'Neill Forebay-541POF106	Largemouth Bass	313	478

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Merced	O'Neill Forebay-541POF107	Striped Bass	385	598
Merced	San Luis Reservoir @ HWY 152-542ADVSL2	Common Carp	345	547
Merced	San Luis Reservoir @ HWY 152-542ADVSL3	Largemouth Bass	331	614
Merced	San Luis Reservoir @ San Luis Creek-542ADVSL2	American Shad	262	444
Merced	San Luis Reservoir @ San Luis Creek-542ADVSL3	Common Carp	413	483
Merced	San Luis Reservoir @ San Luis Creek-542ADVSL4	Largemouth Bass	493	844
Merced	San Luis Reservoir @ San Luis Creek-542ADVSL6	Striped Bass	782	1000
Merced	SanJoaquin R. @ HWY 140-541ADVSJ4	Common Carp	342	513
Merced	O'Neill Forebay	Largemouth Bass	264	565
Merced	O'Neill Forebay-541POF104	Clark's Grebe	453	453
Merced	San Joaquin River at Lander Avenue	Largemouth Bass	466	556
Mono	Bridgeport Reservoir	Clark's Grebe	666	831
Mono	Bridgeport Reservoir	Western Grebe	1581	3988
Mono	East Walker River below Bridgeport Reservoir	Sacramento Blackfish	355	521
Mono	Topaz Lake	Clark's Grebe	2134	2666
Mono	Topaz Lake	Smallmouth Bass	172	1030
Mono	Topaz Lake	Western Grebe	2271	3582
Mono	Lake Crowley	Rainbow Trout	329	616
Mono	Lake Crowley	Western Grebe	2011	4455
Monterey	Lake San Antonio	Clark's Grebe	963	1423
Monterey	Lake San Antonio	Largemouth Bass	391	643
Monterey	Lake San Antonio	Smallmouth Bass	403	602
Monterey	Lake San Antonio	Striped Bass	462	528
Monterey	Lake San Antonio	Western Grebe	1199	5180
Napa	Lake Hennessey	Clark's Grebe	1381	1608
Napa	Lake Hennessey	Largemouth Bass	453	682
Napa	Lake Hennessey	Western Grebe	1112	1509
Napa	Lake Berryessa	Clark's Grebe	6406	10162

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Napa	Lake Berryessa	Largemouth Bass	1143	1970
Napa	Lake Berryessa	Silverside	342	542
Napa	Lake Berryessa	Western Grebe	5220	8614
Plumas	Lake Almanor North-518ADVLAN	Sacramento Sucker	825	1230
Plumas	Antelope Lake	Western Grebe	257	660
Plumas	Lake Almanor	Rainbow Trout	136	485
Plumas	Lake Almanor	Western Grebe	418	2054
Riverside	Perris Reservoir	Clark's Grebe	466	466
Sacramento	American River @ Discovery Park-519SWPDCP	Largemouth Bass	437	988
Sacramento	American River @ Discovery Park-519SWPDCP	Sacramento Pikeminnow	274	1040
Sacramento	American River @ Discovery Park-519SWPDCP	White Catfish	331	514
Sacramento	Dead Horse Slough-FMP-510RESDHS	Largemouth Bass	530	959
Sacramento	Georgiana Slough-510ADVGGS	Largemouth Bass	451	772
Sacramento	Georgiana Slough-510ADVGGS	Redear Sunfish	182	492
Sacramento	Georgiana Slough-510ADVGGS	Sacramento Sucker	358	562
Sacramento	Georgiana Slough-510ADVGGS	Spotted Bass	341	468
Sacramento	Lower Mokelumne River 3-510ADVLM3	Sacramento Pikeminnow	481	481
Sacramento	Lower Mokelumne River 5-510ADVLM5	Sacramento Pikeminnow	435	581
Sacramento	Sacramento River @ Rio Vista-510INDROV	Common Carp	332	461
Sacramento	Sacramento River @ Rio Vista-510INDROV	Largemouth Bass	435	1290
Sacramento	Sacramento River @ Rio Vista-510INDROV	Sacramento Pikeminnow	524	1010
Sacramento	Sacramento River @ Rio Vista-510INDROV	Sacramento Sucker	263	555
Sacramento	Sacramento River @ Rio Vista-510INDROV	Striped Bass	481	481
Sacramento	Sacramento River @ Rio Vista-510INDROV	White Catfish	274	466
Sacramento	Snodgrass Slough Near Delta Meadows-510ADVSGS	Black Crappie	514	686
Sacramento	Snodgrass Slough Near Delta Meadows-510ADVSGS	Common Carp	315	529
Sacramento	Snodgrass Slough Near Delta Meadows-510ADVSGS	Largemouth Bass	442	588
Sacramento	Snodgrass Slough Near Delta Meadows-510ADVSGS	Sacramento Sucker	289	465

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Sacramento	American R @ Discovery Park	Largemouth Bass	443	913
Sacramento	Cosumnes River at River Mile 1-544RESCR1	Black Crappie	1898	2340
Sacramento	Cosumnes River at River Mile 1-544RESCR2	Bluegill	679	993
Sacramento	Cosumnes River at River Mile 1-544RESCR3	Channel Catfish	833	1300
Sacramento	Cosumnes River at River Mile 1-544RESCR5	Largemouth Bass	1295	1650
Sacramento	Cosumnes River at River Mile 1-544RESCR6	Redear Sunfish	581	810
Sacramento	Cosumnes River at River Mile 1-544RESCR7	Spotted Bass	1390	1530
Sacramento	Cosumnes River at River Mile 1-544RESCR8	Striped Bass	1850	1850
Sacramento	Cosumnes River at River Mile 1-544RESCR9	White Catfish	696	755
Sacramento	Cosumnes River u/s I-5 -544INTCSR	Black Crappie	761	1096
Sacramento	Cosumnes River u/s I-5 -544INTCSR	Bluegill	447	692
Sacramento	Cosumnes River u/s I-5 -544INTCSR	Common Carp	277	593
Sacramento	Cosumnes River u/s I-5 -544INTCSR	Hitch	269	580
Sacramento	Cosumnes River u/s I-5 -544INTCSR	Largemouth Bass	957	1800
Sacramento	Cosumnes River u/s I-5 -544INTCSR	Sacramento Sucker	274	901
Sacramento	Lost Slough (off Cosumnes River)-544ADVLTS	Bluegill	328	746
Sacramento	Lost Slough (off Cosumnes River)-544ADVLTS	Largemouth Bass	486	822
Sacramento	Lost Slough (off Cosumnes River)-544ADVLTS	Sacramento Sucker	400	552
San Diego	Lake Hodges	Clark's Grebe	226	483
San Diego	Lake Jennings	Largemouth Bass	304	936
San Diego	Lower Otay Reservoir	Clark's Grebe	414	663
San Diego	Lower Otay Reservoir	Western Grebe	411	669
San Francisco	Lake Merced	Largemouth Bass	353	918
San Joaquin	Beaver Slough (off S Fork Mokelumne River)-544ADVBVS	Largemouth Bass	295	711
San Joaquin	Calaveras River off Deep Water Channel-544ADVCVR	Largemouth Bass	219	523
San Joaquin	Lower Mokelumne River 6-544ADVLM6	Channel Catfish	680	680
San Joaquin	Lower Mokelumne River 7-544ADVLM7	Channel Catfish	872	872
San Joaquin	Lower Mokelumne River 7-544ADVLM8	Sacramento Pikeminnow	1209	1890

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
San Joaquin	Lower Mokelumne River 7-544ADVLM9	Striped Bass	500	691
San Joaquin	Middle River @ Bullfrog-544INDMRB	Largemouth Bass	336	693
San Joaquin	Middle River @ Hwy 4-544ADVMR5	Largemouth Bass	298	455
San Joaquin	Old River at Cliffton Court Forebay-544ADVORC	Striped Bass	477	1260
San Joaquin	Paradise Cut-544ADVPDC	Largemouth Bass	209	638
San Joaquin	San Joaquin River @ Mossdale-544ADVMSD	Largemouth Bass	304	498
San Joaquin	San Joaquin River @ Mossdale-544ADVMSD	White Catfish	210	448
San Joaquin	San Joaquin River @ Potato Slough-544INDPTS	Largemouth Bass	329	951
San Joaquin	San Joaquin River at Vernalis (FMP)	Channel Catfish	302	683
San Joaquin	San Joaquin River at Vernalis (FMP)	Common Carp	326	489
San Joaquin	San Joaquin River at Vernalis (FMP)	Largemouth Bass	559	972
San Joaquin	San Joaquin River at Vernalis (FMP)	Sacramento Sucker	376	674
San Joaquin	San Joaquin River at Vernalis (FMP)	Striped Bass	878	878
San Joaquin	Smith Canal_544ADVSMC_FMP-544ADVSMC	Largemouth Bass	201	766
San Joaquin	Mokelumne River near I-5	Largemouth Bass	725	1170
San Luis Obispo	Santa Margarita Lake	Largemouth Bass	362	457
San Mateo	South Bay (1)-204STHBAY	White Croaker	304	453
San Mateo	South Bay (1)-204STHBAY	White Sturgeon	729	878
Santa Barbara	Lake Cachuma	Clark's Grebe	853	1157
Santa Barbara	Lake Cachuma	Largemouth Bass	504	746
Santa Barbara	Lake Cachuma	Western Grebe	821	2087
Santa Clara	Artesian Slough	Largemouth Bass	231	558
Santa Clara	Artesian Slough	Striped Bass	556	863
Santa Cruz	Loch Lomond Reservoir	Largemouth Bass	183	674
Shasta	Clear Creek_508RESCLR_FMP-508RESCLR	Hardhead	393	485
Shasta	Clear Creek_508RESCLR_FMP-508RESCLR	Sacramento Pikeminnow	681	768
Shasta	Lake Britton_526ADVLBR_FMP-526ADVLBR	Sacramento Sucker	361	499
Shasta	Sacramento River Near Deschutes Rd-508ADVDES	Sacramento Pikeminnow	395	658

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Shasta	Shasta Lake at McCloud River-506ADVSMC	Largemouth Bass	294	537
Shasta	Shasta Lake at Sacramento River-506ADVSSA	Spotted Bass	257	814
Shasta	Shasta Lake Main Stem-506ADVSMS	Largemouth Bass	290	562
Shasta	Whiskeytown Lake at Brandy Creek-524ADVWLB	Smallmouth Bass	364	723
Shasta	Whiskeytown Lake at Clear Creek-524ADVWLC	Sacramento Pikeminnow	635	826
Shasta	Whiskeytown Lake at Clear Creek-524ADVWLC	Sacramento Sucker	435	619
Siskiyou	Tule Lake	Clark's Grebe	271	704
Siskiyou	Tule Lake	Western Grebe	260	1031
Solano	Carquinez Straits region	Striped Bass	483	483
Solano	Suisun Bay (7)-207SUISUN	Striped Bass	334	660
Solano	Liberty Island-510ADVLIB	Striped Bass	325	660
Solano	Prospect Slough (mid-Prospect)-510INTPPS	Common Carp	352	516
Solano	Prospect Slough (mid-Prospect)-510INTPPS	Largemouth Bass	242	495
Solano	Prospect Slough (mid-Prospect)-510INTPPS	Sacramento Sucker	228	491
Solano	Prospect Slough (mid-Prospect)-510INTPPS	Striped Bass	405	943
Solano	Prospect Slough (mid-Prospect)-510INTPPS	White Catfish	360	968
Solano	Steamboat Slough-510ADVSBS	Common Carp	393	503
Solano	Steamboat Slough-510ADVSBS	Largemouth Bass	581	1230
Solano	Steamboat Slough-510ADVSBS	Sacramento Pikeminnow	443	736
Solano	Steamboat Slough-510ADVSBS	Sacramento Sucker	365	517
Sonoma	Laguna de Santa Rosa at Occidental Rd	Largemouth Bass	517	1440
Sonoma	Russian River at Johnson's Beach	Sacramento Pikeminnow	771	1520
Sonoma	Russian River at Johnson's Beach	Sacramento Sucker	910	910
Sonoma	Russian River at Johnson's Beach	Smallmouth Bass	554	945
Sonoma	Russian River at Monte Rio Beach	Green Sunfish	590	590
Sonoma	Russian River at Monte Rio Beach	Largemouth Bass	1399	1680
Sonoma	Russian River at Monte Rio Beach	Sacramento Pikeminnow	964	2150
Sonoma	Russian River at Monte Rio Beach	Sacramento Sucker	909	909

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Sonoma	Russian River at Monte Rio Beach	Smallmouth Bass	648	1010
Sonoma	Russian River at Monte Rio Beach	Tule Perch	505	505
Sonoma	Russian River at Riverfront Park	Sacramento Pikeminnow	483	1170
Sonoma	Russian River at Riverfront Park	Sacramento Sucker	322	728
Sonoma	Russian River at Riverfront Park	Smallmouth Bass	464	732
Sonoma	Russian River Downstream of Cloverdale STP	Sacramento Pikeminnow	474	1150
Sonoma	Russian River Downstream of Cloverdale STP	Sacramento Sucker	201	455
Sonoma	Russian River Downstream of Cloverdale STP	Smallmouth Bass	386	1460
Sonoma	Spring Lake	Largemouth Bass	186	510
Stanislaus	San Joaquin R. @ Merced R.-541ADVSJM	Common Carp	432	706
Stanislaus	San Joaquin River at Laird Park (near J16 and Grayson Rd)-535ADVLDP	White Catfish	299	443
Stanislaus	Stanislaus River-535ADVSLR	Largemouth Bass	458	789
Stanislaus	Tuolumne River @ Shiloh Rd.-535RESTRS	Common Carp	329	498
Stanislaus	Tuolumne River @ Shiloh Rd.-535RESTRS	Largemouth Bass	520	1070
Stanislaus	Tuolumne River @ Shiloh Rd.-535RESTRS	Sacramento Sucker	260	492
Stanislaus	Tuolumne River-535ADVTUR	Largemouth Bass	495	707
Stanislaus	Tuolumne River-535ADVTUR	Sacramento Sucker	303	448
Stanislaus	Turlock Lake	Largemouth Bass	218	444
Stanislaus	Turlock Lake-535PTL005	Common Carp	370	527
Stanislaus	Turlock Lake-535PTL006	Largemouth Bass	218	444
Stanislaus	Woodward Reservoir	Largemouth Bass	326	507
Stanislaus	Woodward Reservoir event 1-535PWR185	Largemouth Bass	336	507
Sutter	Cross Canal-519ADVCRC	Largemouth Bass	469	711
Sutter	Feather River @ Nicolaus-519SWPFRN	Bluegill	252	443
Sutter	Feather River @ Nicolaus-519SWPFRN	Common Carp	282	517
Sutter	Feather River @ Nicolaus-519SWPFRN	Largemouth Bass	447	1590
Sutter	Feather River @ Nicolaus-519SWPFRN	Redear Sunfish	199	519
Sutter	Feather River @ Nicolaus-519SWPFRN	Sacramento Pikeminnow	203	463

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Sutter	Sutter Bypass Below Kirkville Road-519ADVSBP	Largemouth Bass	393	712
Tehama	Sacramento River at Bend Bridge Near Red Bluff	Sacramento Pikeminnow	452	521
Tulare	Success Lake	Clark's Grebe	677	985
Tulare	Success Lake	Largemouth Bass	387	506
Tulare	Success Lake	Western Grebe	537	926
Tuolumne	Don Pedro Reservoir	Largemouth Bass	482	663
Tuolumne	Lake Don Pedro-536PDP168	Chinook Salmon	431	589
Tuolumne	Lake Don Pedro-536PDP169	Largemouth Bass	495	663
Ventura	Lake Casitas	Clark's Grebe	859	1427
Ventura	Lake Casitas	Largemouth Bass	534	799
Ventura	Lake Casitas	Western Grebe	928	1249
Ventura	Lake Piru	Largemouth Bass	600	1060
Ventura	Lake Sherwood	Largemouth Bass	657	940
Yolo	Fremont Weir-511ADVFRW	Striped Bass	364	571
Yolo	Sacramento River - West Sacramento at Rivermile 59 - Between Discovery Park and Miller Park-510ADVR59	Common Carp	298	558
Yolo	Sacramento River - West Sacramento at Rivermile 59 - Between Discovery Park and Miller Park-510ADVR60	Largemouth Bass	885	975
Yolo	Sacramento River - West Sacramento at Rivermile 59 - Between Discovery Park and Miller Park-510ADVR63	Sacramento Sucker	314	478
Yolo	Sacramento River - West Sacramento at Rivermile 59 - Between Discovery Park and Miller Park-510ADVR64	Spotted Bass	509	701
Yolo	Sacramento River @ RM44-510INDM45	Largemouth Bass	285	577
Yolo	Sacramento River @ RM44-510INDM47	Sacramento Pikeminnow	539	1320
Yolo	Sacramento River @ RM44-510INDM48	Sacramento Sucker	231	451
Yolo	Sacramento River @ RM44-510INDM49	Smallmouth Bass	996	1408
Yolo	Sacramento River @ RM44-510INDM50	Spotted Bass	506	991
Yolo	Sacramento River @ RM44-510INDM52	Striped Bass	379	600
Yolo	Sacramento River at Knights Landing-520ADVKNL	Channel Catfish	270	471

Table A-7. Mercury Tissue Levels by Species and Monitoring Station (contd.)

County	Station	Species	AvgPPB	MaxPPB
Yolo	Sacramento River at Knights Landing-520ADVKNL	Largemouth Bass	413	784
Yolo	Sacramento River at Knights Landing-520ADVKNL	Sacramento Pikeminnow	804	1000
Yolo	Sacramento River at Knights Landing-520ADVKNL	Striped Bass	388	717
Yolo	Sacramento River at Veterans Bridge-519SWPVTB	Channel Catfish	466	1265
Yolo	Sacramento River at Veterans Bridge-519SWPVTB	Common Carp	299	558
Yolo	Sacramento River at Veterans Bridge-519SWPVTB	Largemouth Bass	544	1530
Yolo	Sacramento River at Veterans Bridge-519SWPVTB	Sacramento Pikeminnow	708	1710
Yolo	Sacramento River Near Verona Marina, Village Resort AKA Joe's Place-520ADVVER	Sacramento Pikeminnow	388	707
Yolo	Sacramento River Near Verona Marina, Village Resort AKA Joe's Place-520ADVVER	Spotted Bass	436	617
Yolo	Sacramento River Near Verona Marina, Village Resort AKA Joe's Place-520ADVVER	White Catfish	464	693
Yolo	Toe Drain-510RESTOE	Channel Catfish	384	511
Yolo	Toe Drain-510RESTOE	Common Carp	478	938
Yolo	Toe Drain-510RESTOE	Goldfish	263	488
Yolo	Toe Drain-510RESTOE	Largemouth Bass	402	1020
Yolo	Toe Drain-510RESTOE	Striped Bass	503	1070
Yolo	Toe Drain-510RESTOE	White Catfish	525	632
Yuba	Bullards Bar Reservoir at Central-517ADVBBC	Smallmouth Bass	388	681
Yuba	Bullards Bar Reservoir at East Arm-517ADVBBE	Common Carp	524	832
Yuba	Bullards Bar Reservoir at East Arm-517ADVBBE	Largemouth Bass	608	608
Yuba	Bullards Bar Reservoir at East Arm-517ADVBBE	Smallmouth Bass	474	722

Source: California Environmental Data Exchange Network (CEDEN). State Water Resources Control Board. January 23, 2018.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS 7: Population Served by Hazard Mitigation Plans, Emergency Response Plans, or Equivalents

Tables A-8 presents the data from Figure 4-5 in the main body.

Table A-8. Status of Local Hazard Mitigation Plans

County	Status (July 2017)
Alameda	Approved and Adopted
Alpine	No Approved Plan or Expired Plan
Amador	Approved and Adopted
Butte	Approved and Adopted
Calaveras	Approved and Adopted
Colusa	No Approved Plan or Expired Plan
Contra Costa	No Approved Plan or Expired Plan
Del Norte	No Approved Plan or Expired Plan
El Dorado	No Approved Plan or Expired Plan
Fresno	No Approved Plan or Expired Plan
Glenn	No Approved Plan or Expired Plan
Humboldt	Approved and Adopted
Imperial	Approved and Adopted
Inyo	No Approved Plan or Expired Plan
Kern	Approved and Adopted
Kings	Approved and Adopted
Lake	Plan Expires Within One Year
Lassen	No Approved Plan or Expired Plan
Los Angeles	Approved and Adopted
Madera	No Approved Plan or Expired Plan
Marin	Approved and Adopted
Mariposa	Approved and Adopted
Mendocino	Approved and Adopted
Merced	Approved and Adopted
Modoc	Approved and Adopted
Mono	No Approved Plan or Expired Plan
Monterey	Approved and Adopted
Napa	Approved and Adopted
Nevada	Plan Expires Within One Year
Orange	Approved and Adopted
Placer	Approved and Adopted
Plumas	Approved and Adopted
Riverside	No Approved Plan or Expired Plan
Sacramento	Approved and Adopted

Table A-8. Status of Local Hazard Mitigation Plans (contd.)

County	Status (July 2017)
San Benito	Approved and Adopted
San Bernardino	Approved Pending Adoption
San Diego	No Approved Plan or Expired Plan
San Francisco	Approved and Adopted
San Joaquin	Plan Expires Within One Year
San Luis Obispo	Approved and Adopted
San Mateo	Approved and Adopted
Santa Barbara	Approved Pending Adoption
Santa Clara	No Approved Plan or Expired Plan
Santa Cruz	Approved and Adopted
Shasta	No Approved Plan or Expired Plan
Sierra	Approved and Adopted
Siskiyou	No Approved Plan or Expired Plan
Solano	Approved and Adopted
Sonoma	Approved and Adopted
Stanislaus	Approved and Adopted
Sutter	Approved and Adopted
Tehama	Plan Expires Within One Year
Trinity	Approved and Adopted
Tulare	No Approved Plan or Expired Plan
Tuolumne	Approved and Adopted
Ventura	Approved and Adopted
Yolo	Approved and Adopted
Yuba	Approved and Adopted

Source: "Local Hazard Mitigation Program – Local Mitigation Planning." Cal OES. December 7, 2017.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS 8: Population Covered by Water Shortage Contingency Plans

No GIS figures or charts included in main body.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS 9: Urban Population Without State-Mandated Urban Level of Flood Protection

Tables A-9 presents the data from Figure 4-6 in the main body.

Table A-9. Urban Population Without State-Mandated Urban Level of Flood Protection

County	Population Category
Alameda	10,000 to 50,000
Alpine	< 1,000
Amador	1,000 to 10,000
Butte	1,000 to 10,000
Calaveras	< 1,000
Colusa	< 1,000
Contra Costa	10,000 to 50,000
Del Norte	< 1,000
El Dorado	1,000 to 10,000
Fresno	10,000 to 50,000
Glenn	1,000 to 10,000
Humboldt	1,000 to 10,000
Imperial	< 1,000
Inyo	< 1,000
Kern	10,000 to 50,000
Kings	1,000 to 10,000
Lake	1,000 to 10,000
Lassen	< 1,000
Los Angeles	50,000 to 100,000
Madera	1,000 to 10,000
Marin	10,000 to 50,000
Mariposa	< 1,000
Mendocino	1,000 to 10,000
Merced	10,000 to 50,000
Modoc	< 1,000
Mono	< 1,000
Monterey	10,000 to 50,000
Napa	10,000 to 50,000
Nevada	< 1,000
Orange	> 100,000
Placer	1,000 to 10,000
Plumas	< 1,000
Riverside	50,000 to 100,000
Sacramento	> 100,000
San Benito	< 1,000
San Bernardino	10,000 to 50,000
San Diego	50,000 to 100,000
San Francisco	< 1,000
San Joaquin	1,000 to 10,000
San Luis Obispo	1,000 to 10,000
San Mateo	> 100,000
Santa Barbara	10,000 to 50,000

Table A-9. Urban Population Without State-Mandated Urban Level of Flood Protection (contd.)

County	Population Category
Santa Clara	> 100,000
Santa Cruz	10,000 to 50,000
Shasta	1,000 to 10,000
Sierra	< 1,000
Siskiyou	< 1,000
Solano	10,000 to 50,000
Sonoma	10,000 to 50,000
Stanislaus	10,000 to 50,000
Sutter	< 1,000
Tehama	1,000 to 10,000
Trinity	< 1,000
Tulare	50,000 to 100,000
Tuolumne	< 1,000
Ventura	10,000 to 50,000
Yolo	10,000 to 50,000
Yuba	< 1,000

Sources: "Levee Flood Protection Zone", Best Available Maps USACE Comprehensive Study 200-year Floodplain, Flood Hazard Exposure Analysis 100-year Floodplain, TIGER Products, U.S. Census Bureau, CalTrans GIS Data.

Public Health and Safety

Intended Outcome: Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)

PHS 10: Population in Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year

Tables A-10 presents the data from Figure 4-7 in the main body. Table A-11 presents the data from Figure A-8 in the main body.

Table A-10. Population Exposed to 100-year Floodplain

County	Population Category
Alameda	10,000 to 50,000
Alpine	< 10,000
Amador	< 10,000
Butte	10,000 to 50,000
Calaveras	< 10,000
Colusa	< 10,000
Contra Costa	10,000 to 50,000
Del Norte	< 10,000
El Dorado	< 10,000
Fresno	10,000 to 50,000
Glenn	< 10,000
Humboldt	< 10,000
Imperial	< 10,000
Inyo	< 10,000
Kern	10,000 to 50,000
Kings	< 10,000
Lake	< 10,000
Lassen	< 10,000
Los Angeles	50,000 to 100,000
Madera	10,000 to 50,000
Marin	10,000 to 50,000
Mariposa	< 10,000
Mendocino	< 10,000
Merced	10,000 to 50,000
Modoc	< 10,000
Mono	< 10,000
Monterey	10,000 to 50,000
Napa	10,000 to 50,000
Nevada	< 10,000
Orange	100,000 to 250,000
Placer	< 10,000
Plumas	< 10,000
Riverside	10,000 to 50,000
Sacramento	10,000 to 50,000
San Benito	< 10,000
San Bernardino	10,000 to 50,000

Table A-10. Population Exposed to 100-year Floodplain (contd.)

County	Population Category
San Diego	50,000 to 100,000
San Francisco	< 10,000
San Joaquin	10,000 to 50,000
San Luis Obispo	10,000 to 50,000
San Mateo	100,000 to 250,000
Santa Barbara	10,000 to 50,000
Santa Clara	100,000 to 250,000
Santa Cruz	10,000 to 50,000
Shasta	< 10,000
Sierra	< 10,000
Siskiyou	< 10,000
Solano	10,000 to 50,000
Sonoma	10,000 to 50,000
Stanislaus	10,000 to 50,000
Sutter	< 10,000
Tehama	< 10,000
Trinity	< 10,000
Tulare	50,000 to 100,000
Tuolumne	< 10,000
Ventura	10,000 to 50,000
Yolo	10,000 to 50,000
Yuba	10,000 to 50,000

Source: Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

Table A-11. Population Exposed to 500-year Floodplains

County	Population Category
Alameda	100,000 to 250,000
Alpine	< 10,000
Amador	< 10,000
Butte	50,000 to 100,000
Calaveras	< 10,000
Colusa	< 10,000
Contra Costa	50,000 to 100,000
Del Norte	< 10,000
El Dorado	< 10,000
Fresno	100,000 to 250,000
Glenn	< 10,000
Humboldt	10,000 to 50,000
Imperial	< 10,000
Inyo	< 10,000
Kern	100,000 to 250,000
Kings	10,000 to 50,000
Lake	10,000 to 50,000
Lassen	< 10,000

Table A-11. Population Exposed to 500-year Floodplains (contd.)

County	Population Category
Los Angeles	> 250,000
Madera	10,000 to 50,000
Marin	50,000 to 100,000
Mariposa	< 10,000
Mendocino	< 10,000
Merced	50,000 to 100,000
Modoc	< 10,000
Mono	< 10,000
Monterey	100,000 to 250,000
Napa	10,000 to 50,000
Nevada	< 10,000
Orange	> 250,000
Placer	< 10,000
Plumas	< 10,000
Riverside	> 250,000
Sacramento	> 250,000
San Benito	< 10,000
San Bernardino	> 250,000
San Diego	100,000 to 250,000
San Francisco	< 10,000
San Joaquin	> 250,000
San Luis Obispo	10,000 to 50,000
San Mateo	100,000 to 250,000
Santa Barbara	50,000 to 100,000
Santa Clara	> 250,000
Santa Cruz	10,000 to 50,000
Shasta	10,000 to 50,000
Sierra	< 10,000
Siskiyou	< 10,000
Solano	50,000 to 100,000
Sonoma	10,000 to 50,000
Stanislaus	10,000 to 50,000
Sutter	50,000 to 100,000
Tehama	10,000 to 50,000
Trinity	< 10,000
Tulare	100,000 to 250,000
Tuolumne	< 10,000
Ventura	100,000 to 250,000
Yolo	50,000 to 100,000
Yuba	10,000 to 50,000

Source: Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

Ecosystem Vitality

Intended Outcome: Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.

EV 1: Native Fish Diversity Index

Table A-12 presents the data from Figure 4-9 in the main body.

Table A-12. Conservation Status of California Freshwater Fish

Year	Extinct	Listed	Species of Least Concern	Least Concern
1976	3 (3%)	10 (9%)	35 (32%)	60 (56%)
1989	6 (5%)	15 (13%)	50 (43%)	44 (38%)
1995	6 (5%)	19 (16%)	53 (46%)	38 (33%)
2010	7 (6%)	31 (24%)	68 (53%)	23 (18%)
2014	7 (6%)	31 (25%)	62 (50%)	24 (19%)

Sources: Moyle 1976, Moyle et al. 1989, Moyle et al. 1995, Moyle at al. 2015

Ecosystem Vitality

Intended Outcome: Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.

EV 2: Non-Native Invasive Species Distribution and Status

Table A-13 presents the data from Figure 4-11 in the main body. Table A-14 presents the data from Figure 4-12 in the main body.

Table A-13. Freshwater/Marine Species Introduced over Time in California

Time Period	Freshwater	Brackish	Marine	Total
Up to 1900	53			58
Up to 1950	137	10	2	149
Up to 2000	298	35	15	348
Up to Present	333	37	20	390

Source: USGS NAS Database

Table A-14. Distribution and Frequency of Aquatic Invasive Species Records

HUC 8 ID	HUC 8 Watershed Name	Records of Non-Native Invasive Species per HUC-8
17120007	Warner Lakes	< 10
17100311	Illinois	< 10
17100309	Applegate	< 10
18020001	Goose Lake	< 10
18010206	Upper Klamath	10 - 50
18010204	Lost	10 - 50
18010101	Smith	10 - 50
18010205	Butte	< 10
18010207	Shasta	10 - 50
18010209	Lower Klamath	10 - 50
18080001	Surprise Valley	10 - 50
18010208	Scott	10 - 50
18020002	Upper Pit	50 - 100
18010210	Salmon	< 10
18020004	McCloud	< 10
18020005	Sacramento Headwaters	10 - 50
18020003	Lower Pit	100 - 200
18010211	Trinity	10 - 50
18080002	Madeline Plains	< 10
18010102	Mad-Redwood	> 200
18020151	Cow Creek	< 10
18020154	Clear Creek-Sacramento River	50 - 100
18010212	South Fork Trinity	< 10
18020153	Battle Creek	< 10
18080003	Honey-Eagle Lakes	10 - 50
18020152	Cottonwood Creek	10 - 50
18010107	Mattole	< 10
18010105	Lower Eel	10 - 50
18020155	Paynes Creek-Sacramento River	10 - 50
18020121	North Fork Feather	10 - 50
18020156	Thomes Creek-Sacramento River	10 - 50
18020122	East Branch North Fork Feather	10 - 50
18010106	South Fork Eel	10 - 50
18020157	Big Chico Creek-Sacramento River	50 - 100
18010104	Middle Fork Eel	< 10
18020123	Middle Fork Feather	10 - 50
18020158	Butte Creek	100 - 200
18020115	Upper Stony	10 - 50
18010103	Upper Eel	10 - 50
16050102	Truckee	50 - 100

Table A-14. Distribution and Frequency of Aquatic Invasive Species Records (contd.)

HUC 8 ID	HUC 8 Watershed Name	Records of Non-Native Invasive Species per HUC-8
18020125	Upper Yuba	100 - 200
18010108	Big-Navarro-Garcia	50 - 100
18020159	Honcut Headwaters-Lower Feather	> 200
18020104	Sacramento-Stone Corral	100 - 200
18020126	Upper Bear	10 - 50
18020128	North Fork American	10 - 50
16050101	Lake Tahoe	50 - 100
18020116	Upper Cache	> 200
18020161	Upper Coon-Upper Auburn	10 - 50
16050201	Upper Carson	10 - 50
18020129	South Fork American	10 - 50
18010110	Russian	100 - 200
18020111	Lower American	50 - 100
18020162	Upper Putah	10 - 50
16050302	West Walker	10 - 50
18010109	Gualala-Salmon	10 - 50
18040013	Upper Cosumnes	50 - 100
18020163	Lower Sacramento	> 200
16050301	East Walker	10 - 50
18040012	Upper Mokelumne	100 - 200
18050002	San Pablo Bay	> 200
18040011	Upper Calaveras California	10 - 50
18040010	Upper Stanislaus	50 - 100
18050001	Suisun Bay	> 200
16060010	Fish Lake-Soda Spring Valleys	< 10
18050005	Tomales-Drake Bays	> 200
18090101	Mono Lake	10 - 50
18040009	Upper Tuolumne	50 - 100
18040051	Rock Creek-French Camp Slough	< 10
18040003	San Joaquin Delta	> 200
18040008	Upper Merced	100 - 200
18050004	San Francisco Bay	> 200
18090102	Crowley Lake	> 200
18040002	Lower San Joaquin River	10 - 50
18040006	Upper San Joaquin	100 - 200
18050006	San Francisco Coastal South	100 - 200
18050003	Coyote	100 - 200
18040007	Fresno River	10 - 50
18040001	Middle San Joaquin-Lower Chowchilla	> 200
18090201	Eureka-Saline Valleys	10 - 50

Table A-14. Distribution and Frequency of Aquatic Invasive Species Records (contd.)

HUC 8 ID	HUC 8 Watershed Name	Records of Non-Native Invasive Species per HUC-8
18030010	Upper King	10 - 50
18060015	Monterey Bay	50 - 100
18060002	Pajaro	50 - 100
18030009	Upper Dry	10 - 50
18090202	Upper Amargosa	10 - 50
18090103	Owens Lake	10 - 50
18040014	Panoche-San Luis Reservoir	< 10
18030007	Upper Kaweah	100 - 200
18030001	Upper Kern	10 - 50
18030006	Upper Tule	10 - 50
18090203	Death Valley-Lower Amargosa	10 - 50
18090204	Panamint Valley	10 - 50
18060005	Salinas	100 - 200
18030012	Tulare Lake Bed	50 - 100
18030002	South Fork Kern	10 - 50
16060015	Ivanpah-Pahrump Valleys	< 10
18030005	Upper Deer-Upper White	10 - 50
18060006	Central Coastal	> 200
18090205	Indian Wells-Searles Valleys	10 - 50
18030004	Upper Poso	< 10
18060004	Estrella	< 10
18060003	Carrizo Plain	< 10
15030102	Piute Wash	< 10
18030003	Middle Kern-Upper Tehachapi-Grapevine	50 - 100
18090207	Coyote-Cuddeback Lakes	< 10
15030101	Havasu-Mohave Lakes	10 - 50
18060007	Cuyama	10 - 50
18090206	Antelope-Fremont Valleys	10 - 50
18060008	Santa Maria	10 - 50
18090208	Mojave	100 - 200
18060009	San Antonio	10 - 50
18060010	Santa Ynez	50 - 100
18070102	Santa Clara	> 200
18060013	Santa Barbara Coastal	100 - 200
18070101	Ventura	50 - 100
18100100	Southern Mojave	10 - 50
18070103	Calleguas	50 - 100
18070105	Los Angeles	100 - 200
18070203	Santa Ana	> 200
18070104	Santa Monica Bay	> 200

Table A-14. Distribution and Frequency of Aquatic Invasive Species Records (contd.)

HUC 8 ID	HUC 8 Watershed Name	Records of Non-Native Invasive Species per HUC-8
18070106	San Gabriel	100 - 200
18060014	Santa Barbara Channel Islands	50 - 100
18100201	Whitewater River	50 - 100
18070202	San Jacinto	50 - 100
18070201	Seal Beach	50 - 100
18070204	Newport Bay	50 - 100
15030104	Imperial Reservoir	> 200
18070302	Santa Margarita	100 - 200
18070301	Aliso-San Onofre	100 - 200
18070303	San Luis Rey-Escondido	100 - 200
18100203	San Felipe Creek	10 - 50
18070107	San Pedro Channel Islands	50 - 100
18100204	Salton Sea	> 200
18070304	San Diego	> 200
18100202	Carrizo Creek	10 - 50
18070305	Cottonwood-Tijuana	50 - 100
15030107	Lower Colorado	100 - 200

Source: USGS NAS Database

Ecosystem Vitality

Intended Outcome: Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness.

EV 3: Acreage of Wetlands

Table A-15 presents the data from Figure 4-13 in the main body.

Table A-15. Distribution of Wetland Acreage Through California

HUC 8 ID	HUC 8 Watershed Name	Acreage of Wetland in Watershed
17120007	Warner Lakes	0 - 10,000
17100311	Illinois	0 - 10,000
17100312	Chetco	0 - 10,000
17100309	Applegate	0 - 10,000
18020001	Goose Lake	10,000 - 50,000
18010206	Upper Klamath	0 - 10,000
18010204	Lost	50,000 - 100,000
18010101	Smith	0 - 10,000
18010205	Butte	0 - 10,000
18010207	Shasta	10,000 - 50,000
18010209	Lower Klamath	0 - 10,000
18080001	Surprise Valley	10,000 - 50,000
18010208	Scott	0 - 10,000
16040204	Massacre Lake	0 - 10,000
18020002	Upper Pit	50,000 - 100,000
18010210	Salmon	0 - 10,000
18020004	McCloud	0 - 10,000
18020005	Sacramento Headwaters	0 - 10,000
18020003	Lower Pit	10,000 - 50,000
18010211	Trinity	0 - 10,000
18080002	Madeline Plains	50,000 - 100,000
18010102	Mad-Redwood	10,000 - 50,000
16040203	Smoke Creek Desert	0 - 10,000
18020151	Cow Creek	0 - 10,000
18020154	Clear Creek-Sacramento River	0 - 10,000
18010212	South Fork Trinity	0 - 10,000
18020153	Battle Creek	0 - 10,000
18080003	Honey-Eagle Lakes	50,000 - 100,000
18020152	Cottonwood Creek	0 - 10,000
18010107	Mattole	0 - 10,000
18010105	Lower Eel	10,000 - 50,000
18020155	Paynes Creek-Sacramento River	0 - 10,000

Table A-15. Distribution of Wetland Acreage Through California (contd.)

HUC 8 ID	HUC 8 Watershed Name	Acreage of Wetland in Watershed
18020121	North Fork Feather	10,000 - 50,000
18020156	Thomes Creek-Sacramento River	10,000 - 50,000
18020122	East Branch North Fork Feather	10,000 - 50,000
18010106	South Fork Eel	0 - 10,000
18020157	Big Chico Creek-Sacramento River	10,000 - 50,000
18010104	Middle Fork Eel	0 - 10,000
18020123	Middle Fork Feather	10,000 - 50,000
18020158	Butte Creek	50,000 - 100,000
18020115	Upper Stony	0 - 10,000
18010103	Upper Eel	0 - 10,000
16050102	Truckee	0 - 10,000
18020125	Upper Yuba	0 - 10,000
18010108	Big-Navarro-Garcia	0 - 10,000
18020159	Honcut Headwaters-Lower Feather	10,000 - 50,000
18020104	Sacramento-Stone Corral	10,000 - 50,000
18020126	Upper Bear	0 - 10,000
18020128	North Fork American	0 - 10,000
16050101	Lake Tahoe	0 - 10,000
18020116	Upper Cache	0 - 10,000
18020161	Upper Coon-Upper Auburn	0 - 10,000
16050201	Upper Carson	10,000 - 50,000
18020129	South Fork American	0 - 10,000
18010110	Russian	0 - 10,000
18020111	Lower American	0 - 10,000
18020162	Upper Putah	0 - 10,000
16050302	West Walker	10,000 - 50,000
18010109	Gualala-Salmon	0 - 10,000
18040013	Upper Cosumnes	10,000 - 50,000
18020163	Lower Sacramento	10,000 - 50,000
16050301	East Walker	10,000 - 50,000
18040012	Upper Mokelumne	10,000 - 50,000
18050002	San Pablo Bay	10,000 - 50,000
18040011	Upper Calaveras California	0 - 10,000
18040010	Upper Stanislaus	0 - 10,000
18050001	Suisun Bay	50,000 - 100,000
16060010	Fish Lake-Soda Spring Valleys	0 - 10,000
18050005	Tomales-Drake Bays	0 - 10,000
18090101	Mono Lake	0 - 10,000
18040009	Upper Tuolumne	10,000 - 50,000
18040051	Rock Creek-French Camp Slough	0 - 10,000

Table A-15. Distribution of Wetland Acreage Through California (contd.)

HUC 8 ID	HUC 8 Watershed Name	Acreage of Wetland in Watershed
18040003	San Joaquin Delta	10,000 - 50,000
18040008	Upper Merced	10,000 - 50,000
18050004	San Francisco Bay	10,000 - 50,000
18090102	Crowley Lake	10,000 - 50,000
18040002	Lower San Joaquin River	0 - 10,000
18040006	Upper San Joaquin	10,000 - 50,000
18050006	San Francisco Coastal South	0 - 10,000
18050003	Coyote	0 - 10,000
18040007	Fresno River	0 - 10,000
18040001	Middle San Joaquin-Lower Chowchilla	50,000 - 100,000
18090201	Eureka-Saline Valleys	0 - 10,000
18030010	Upper King	10,000 - 50,000
18060015	Monterey Bay	0 - 10,000
18060002	Pajaro	0 - 10,000
18030009	Upper Dry	10,000 - 50,000
18090202	Upper Amargosa	0 - 10,000
18090103	Owens Lake	10,000 - 50,000
18040014	Panoche-San Luis Reservoir	0 - 10,000
18030007	Upper Kaweah	0 - 10,000
18030001	Upper Kern	10,000 - 50,000
18030006	Upper Tule	0 - 10,000
18090203	Death Valley-Lower Amargosa	0 - 10,000
18090204	Panamint Valley	0 - 10,000
18060005	Salinas	10,000 - 50,000
18030012	Tulare Lake Bed	10,000 - 50,000
18030002	South Fork Kern	10,000 - 50,000
16060015	Ivanpah-Pahrump Valleys	0 - 10,000
18030005	Upper Deer-Upper White	0 - 10,000
18060006	Central Coastal	10,000 - 50,000
18090205	Indian Wells-Searles Valleys	0 - 10,000
18030004	Upper Poso	0 - 10,000
18060004	Estrella	0 - 10,000
18060003	Carrizo Plain	0 - 10,000
15030102	Piute Wash	0 - 10,000
18030003	Middle Kern-Upper Tehachapi-Grapevine	0 - 10,000
18090207	Coyote-Cuddeback Lakes	0 - 10,000
15030101	Havasu-Mohave Lakes	0 - 10,000
18060007	Cuyama	0 - 10,000
18090206	Antelope-Fremont Valleys	0 - 10,000
18060008	Santa Maria	0 - 10,000

Table A-15. Distribution of Wetland Acreage Through California (contd.)

HUC 8 ID	HUC 8 Watershed Name	Acreage of Wetland in Watershed
18090208	Mojave	0 - 10,000
18060009	San Antonio	0 - 10,000
18060010	Santa Ynez	0 - 10,000
18070102	Santa Clara	0 - 10,000
18060013	Santa Barbara Coastal	0 - 10,000
18070101	Ventura	0 - 10,000
18100100	Southern Mojave	0 - 10,000
18070103	Calleguas	0 - 10,000
18070105	Los Angeles	0 - 10,000
18070203	Santa Ana	10,000 - 50,000
18070104	Santa Monica Bay	0 - 10,000
18070106	San Gabriel	0 - 10,000
18060014	Santa Barbara Channel Islands	0 - 10,000
18100201	Whitewater River	0 - 10,000
18070202	San Jacinto	0 - 10,000
18070201	Seal Beach	0 - 10,000
18070204	Newport Bay	0 - 10,000
15030104	Imperial Reservoir	10,000 - 50,000
18070302	Santa Margarita	0 - 10,000
18070301	Aliso-San Onofre	0 - 10,000
18070303	San Luis Rey-Escondido	10,000 - 50,000
18100203	San Felipe Creek	0 - 10,000
18070107	San Pedro Channel Islands	0 - 10,000
18100204	Salton Sea	10,000 - 50,000
18070304	San Diego	10,000 - 50,000
18100202	Carrizo Creek	0 - 10,000
18070305	Cottonwood-Tijuana	0 - 10,000
15030107	Lower Colorado	0 - 10,000

Source: National Wetlands Inventory. May 2018. U.S. Fish and Wildlife Service.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV 4: Degree of Aquatic Fragmentation

Table A-16 presents the data from Figure 4-14 in the main body.

Table A-16. Degree of Aquatic Fragmentation

HUC 8 ID	HUC 8 Watershed Name	Aquatic Fragmentation Score
17120007	Warner Lakes	40 - 60
17100311	Illinois	40 - 60
17100312	Chetco	0 - 20
17100309	Applegate	20 - 40
18020001	Goose Lake	20 - 40
18010206	Upper Klamath	0 - 20
18010204	Lost	40 - 60
18010101	Smith	40 - 60
18010205	Butte	20 - 40
18010207	Shasta	0 - 20
18010209	Lower Klamath	40 - 60
18080001	Surprise Valley	40 - 60
18010208	Scott	0 - 20
16040204	Massacre Lake	40 - 60
18020002	Upper Pit	20 - 40
18010210	Salmon	40 - 60
18020004	McCloud	0 - 20
18020005	Sacramento Headwaters	0 - 20
18020003	Lower Pit	20 - 40
18010211	Trinity	40 - 60
18080002	Madeline Plains	20 - 40
18010102	Mad-Redwood	20 - 40
16040203	Smoke Creek Desert	80 - 100
18020151	Cow Creek	0 - 20
18020154	Clear Creek-Sacramento River	0 - 20
18010212	South Fork Trinity	20 - 40
18020153	Battle Creek	0 - 20
18080003	Honey-Eagle Lakes	20 - 40
18020152	Cottonwood Creek	20 - 40
18010107	Mattole	60 - 80
18010105	Lower Eel	40 - 60
18020155	Paynes Creek-Sacramento River	40 - 60
18020121	North Fork Feather	0 - 20

Table A-16. Degree of Aquatic Fragmentation (contd.)

HUC 8 ID	HUC 8 Watershed Name	Aquatic Fragmentation Score
18020156	Thomes Creek-Sacramento River	20 - 40
18020122	East Branch North Fork Feather	0 - 20
18010106	South Fork Eel	20 - 40
18020157	Big Chico Creek-Sacramento River	40 - 60
18010104	Middle Fork Eel	40 - 60
18020123	Middle Fork Feather	0 - 20
18020158	Butte Creek	20 - 40
18020115	Upper Stony	40 - 60
18010103	Upper Eel	20 - 40
16050102	Truckee	0 - 20
18020125	Upper Yuba	0 - 20
18010108	Big-Navarro-Garcia	20 - 40
18020159	Honcut Headwaters-Lower Feather	0 - 20
18020104	Sacramento-Stone Corral	20 - 40
18020126	Upper Bear	0 - 20
18020128	North Fork American	20 - 40
16050101	Lake Tahoe	60 - 80
18020116	Upper Cache	20 - 40
18020161	Upper Coon-Upper Auburn	0 - 20
16050201	Upper Carson	60 - 80
18020129	South Fork American	0 - 20
18010110	Russian	0 - 20
18020111	Lower American	0 - 20
18020162	Upper Putah	20 - 40
16050302	West Walker	60 - 80
18010109	Gualala-Salmon	40 - 60
18040013	Upper Cosumnes	0 - 20
18020163	Lower Sacramento	0 - 20
16050301	East Walker	60 - 80
18040012	Upper Mokelumne	0 - 20
18050002	San Pablo Bay	0 - 20
18040011	Upper Calaveras California	0 - 20
18040010	Upper Stanislaus	20 - 40
18050001	Suisun Bay	0 - 20
16060010	Fish Lake-Soda Spring Valleys	80 - 100
18050005	Tomales-Drake Bays	0 - 20
18090101	Mono Lake	60 - 80
18040009	Upper Tuolumne	0 - 20
18040051	Rock Creek-French Camp Slough	40 - 60
18040003	San Joaquin Delta	0 - 20

Table A-16. Degree of Aquatic Fragmentation (contd.)

HUC 8 ID	HUC 8 Watershed Name	Aquatic Fragmentation Score
18040008	Upper Merced	20 - 40
18050004	San Francisco Bay	0 - 20
18090102	Crowley Lake	40 - 60
18040002	Lower San Joaquin River	60 - 80
18040006	Upper San Joaquin	20 - 40
18050006	San Francisco Coastal South	0 - 20
18050003	Coyote	0 - 20
18040007	Fresno River	0 - 20
18040001	Middle San Joaquin-Lower Chowchilla	20 - 40
18090201	Eureka-Saline Valleys	80 - 100
18030010	Upper King	40 - 60
18060015	Monterey Bay	0 - 20
18060002	Pajaro	0 - 20
18030009	Upper Dry	0 - 20
18090202	Upper Amargosa	60 - 80
18090103	Owens Lake	60 - 80
18040014	Panoche-San Luis Reservoir	40 - 60
18030007	Upper Kaweah	20 - 40
18030001	Upper Kern	60 - 80
18030006	Upper Tule	20 - 40
18090203	Death Valley-Lower Amargosa	60 - 80
18090204	Panamint Valley	40 - 60
18060005	Salinas	0 - 20
18030012	Tulare Lake Bed	0 - 20
18030002	South Fork Kern	60 - 80
16060015	Ivanpah-Pahrump Valleys	40 - 60
18030005	Upper Deer-Upper White	0 - 20
18060006	Central Coastal	0 - 20
18090205	Indian Wells-Searles Valleys	20 - 40
18030004	Upper Poso	0 - 20
18060004	Estrella	0 - 20
18060003	Carrizo Plain	20 - 40
15030102	Piute Wash	20 - 40
18030003	Middle Kern-Upper Tehachapi-Grapevine	0 - 20
18090207	Coyote-Cuddeback Lakes	20 - 40
15030101	Havasu-Mohave Lakes	60 - 80
18060007	Cuyama	60 - 80
18090206	Antelope-Fremont Valleys	0 - 20
18060008	Santa Maria	40 - 60
18090208	Mojave	0 - 20

Table A-16. Degree of Aquatic Fragmentation (contd.)

HUC 8 ID	HUC 8 Watershed Name	Aquatic Fragmentation Score
18060009	San Antonio	0 - 20
18060010	Santa Ynez	40 - 60
18070102	Santa Clara	20 - 40
18060013	Santa Barbara Coastal	0 - 20
18070101	Ventura	20 - 40
18100100	Southern Mojave	40 - 60
18070103	Calleguas	0 - 20
18070105	Los Angeles	0 - 20
18070203	Santa Ana	0 - 20
18070104	Santa Monica Bay	0 - 20
18070106	San Gabriel	0 - 20
18100201	Whitewater River	20 - 40
18070202	San Jacinto	0 - 20
18070201	Seal Beach	0 - 20
18070204	Newport Bay	0 - 20
15030104	Imperial Reservoir	60 - 80
18070302	Santa Margarita	0 - 20
18070301	Aliso-San Onofre	20 - 40
18070303	San Luis Rey-Escondido	0 - 20
18100203	San Felipe Creek	60 - 80
18070107	San Pedro Channel Islands	40 - 60
18100204	Salton Sea	60 - 80
18070304	San Diego	0 - 20
18100202	Carrizo Creek	40 - 60
18070305	Cottonwood-Tijuana	0 - 20
15030107	Lower Colorado	60 - 80

Sources: TIGER Products, U.S. Census Bureau
National Hydrologic Dataset, U.S. Geologic Survey
CalTrans GIS Data, CalTrans
National Forest System Roads, U.S. Forest Service

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV 5: Impaired Water Bodies – by Hydrologic Region

Table A-17 presents the data from Figures 4-15 through 4-17 in the main body.

Table A-17. Impaired Water Bodies in the Hydrologic Regions

Hydrologic Region	Water Body Name	Constituent of Concern
North Coast	Eureka Plain HU, Humboldt Bay	Other
North Coast	Bodega HU, Bodega Harbor HA	Other
North Coast	Klamath River HU, Tule Lake and Lower Klamath Lake National Wildlife Refuge	Other
North Coast	Mendocino Coast HU, Navarro River HA, Delta	Sediment
North Coast	Bodega HU, Estero Americano HA, estuary	Other
North Coast	Dead Lake	Metals/Metalloids
North Coast	Iron Gate Reservoir	Other
North Coast	Copco Lake	Other
North Coast	Shastina, Lake	Metals/Metalloids
North Coast	Trinity Lake (was Claire Engle Lake)	Metals/Metalloids
North Coast	Ruth Lake	Metals/Metalloids
North Coast	Eel River HU, Upper Main HA, Lake Pillsbury HSA, Lake Pillsbury	Metals/Metalloids
North Coast	Russian River HU, Middle Russian River HA, Warm Springs HSA, Lake Sonoma [Reservoir]	Metals/Metalloids
North Coast	Russian River HU, Upper Russian River HA, Coyote Valley HSA, Lake Mendocino [Reservoir]	Metals/Metalloids
North Coast	Bodega HU, Estero Americano HA, Americano Creek	Other
North Coast	Campbell Cove	Other
North Coast	Trinidad State Beach	Other
North Coast	Klamath River HU, Lower HA, Klamath Glen HSA	Sediment
North Coast	Klamath River HU, Salmon River HA	Other
North Coast	Klamath River HU, Salmon River HA, Wooley Creek HSA	Other
North Coast	Klamath River HU, Middle HA and Lower HA, Scott River to Trinity River	Sediment
North Coast	Klamath River HU, Middle HA, Iron Gate Dam to Scott River	Sediment
North Coast	Klamath River HU, Middle HA, Oregon to Iron Gate	Other
North Coast	Klamath River HU, Scott River HA	Sediment
North Coast	Klamath River HU, Shasta River HA	Other
North Coast	Klamath River HU, Lost River HA, Tule Lake and Mt Dome HSAs	Other
North Coast	Trinity River HU, Lower Trinity HA	Sediment
North Coast	Trinity River HU, South Fork HA	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
North Coast	Trinity River HU, Middle HA	Sediment
North Coast	Trinity River HU, Upper HA	Sediment
North Coast	Trinity River HU, Upper HA, Trinity River, East Fork	Metals/Metalloids
North Coast	Redwood Creek HU, Redwood Creek	Other
North Coast	Trinidad HU, Little River HA	Other
North Coast	Mad River HU, Mad River	Other
North Coast	Eureka Plain HU, Jacoby Creek watershed	Sediment
North Coast	Eureka Plain HU, Elk River Watershed, Upper Elk River	Sediment
North Coast	Eureka Plain HU, Elk River Watershed, Upper Little South Fork Elk River	Sediment
North Coast	Eureka Plain HU, Elk River Watershed, Lower Elk River and Martin Slough	Other
North Coast	Eureka Plain HU, Freshwater Creek	Sediment
North Coast	Eureka Plain HU, Jolly Giant Creek	Other
North Coast	Eureka Plain HU, Gannon Slough	Other
North Coast	Eel River HU, Van Duzen River HA	Sediment
North Coast	Mad River HU, Norton Creek	Other
North Coast	Eel River HU, Lower Eel River HA (includes the Eel River Delta)	Other
North Coast	Eel River HU, South Fork HA	Metals/Metalloids
North Coast	Eel River HU, Middle Main HA	Metals/Metalloids
North Coast	Eel River HU, North Fork HA, Upper North Fork Eel River Watershed	Other
North Coast	Eel River HU, North Fork HA, Lower North Fork Eel River Watershed	Sediment
North Coast	Eel River HU, Upper Main HA (Includes Tomki Creek)	Other
North Coast	Eel River HU, Middle Fork HA, Eden Valley and Round Valley HSAs	Metals/Metalloids
North Coast	Eel River HU, Middle Fork HA, Wilderness and Black Butte HSAs	Other
North Coast	Cape Mendocino HU, Mattole River HA, Mattole River Watershed	Sediment
North Coast	Mendocino Coast HU, Rockport HA, Ten Mile River HSA	Other
North Coast	Mendocino Coast HU, Noyo River HA, Noyo River	Other
North Coast	Mendocino Coast HU, Noyo River HA, Pudding Creek	Other
North Coast	Mendocino Coast HU, Big River HA, Berry Gulch	Other
North Coast	Mendocino Coast HU, Big River HA, Big River	Other
North Coast	Mendocino Coast HU, Albion River HA, Albion River	Other
North Coast	Mendocino Coast HU, Navarro River HA	Sediment
North Coast	Mendocino Coast HU, Garcia River HA, Garcia River	Other
North Coast	Mendocino Coast HU, Gualala River HA, Gualala River	Metals/Metalloids

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
North Coast	Russian River HU, Lower Russian River HA, Guerneville HSA, Green Valley Creek watershed	Other
North Coast	Russian River HU, Lower Russian River HA, Guerneville HSA	Other
North Coast	Russian River HU, Lower Russian River HA, Austin Creek HSA	Other
North Coast	Russian River HU, Middle Russian River HA, Laguna HSA, tributaries to the Laguna de Santa Rosa (except Santa Rosa Creek and its tributaries)	Other
North Coast	Russian River HU, Middle Russian River HA, Santa Rosa HSA, mainstem Santa Rosa Creek	Other
North Coast	Russian River HU, Middle Russian River HA, Santa Rosa HSA, tributaries to Santa Rosa Creek	Other
North Coast	Russian River HU, Middle Russian River HA, Mark West HSA, mainstem Mark West Creek upstream of the confluence with the Laguna de Santa Rosa	Other
North Coast	Russian River HU, Middle Russian River HA, Mark West HSA, Windsor Creek and its tributaries	Sediment
North Coast	Russian River HU, Middle Russian River HA, Mark West HSA, tributaries to Mark West Creek (except Windsor Creek and its tributaries)	Other
North Coast	Russian River HU, Middle Russian River HA, Warm Springs HSA	Sediment
North Coast	Russian River HU, Middle Russian River HA, Geyserville HSA	Other
North Coast	Russian River HU, Middle Russian River HA, Laguna HSA, mainstem Laguna de Santa Rosa	Other
North Coast	Russian River HU, Middle Russian River HA, Mark West HSA, mainstem Mark West Creek downstream of the confluence with the Laguna de Santa Rosa	Other
North Coast	Russian River HU, Middle Russian River HA, Big Sulphur Creek HSA	Sediment
North Coast	Russian River HU, Upper Russian River HA, Ukiah HSA	Other
North Coast	Russian River HU, Upper Russian River HA, Coyote Valley HSA	Sediment
North Coast	Russian River HU, Upper Russian River HA, Forsythe Creek HSA	Sediment
North Coast	Bodega HU, Estero de San Antonio HA, Stemple Creek/Estero de San Antonio	Other
North Lahontan	Bridgeport Reservoir	Nutrients
North Lahontan	Twin Lake, Upper (East Walker River HU)	Metals/Metalloids
North Lahontan	Topaz Lake	Metals/Metalloids
North Lahontan	Indian Creek Reservoir	Nutrients
North Lahontan	Tahoe Keys Sailing Lagoon	Other
North Lahontan	Tahoe, Lake	Nutrients

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
North Lahontan	Eagle Lake (Lassen County)	Nutrients
North Lahontan	Donner Lake	Other
North Lahontan	Honey Lake Wildfowl Management Ponds	Metals/Metalloids
North Lahontan	Honey Lake	Metals/Metalloids
North Lahontan	Honey Lake Area Wetlands	Metals/Metalloids
North Lahontan	General Creek	Metals/Metalloids
North Lahontan	Squaw Creek	Sediment
North Lahontan	Bidwell Creek	Other
North Lahontan	Mill Creek (Modoc County)	Other
North Lahontan	Aspen Creek	Metals/Metalloids
North Lahontan	Dressler Ditch	Sediment
North Lahontan	Snowshoe Thompson Ditch 1	Nutrients
North Lahontan	Carson River, West Fork (Woodfords to Paynesville)	Other
North Lahontan	Carson River, West Fork (Paynesville to State Line)	Other
North Lahontan	Hidden Valley Creek	Nutrients
North Lahontan	Truckee River, Upper (below Christmas Valley)	Metals/Metalloids
North Lahontan	Blackwood Creek	Metals/Metalloids
North Lahontan	Truckee River, Upper (above Christmas Valley)	Metals/Metalloids
North Lahontan	Heavenly Valley Creek (source to USFS boundary)	Other
North Lahontan	Monitor Creek	Metals/Metalloids
North Lahontan	Leviathan Creek	Metals/Metalloids
North Lahontan	Bryant Creek	Metals/Metalloids
North Lahontan	Truckee River	Sediment
North Lahontan	Bronco Creek	Sediment
North Lahontan	Susan River (Headwaters to Susanville)	Metals/Metalloids
North Lahontan	Susan River (Susanville to Litchfield)	Metals/Metalloids
North Lahontan	Tallac Creek (below Hwy 89)	Other
North Lahontan	Susan River (Litchfield to Honey Lake)	Metals/Metalloids
North Lahontan	Gray Creek (Nevada County)	Sediment
North Lahontan	Heavenly Valley Creek (USFS boundary to Trout Creek)	Other
North Lahontan	Bijou Park Creek	Metals/Metalloids
North Lahontan	Ward Creek	Metals/Metalloids
North Lahontan	Bodie Creek	Metals/Metalloids
North Lahontan	Robinson Creek (Twin Lakes to Hwy 395)	Other
North Lahontan	Swauger Creek	Nutrients
North Lahontan	Buckeye Creek	Other
North Lahontan	West Walker River	Metals/Metalloids
North Lahontan	Wolf Creek (Alpine County)	Sediment
North Lahontan	Carson River, East Fork	Other
North Lahontan	Robinson Creek (Hwy 395 to Bridgeport Res)	Other
North Lahontan	East Walker River, above Bridgeport Reservoir	Other
North Lahontan	East Walker River, below Bridgeport Reservoir	Sediment
North Lahontan	Indian Creek (Alpine County)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
North Lahontan	Carson River, West Fork (Headwaters to Woodfords)	Nutrients
North Lahontan	Cold Creek	Nutrients
North Lahontan	Trout Creek (above Hwy 50)	Other
North Lahontan	Trout Creek (below Hwy 50)	Other
Sacramento River	Sacramento San Joaquin Delta	Pesticides
Sacramento River	Solano, Lake	Other
Sacramento River	Folsom Lake	Other
Sacramento River	Thermalito Afterbay	Other
Sacramento River	Combie, Lake	Other
Sacramento River	Englebright Lake	Other
Sacramento River	Scotts Flat Reservoir	Other
Sacramento River	Shasta Lake	Other
Sacramento River	Loon Lake	Other
Sacramento River	Robinsons Riffle Pond (Butte County)	Other
Sacramento River	Pacific Heights Pond, Lower (Butte County)	Toxicity
Sacramento River	Rollins Reservoir	Other
Sacramento River	Moon Lake	Other
Sacramento River	Indian Valley Reservoir (Lake County)	Other
Sacramento River	Oroville Wildlife Area Fishing Pond (Butte County)	Toxicity
Sacramento River	West Valley Reservoir	Other
Sacramento River	Black Butte Reservoir	Other
Sacramento River	Berryessa, Lake	Other
Sacramento River	Mile Long Pond (Butte County)	Toxicity
Sacramento River	Merle Collins Lake	Other
Sacramento River	Stony Gorge Reservoir	Other
Sacramento River	Siskiyou, Lake	Other
Sacramento River	Meadows Slough (Sacramento County)	Other
Sacramento River	Lower Blue Lake	Other
Sacramento River	Zayak (Swan) Lake	Other
Sacramento River	Keswick Reservoir (portion downstream from Spring Creek)	Other
Sacramento River	Whiskeytown Lake	Other
Sacramento River	California, Lake	Other
Sacramento River	Clear Lake	Other
Sacramento River	Hell Hole Reservoir	Other
Sacramento River	New Bullards Bar Reservoir	Other
Sacramento River	Britton Lake	Other
Sacramento River	Eastman Lake (Shasta County)	Other
Sacramento River	Fingers Lake	Other
Sacramento River	Oxbow Reservoir (Ralston Afterbay, El Dorado and Placer Counties)	Other
Sacramento River	Almanor Lake	Other
Sacramento River	Davis Creek Reservoir	Other
Sacramento River	Slab Creek Reservoir (El Dorado County)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Sacramento River	Thermalito Forebay	Other
Sacramento River	Camp Far West Reservoir	Other
Sacramento River	Wildwood, Lake (Nevada County)	Other
Sacramento River	Oroville, Lake	Other
Sacramento River	Natoma, Lake	Other
Sacramento River	East Park Reservoir	Other
Sacramento River	Whiskeytown Lake (areas near Oak Bottom, Brandy Creek Campgrounds and Whiskeytown)	Other
Sacramento River	Shasta Lake (area where West Squaw Creek enters)	Other
Sacramento River/San Joaquin	Sacramento San Joaquin Delta	Pesticides
Sacramento River/San Joaquin	Delta Waterways (northern portion)	Other
Sacramento River/San Joaquin	Delta Waterways (export area)	Toxicity
Sacramento River/San Joaquin	Delta Waterways (southern portion)	Pesticides
Sacramento River/San Joaquin	Delta Waterways (central portion)	Pesticides
Sacramento River/San Joaquin	Delta Waterways (western portion)	Pesticides
Sacramento River/San Joaquin	Delta Waterways (Stockton Ship Channel)	Toxicity
Sacramento River/San Joaquin	Delta Waterways (eastern portion)	Pesticides
Sacramento River/San Joaquin	Delta Waterways (northwestern portion)	Pesticides
Sacramento River/San Joaquin	Discovery Bay	Other
Sacramento River	Eel River HU, Middle Fork HA, Wilderness and Black Butte HSAs	Other
Sacramento River	Russian River HU, Upper Russian River HA, Coyote Valley HSA	Other
Sacramento River	Bear River, Upper (from Combie Lake to Camp Far West Reservoir, Nevada and Placer Counties)	Other
Sacramento River	Chicken Ranch Slough	Pesticides
Sacramento River	Clear Creek (below Whiskeytown Lake, Shasta County)	Other
Sacramento River	Mill Creek (Tehama County)	Other
Sacramento River	Putah Creek (Solano Lake to Putah Creek Sinks; partly in Delta Waterways, northwestern portion)	Other
Sacramento River	North Canyon Creek (El Dorado County)	Other
Sacramento River	Gold Run (Nevada County)	Other
Sacramento River	Rock Creek (Nevada County)	Other
Sacramento River	Feather River, Middle Fork (Sierra Valley to Lake Oroville, Butte and Plumas Counties)	Toxicity

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Sacramento River	Elk Grove Creek	Pesticides
Sacramento River	Arcade Creek	Pesticides
Sacramento River	Wadsworth Canal	Pesticides
Sacramento River	Morrison Slough	Pesticides
Sacramento River	Duck Slough (in Delta Waterways, northern portion)	Pesticides
Sacramento River	Bear Creek (Colusa County)	Other
Sacramento River	Davis Creek (upstream from Davis Creek Reservoir, Yolo County)	Other
Sacramento River	Miners Ravine (Placer County)	Other
Sacramento River	Bear River, Lower (below Camp Far West Reservoir)	Other
Sacramento River	Little Deer Creek	Other
Sacramento River	Oregon Creek (Yuba and Sierra Counties)	Other
Sacramento River	Coon Creek (from confluence of Orr and Dry Creeks to East Side Canal, Placer and Sutter Counties)	Other
Sacramento River	Kaseberg Creek, unnamed eastern tributary (from Green Grove Ln to Del Webb Blvd)	Pesticides
Sacramento River	Stony Creek	Pesticides
Sacramento River	Sacramento River (Cottonwood Creek to Red Bluff)	Toxicity
Sacramento River	Mud Creek (Butte County)	Toxicity
Sacramento River	West Squaw Creek (below Balaklala Mine)	Other
Sacramento River	Poorman Creek (Nevada County)	Other
Sacramento River	Sacramento Slough	Other
Sacramento River	Pleasant Grove Creek, South Branch, unnamed southeastern trib (from east of Sierra View Country Club to confl with Pleasant Grove Cr, South Branch)	Pesticides
Sacramento River	Walker Creek (Glenn County)	Pesticides
Sacramento River	Coyote Creek (Tehama County)	Other
Sacramento River	Sacramento River (Keswick Dam to Cottonwood Creek)	Toxicity
Sacramento River	Natomas East Main Drainage Canal (aka Steelhead Creek, downstream of confluence with Arcade Creek)	Other
Sacramento River	Pleasant Grove Creek, unnamed northern tributary (from Mt Tamalpais Dr to confluence with Pleasant Grove Creek)	Pesticides
Sacramento River	Knights Landing Ridge Cut (Yolo County)	Other
Sacramento River	Willow Slough Bypass (Yolo County)	Other
Sacramento River	Harley Gulch	Other
Sacramento River	Spring Creek (Nevada County)	Other
Sacramento River	Castle Creek, Upper (Nevada County)	Other
Sacramento River	Kanaka Creek	Other
Sacramento River	Pleasant Grove Creek	Pesticides
Sacramento River	Sand Creek (Colusa County)	Other
Sacramento River	Burch Creek (Tehama County)	Toxicity
Sacramento River	Feather River, Lower (Lake Oroville Dam to Confluence with Sacramento River)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Sacramento River	Kaseberg Creek (tributary to Pleasant Grove Creek, Placer County)	Toxicity
Sacramento River	Coon Creek, Lower (from Pacific Avenue to Main Canal, Sutter County)	Toxicity
Sacramento River	Hamilton Slough (from south of Thermalito Afterbay to south of Biggs, Butte County)	Toxicity
Sacramento River	China Slough (from Leininger Road to Sacramento River, Tehama County)	Toxicity
Sacramento River	Pine Creek (Butte County)	Toxicity
Sacramento River	Oak Run Creek	Other
Sacramento River	Rock Creek (Placer County)	Other
Sacramento River	Yankee Slough (Placer and Sutter Counties)	Pesticides
Sacramento River	Deer Creek (from Deer Creek Reservoir to Lake Wildwood, Nevada County)	Other
Sacramento River	Squirrel Creek (Nevada County)	Other
Sacramento River	Yuba River, North Fork	Other
Sacramento River	Feather River, North Fork (below Lake Almanor)	Other
Sacramento River	Sutter Bypass	Other
Sacramento River	Anderson Creek (Shasta County)	Other
Sacramento River	Simmerly Slough (Yuba County)	Toxicity
Sacramento River	Yuba River (confluence of North and Middle Yuba Rivers to Englebright Lake)	Other
Sacramento River	Butte Creek (Butte County)	Other
Sacramento River	Spring Creek, Lower (Iron Mountain Mine to Keswick Reservoir)	Other
Sacramento River	Pit River, North Fork	Other
Sacramento River	Pit River, South Fork	Other
Sacramento River	Pit River (from confluence of N and S forks to Shasta Lake)	Other
Sacramento River	Cache Creek, North Fork (below Indian Valley Reservoir, Lake County)	Other
Sacramento River	Scotchman Creek (Nevada County)	Other
Sacramento River	Natomas East Main Drainage Canal (aka Steelhead Creek, upstream of confluence with Arcade Creek)	Other
Sacramento River	Natomas Cross Canal (Sutter County)	Other
Sacramento River	Cherokee Creek (Sierra County)	Other
Sacramento River	Feather River, West Branch (from Griffin Gulch to Lake Oroville)	Toxicity
Sacramento River	American River, Lower (Nimbus Dam to confluence with Sacramento River)	Other
Sacramento River	Live Oak Slough	Other
Sacramento River	Gilsizer Slough (from Yuba City to downstream of Township Road, Sutter County)	Other
Sacramento River	Big Chico Creek (Butte and Tehama Counties)	Other
Sacramento River	Freshwater Creek (Little Valley to Salt Creek, Colusa County)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Sacramento River	Stone Corral Creek	Other
Sacramento River	South Cow Creek	Other
Sacramento River	Clover Creek	Other
Sacramento River	Sacramento River (Knights Landing to the Delta)	Other
Sacramento River	American River, South Fork (below Slab Creek Reservoir to Folsom Lake)	Other
Sacramento River	Strong Ranch Slough	Pesticides
Sacramento River	Kaseberg Creek, unnamed southeastern tributary (from Silverado Middle School to Timber Creek Golf Course, Placer County)	Pesticides
Sacramento River	Kaseberg Creek, unnamed southern tributary (from Baseline Road to Timber Creek Golf Course, Placer County)	Pesticides
Sacramento River	Main Drainage Canal	Other
Sacramento River	Canyon Creek (Modoc County)	Other
Sacramento River	Willow Slough (Yolo County)	Toxicity
Sacramento River	Yuba River, South Fork (Spaulding, Lake to Englebright Lake)	Other
Sacramento River	Sycamore Slough (Yolo County)	Other
Sacramento River	Davis Creek (downstream from Davis Creek Reservoir, Yolo County)	Other
Sacramento River	Yuba River (Englebright Lake Dam to Feather River, Lower)	Other
Sacramento River	French Ravine	Other
Sacramento River	Yuba River, South Fork (Headwaters to Spaulding, Lake)	Other
Sacramento River	Sucker Run (Butte County)	Toxicity
Sacramento River	Dolly Creek	Other
Sacramento River	Spring Creek (Colusa County)	Pesticides
Sacramento River	Sulphur Creek (Colusa County)	Other
Sacramento River	Indian Creek (from Antelope Lake to East Branch of North Fork Feather River, Plumas County)	Other
Sacramento River	Elder Creek	Pesticides
Sacramento River	Little Cow Creek (downstream from Afterthought Mine)	Other
Sacramento River	Sweany Creek (Solano County)	Toxicity
Sacramento River	Little Grizzly Creek	Other
Sacramento River	Tule Canal (Yolo County)	Other
Sacramento River	Fall River (Pit)	Other
Sacramento River	Ash Creek, Upper	Other
Sacramento River	Feather River, South Fork (from Little Grass Valley Reservoir to Lake Oroville, Butte and Plumas Counties)	Other
Sacramento River	Spanish Creek (Plumas County)	Other
Sacramento River	Colusa Basin Drain	Pesticides

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Sacramento River	Little Backbone Creek, Lower	Other
Sacramento River	Dry Creek (Placer and Sacramento Counties)	Other
Sacramento River	Butte Slough	Pesticides
Sacramento River	Snake River (Butte and Sutter Counties)	Pesticides
Sacramento River	Rush Creek (Modoc County)	Other
Sacramento River	James Creek	Other
Sacramento River	Coon Hollow Creek (El Dorado County)	Pesticides
Sacramento River	Jack Slough	Pesticides
Sacramento River	Shady Creek (Nevada County)	Other
Sacramento River	Concow Creek (tributary to West Branch Feather River, Butte County)	Toxicity
Sacramento River	Pleasant Grove Creek, South Branch	Pesticides
Sacramento River	Sacramento River (Red Bluff to Knights Landing)	Other
Sacramento River	Beaver Creek	Other
Sacramento River	Ulatis Creek (Solano County)	Toxicity
Sacramento River	Horse Creek (Rising Star Mine to Shasta Lake)	Other
Sacramento River	Gordon Slough (from headwaters and Goodnow Slough to Adams Canal, Yolo County)	Other
Sacramento River	Cache Creek, Lower (Clear Lake Dam to Cache Creek Settling Basin near Yolo Bypass)	Toxicity
Sacramento River	Honcut Creek (Butte and Yuba Counties)	Other
Sacramento River	Kentucky Creek (Nevada County)	Other
Sacramento River	Morrison Creek	Pesticides
Sacramento River	Willow Creek (Shasta County, below Greenhorn Mine to Clear Creek)	Other
Sacramento River	Town Creek	Other
Sacramento River	Deer Creek (Nevada County, Above Scotts Flat Reservoir to the Confluence of Deer Creek North and South Forks)	Other
Sacramento River	Humbug Creek (Diggins Creek to Yuba River, South Fork)	Other
Sacramento River	Pleasant Grove Creek, unnamed northern tributary (from Greywood Circle to confluence with Pleasant Grove Creek)	Pesticides
Sacramento River	Winters Canal (Yolo County)	Pesticides
Sacramento River	American River, North Fork	Other
Sacramento River	Wolf Creek (Nevada County)	Other
Sacramento River	Fall River, tributary to Feather River, Middle Fork (Butte and Plumas Counties)	Toxicity
Sacramento River	Curry Creek (Placer and Sutter Counties)	Toxicity
Sacramento River	Willow Creek (Lassen County, Central Valley)	Other
Sacramento River	Lassen Creek (Modoc County)	Toxicity
San Francisco Bay	Suisun Bay	Pesticides
San Francisco Bay	Mission Creek	Pesticides
San Francisco Bay	Sacramento San Joaquin Delta	Pesticides

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
San Francisco Bay	Oiger Quarry Ponds	Other
San Francisco Bay	Lexington Reservoir	Other
San Francisco Bay	Lake Chabot (Solano Co)	Other
San Francisco Bay	Briones Reservoir	Other
San Francisco Bay	San Francisco Bay, Central	Pesticides
San Francisco Bay	Oakland Inner Harbor (Fruitvale Site, part of SF Bay, Lower)	Pesticides
San Francisco Bay	Carquinez Strait	Pesticides
San Francisco Bay	Oakland Inner Harbor (Pacific Dry-dock Yard 1 Site, part of SF Bay, Lower)	Other
San Francisco Bay	San Francisco Bay, South	Pesticides
San Francisco Bay	San Pablo Bay	Pesticides
San Francisco Bay	Nicasio Reservoir	Other
San Francisco Bay	Coyote Reservoir	Other
San Francisco Bay	Tomales Bay	Other
San Francisco Bay	Richardson Bay	Pesticides
San Francisco Bay	Stevens Creek Reservoir	Pesticides
San Francisco Bay	Central Basin, San Francisco (part of SF Bay, Lower)	Pesticides
San Francisco Bay	Stege Marsh	Pesticides
San Francisco Bay	Islais Creek	Nutrients
San Francisco Bay	Shadow Cliffs Reservoir	Other
San Francisco Bay	San Francisco Bay, Lower	Pesticides
San Francisco Bay	San Leandro Bay (part of SF Bay, Lower)	Pesticides
San Francisco Bay	Suisun Marsh Wetlands	Other
San Francisco Bay	Oakland Inner Harbor	Fecal Indicator Bacteria
San Francisco Bay	Castro Cove, Richmond (San Pablo Basin)	Pesticides
San Francisco Bay	Soulajule Reservoir	Other
San Francisco Bay	Bon Tempe Reservoir	Other
San Francisco Bay	Lake Merced	Nutrients
San Francisco Bay	Pilarcitos Lake	Other
San Francisco Bay	Upper San Leandro Reservoir	Other
San Francisco Bay	Lake Chabot (Alameda Co)	Pesticides
San Francisco Bay	Lake Merritt	Other
San Francisco Bay	Del Valle Reservoir	Other
San Francisco Bay	Calaveras Reservoir	Other
San Francisco Bay	Lower Crystal Springs Reservoir	Other
San Francisco Bay	Anderson Reservoir	Other
San Francisco Bay	Almaden Reservoir	Other
San Francisco Bay	Calero Reservoir	Other
San Francisco Bay	Guadalupe Reservoir	Other
San Francisco Bay	Almaden Lake	Other
San Francisco Bay	Henne, Lake	Other
San Francisco Bay	San Pablo Reservoir	Pesticides
San Francisco Bay	Lake Herman	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
San Francisco Bay	Lafayette Reservoir	Other
San Francisco Bay	Suisun Slough	Pesticides
San Francisco Bay	Millerton Point	Fecal Indicator Bacteria
San Francisco Bay	Pacific Ocean at Pillar Point Beach	Fecal Indicator Bacteria
San Francisco Bay	Drakes Estero (at Schooner Bay oyster beds)	Fecal Indicator Bacteria
San Francisco Bay	Golden Hinde Beach	Fecal Indicator Bacteria
San Francisco Bay	Chicken Ranch Beach	Fecal Indicator Bacteria
San Francisco Bay	Crissy Field Beach	Fecal Indicator Bacteria
San Francisco Bay	Fort Baker, Horseshoe Cove (San Francisco Bay, Central)	Fecal Indicator Bacteria
San Francisco Bay	Aquatic Park Beach	Fecal Indicator Bacteria
San Francisco Bay	Crown Beach (San Francisco Bay, Lower)	Fecal Indicator Bacteria
San Francisco Bay	Candlestick Point	Fecal Indicator Bacteria
San Francisco Bay	McNears Beach	Fecal Indicator Bacteria
San Francisco Bay	Walker Creek	Other
San Francisco Bay	Lagunitas Creek	Other
San Francisco Bay	Olema Creek	Fecal Indicator Bacteria
San Francisco Bay	San Pedro Creek	Fecal Indicator Bacteria
San Francisco Bay	San Vicente Creek	Fecal Indicator Bacteria
San Francisco Bay	San Gregorio Creek	Fecal Indicator Bacteria
San Francisco Bay	Pescadero Creek	Other
San Francisco Bay	Pomponio Creek	Fecal Indicator Bacteria
San Francisco Bay	Butano Creek	Other
San Francisco Bay	Corte Madera Creek	Pesticides
San Francisco Bay	San Rafael Creek	Pesticides
San Francisco Bay	Coyote Creek (Marin County)	Pesticides
San Francisco Bay	Arroyo Corte Madera Del Presidio	Pesticides
San Francisco Bay	Cerrito Creek	Other
San Francisco Bay	San Leandro Creek, Lower	Pesticides
San Francisco Bay	San Lorenzo Creek	Pesticides
San Francisco Bay	Damon Slough	Other
San Francisco Bay	Old Alameda Creek	Other
San Francisco Bay	Arroyo Del Valle	Pesticides
San Francisco Bay	Alameda Creek	Pesticides
San Francisco Bay	Arroyo Las Positas	Nutrients
San Francisco Bay	Arroyo Mocho	Other
San Francisco Bay	Arroyo De La Laguna	Pesticides
San Francisco Bay	Colma Creek	Other
San Francisco Bay	San Mateo Creek	Other
San Francisco Bay	San Mateo Creek, Lower	Other
San Francisco Bay	Guadalupe Slough	Other
San Francisco Bay	Coyote Creek (Santa Clara Co.)	Pesticides
San Francisco Bay	San Felipe Creek	Pesticides
San Francisco Bay	Silver Creek (Santa Clara County)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
San Francisco Bay	Los Gatos Creek (R2)	Pesticides
San Francisco Bay	Alamitos Creek	Other
San Francisco Bay	Guadalupe River	Pesticides
San Francisco Bay	Guadalupe Creek	Other
San Francisco Bay	Stevens Creek	Other
San Francisco Bay	Permanente Creek	Other
San Francisco Bay	San Francisquito Creek	Other
San Francisco Bay	Matadero Creek	Pesticides
San Francisco Bay	Saratoga Creek	Other
San Francisco Bay	San Tomas Aquinas Creek	Other
San Francisco Bay	Napa River, Mare Island Strait	Pesticides
San Francisco Bay	Novato Creek	Pesticides
San Francisco Bay	Gallinas Creek	Pesticides
San Francisco Bay	Petaluma River	Other
San Francisco Bay	Sonoma Creek, non-tidal	Nutrients
San Francisco Bay	Sonoma Creek, tidal	Nutrients
San Francisco Bay	Napa River, non-tidal	Nutrients
San Francisco Bay	Napa River, tidal	Nutrients
San Francisco Bay	Rindler Creek	Other
San Francisco Bay	Wildcat Creek	Pesticides
San Francisco Bay	Baxter Creek (Contra Costa County)	Other
San Francisco Bay	San Pablo Creek	Other
San Francisco Bay	Pinole Creek	Pesticides
San Francisco Bay	Rodeo Creek (Contra Costa County)	Pesticides
San Francisco Bay	Suisun Creek	Nutrients
San Francisco Bay	Ledgewood Creek	Pesticides
San Francisco Bay	Pine Creek (Contra Costa Co)	Pesticides
San Francisco Bay	Mt. Diablo Creek	Other
San Francisco Bay	Walnut Creek	Pesticides
San Francisco Bay	Kirker Creek	Other
San Francisco Bay	Schoonmaker Beach (Richardson Bay)	Fecal Indicator Bacteria
San Francisco Bay	Aquatic Park (Marina Lagoon, San Mateo County)	Fecal Indicator Bacteria
San Francisco Bay	Calabazas Creek (Santa Clara County)	Pesticides
San Francisco Bay	Petaluma River (tidal portion)	Pesticides
San Francisco Bay	Miller Creek	Pesticides
San Francisco Bay	China Camp Beach	Fecal Indicator Bacteria
San Francisco Bay	Keller Beach (San Francisco Bay, Central)	Fecal Indicator Bacteria
San Francisco Bay	Lakeshore Park Beach (Marina Lagoon, San Mateo County)	Fecal Indicator Bacteria
San Francisco Bay	San Antonio Creek (Marin/Sonoma Co)	Pesticides
San Francisco Bay	Cordonices Creek	Other
San Francisco Bay	Paradise Cove Beach (San Francisco Bay, Central)	Fecal Indicator Bacteria
San Francisco Bay	Kiteboard Beach (San Francisco Bay, Lower)	Fecal Indicator Bacteria
San Francisco Bay	Laurel Creek (Solano Co)	Pesticides

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
San Francisco Bay	Grayson Creek	Other
San Francisco Bay	Oyster Point Marina (San Francisco Bay, Lower)	Fecal Indicator Bacteria
San Francisco Bay	Strawberry Creek (Alameda County)	Other
San Francisco Bay	Sausal Creek	Other
Sacramento River/San Joaquin	Sacramento San Joaquin Delta	Pesticides
Sacramento River/San Joaquin	Delta Waterways (northern portion)	Other
Sacramento River/San Joaquin	Delta Waterways (export area)	Other
Sacramento River/San Joaquin	Delta Waterways (southern portion)	Pesticides
Sacramento River/San Joaquin	Delta Waterways (central portion)	Pesticides
Sacramento River/San Joaquin	Delta Waterways (western portion)	Pesticides
Sacramento River/San Joaquin	Delta Waterways (Stockton Ship Channel)	Other
Sacramento River/San Joaquin	Delta Waterways (eastern portion)	Pesticides
Sacramento River/San Joaquin	Delta Waterways (northwestern portion)	Pesticides
Sacramento River/San Joaquin	Discovery Bay	Metals/Metalloids
San Joaquin	Sacramento San Joaquin Delta	Pesticides
San Joaquin	Woodward Reservoir	Metals/Metalloids
San Joaquin	Turlock Lake	Metals/Metalloids
San Joaquin	Don Pedro Lake	Metals/Metalloids
San Joaquin	McClure Reservoir (Mariposa County)	Metals/Metalloids
San Joaquin	Eastman Lake (Madera County)	Metals/Metalloids
San Joaquin	San Luis Reservoir	Metals/Metalloids
San Joaquin	Davis No 2, unnamed spillway (near N Podesta Lane)	Metals/Metalloids
San Joaquin	Pardee Reservoir	Metals/Metalloids
San Joaquin	Los Banos Reservoir	Metals/Metalloids
San Joaquin	Mendota Pool	Metals/Metalloids
San Joaquin	Delta Waterways (southern portion)	Pesticides
San Joaquin	Camanche Reservoir	Metals/Metalloids
San Joaquin	New Melones Reservoir	Metals/Metalloids
San Joaquin	Hensley Lake	Metals/Metalloids
San Joaquin	Millerton Lake	Metals/Metalloids
San Joaquin	Modesto Reservoir	Metals/Metalloids
San Joaquin	ONeill Forebay	Metals/Metalloids
San Joaquin	Marsh Creek Reservoir	Metals/Metalloids
San Joaquin	Amador Lake	Other
San Joaquin	Los Vaqueros Reservoir	Metals/Metalloids

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
San Joaquin	Grasslands Marshes	Metals/Metalloids
San Joaquin	Hetch Hetchy Reservoir	Metals/Metalloids
San Joaquin	Ramona Lake (Fresno County)	Other
San Joaquin	Ramona Lake	Pesticides
San Joaquin	New Hogan Lake (Calaveras County)	Metals/Metalloids
San Joaquin	Tulloch Reservoir	Metals/Metalloids
San Joaquin	Discovery Bay	Metals/Metalloids
San Joaquin	Rose Creek (Tuolumne County)	Fecal Indicator Bacteria
San Joaquin	Niagara Creek (Tuolumne County)	Fecal Indicator Bacteria
San Joaquin	Bell Creek (Tuolumne County)	Fecal Indicator Bacteria
San Joaquin	Brack Tract Drain, at Woodbridge Rd (San Joaquin County)	Metals/Metalloids
San Joaquin	Bear River (from Allen to Upper Bear River Reservoir, Amador County)	Other
San Joaquin	Bear Creek (from Bear Valley to San Joaquin River, Mariposa and Merced Counties)	Fecal Indicator Bacteria
San Joaquin	Salt Slough (upstream from confluence with San Joaquin River)	Pesticides
San Joaquin	Kellogg Creek (Los Vaqueros Reservoir to Discovery Bay; partly in Delta Waterways, western portion)	Other
San Joaquin	Mokelumne River, Lower (in Delta Waterways, eastern portion)	Metals/Metalloids
San Joaquin	Old River (San Joaquin River to Delta-Mendota Canal; in Delta Waterways, southern portion)	Other
San Joaquin	San Joaquin River (Merced River to Tuolumne River)	Pesticides
San Joaquin	Potato Slough, Little (San Joaquin County)	Other
San Joaquin	Berenda Creek (Madera County)	Pesticides
San Joaquin	Laguna Creek (tributary to Cosumnes River, Sacramento County)	Other
San Joaquin	Mormon Slough (Commerce Street to Stockton Deep Water Channel; partly in Delta Waterways, eastern portion)	Other
San Joaquin	Turnback Creek (Tuolumne County)	Fecal Indicator Bacteria
San Joaquin	Smith Canal (in Delta Waterways, eastern portion)	Pesticides
San Joaquin	Bear Creek (San Joaquin and Calaveras Counties; partly in Delta Waterways, eastern portion)	Metals/Metalloids
San Joaquin	San Joaquin River (Bear Creek to Mud Slough)	Pesticides
San Joaquin	Mud Slough, North (downstream of San Luis Drain)	Pesticides
San Joaquin	Sand Creek (tributary to Marsh Creek, Contra Costa County; partly in Delta Waterways, western portion)	Pesticides
San Joaquin	Stanislaus River, Lower	Metals/Metalloids
San Joaquin	San Joaquin River (Tuolumne River to Stanislaus River)	Pesticides
San Joaquin	Harding Drain	Pesticides
San Joaquin	Ingalsbe Slough (tributary to Merced River, Merced County)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
San Joaquin	Duck Slough (Merced County)	Pesticides
San Joaquin	Del Puerto Creek	Pesticides
San Joaquin	Newman Wasteway	Pesticides
San Joaquin	Calaveras River, Lower (from Stockton Diverting Canal to the San Joaquin River; partly in Delta Waterways, eastern portion)	Metals/Metalloids
San Joaquin	Grant Line Canal subwatershed near Calpack Rd (San Joaquin County)	Other
San Joaquin	Turner Slough (Merced County)	Fecal Indicator Bacteria
San Joaquin	Calaveras River, Lower (from Bellota Weir to Stockton Diverting Canal)	Other
San Joaquin	Lone Tree Creek	Other
San Joaquin	Langworth Pipeline (Stanislaus County)	Other
San Joaquin	Deep Slough (Merced County)	Other
San Joaquin	Sullivan Creek (from Phoenix Reservoir to Don Pedro Lake, Tuolumne County)	Fecal Indicator Bacteria
San Joaquin	Tom Paine Slough (in Delta Waterways, southern portion)	Other
San Joaquin	Cottonwood Creek (S Madera County)	Fecal Indicator Bacteria
San Joaquin	San Joaquin River (Mendota Pool to Bear Creek)	Pesticides
San Joaquin	Woods Creek (Tuolumne County)	Fecal Indicator Bacteria
San Joaquin	Ingram Creek (from confluence with Hospital Creek to Hwy 33 crossing)	Pesticides
San Joaquin	Poso Slough	Other
San Joaquin	Littlejohns Creek	Fecal Indicator Bacteria
San Joaquin	San Joaquin River (Mud Slough to Merced River)	Pesticides
San Joaquin	Grayson Drain (at outfall)	Fecal Indicator Bacteria
San Joaquin	Orestimba Creek (above Kilburn Road)	Pesticides
San Joaquin	Lone Willow Slough (Madera County)	Other
San Joaquin	French Camp Slough (confluence of Littlejohns and Lone Tree Creeks to San Joaquin River, San Joaquin Co; partly in Delta Waterways, eastern portion)	Other
San Joaquin	Los Banos Creek (below Los Banos Reservoir, Merced County)	Other
San Joaquin	Tuolumne River, Lower (Don Pedro Reservoir to San Joaquin River)	Pesticides
San Joaquin	Agatha Canal (Merced County)	Other
San Joaquin	Five Mile Slough (Alexandria Place to Fourteen Mile Slough; in Delta Waterways, eastern portion)	Fecal Indicator Bacteria
San Joaquin	Rattlesnake Creek (at confluence w Mokelumne River, N Fork)	Fecal Indicator Bacteria
San Joaquin	Deadman Creek (Merced County)	Pesticides
San Joaquin	Hospital Creek (San Joaquin and Stanislaus Counties)	Metals/Metalloids
San Joaquin	Grant Line Canal subwatershed at Clifton Court Rd (San Joaquin County)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
San Joaquin	Black Rascal Creek (Merced County)	Other
San Joaquin	San Joaquin River (Stanislaus River to Delta Boundary)	Pesticides
San Joaquin	Berenda Slough (Madera County)	Other
San Joaquin	Orestimba Creek (below Kilburn Road)	Pesticides
San Joaquin	Merced River, Lower (McSwain Reservoir to San Joaquin River)	Metals/Metalloids
San Joaquin	Ingram Creek (from confluence with San Joaquin River to confluence with Hospital Creek)	Other
San Joaquin	Mud Slough, North (upstream of San Luis Drain)	Other
San Joaquin	Marsh Creek (Marsh Creek Reservoir to San Joaquin River; partly in Delta Waterways, western portion)	Metals/Metalloids
San Joaquin	Mosher Slough (upstream of I-5; partly in Delta Waterways, eastern portion)	Fecal Indicator Bacteria
San Joaquin	Walker Slough (partly in Delta Waterways, eastern portion)	Fecal Indicator Bacteria
San Joaquin	Mormon Slough (Stockton Diverting Canal to Commerce Street)	Fecal Indicator Bacteria
San Joaquin	Dry Creek (Madera County)	Other
San Joaquin	Mustang Creek (Merced County)	Pesticides
San Joaquin	Curtis Creek (Tuolumne County)	Other
San Joaquin	Salt Slough (Mud Slough to Sand Dam, Merced County)	Pesticides
San Joaquin	Marsh Creek (Dunn Creek to Marsh Creek Reservoir)	Metals/Metalloids
San Joaquin	Cosumnes River, Lower (below Michigan Bar; partly in Delta Waterways, eastern portion)	Fecal Indicator Bacteria
San Joaquin	Avena Drain	Other
San Joaquin	Twain Harte Creek (Tuolumne County)	Fecal Indicator Bacteria
San Joaquin	Little Panoche Creek	Other
San Joaquin	Dry Creek (tributary to Tuolumne River at Modesto, E Stanislaus County)	Pesticides
San Joaquin	Miles Creek (Merced County)	Other
San Joaquin	Mormon Slough (from Stockton Diverting Canal to Bellota Weir--Calaveras River)	Pesticides
San Joaquin	Bear River (Lower Bear River Reservoir to Mokelumne River, N Fork, Amador County)	Metals/Metalloids
San Joaquin	Bull Meadow Creek (Tuolumne County)	Fecal Indicator Bacteria
San Joaquin	Turner Slough (drains into San Joaquin River (Bear Creek to Mud Slough), Merced County)	Other
San Joaquin/Tulare Lake	San Joaquin River (Friant Dam to Mendota Pool)	Other
San Joaquin	Mosher Slough (downstream of I-5; in Delta Waterways, eastern portion)	Other
San Joaquin	Highline Canal (from Mustang Creek to Lateral No 8, Merced and Stanislaus Counties)	Pesticides

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
San Joaquin	Mountain House Creek (from Altamont Pass to Old River, Alameda and San Joaquin Counties; partly in Delta Waterways, southern portion)	Other
San Joaquin	Pixley Slough (San Joaquin County; partly in Delta Waterways, eastern portion)	Fecal Indicator Bacteria
San Joaquin	Temple Creek	Other
San Joaquin	Dunn Creek (Mt Diablo Mine to Marsh Creek)	Metals/Metalloids
San Joaquin	Middle River (in Delta Waterways, southern portion)	Other
San Joaquin	Fresno River (Above Hensley Reservoir to confl w Nelder Creek and Lewis Fork)	Other
San Joaquin	Willow Creek (Madera County)	Other
San Joaquin	Salado Creek (Stanislaus County)	Fecal Indicator Bacteria
San Joaquin	Duck Creek (San Joaquin County)	Metals/Metalloids
San Joaquin	Westley Wasteway (Stanislaus County)	Pesticides
Central Coast	Monterey Harbor	Other
Central Coast	Espinosa Lake	Other
Central Coast	Morro Bay	Sediment
Central Coast	Elkhorn Slough	Other
Central Coast	Salinas River Refuge Lagoon (South)	Sediment
Central Coast	Goleta Slough/Estuary	Other
Central Coast	Soda Lake	Nutrients
Central Coast	Moss Landing Harbor	Fecal Indicator Bacteria
Central Coast	Moro Cojo Slough	Nutrients
Central Coast	Santa Cruz Harbor	Other
Central Coast	San Lorenzo River Lagoon	Fecal Indicator Bacteria
Central Coast	Salinas River Lagoon (North)	Nutrients
Central Coast	Soquel Lagoon	Fecal Indicator Bacteria
Central Coast	Pajaro River Estuary	Other
Central Coast	Old Salinas River Estuary	Nutrients
Central Coast	Carpinteria Marsh (El Estero)	Other
Central Coast	Santa Maria River Estuary	Fecal Indicator Bacteria
Central Coast	Schwan Lake	Nutrients
Central Coast	Pinto Lake	Other
Central Coast	Uvas Reservoir	Other
Central Coast	Chesbro Reservoir	Other
Central Coast	Hernandez Reservoir	Other
Central Coast	Nacimiento Reservoir	Other
Central Coast	San Antonio Reservoir	Other
Central Coast	Oso Flaco Lake	Other
Central Coast	Cachuma, Lake	Other
Central Coast	Corcoran Lagoon	Fecal Indicator Bacteria
Central Coast	Pacific Ocean at Cayucos (Cayucos Creek Mouth)	Fecal Indicator Bacteria
Central Coast	Pacific Ocean at Capitola Beach (Santa Cruz County)	Fecal Indicator Bacteria
Central Coast	Waddell Creek Lagoon	Other
Central Coast	Kings Creek	Sediment

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Central Coast	Boulder Creek	Sediment
Central Coast	Love Creek	Sediment
Central Coast	San Lorenzo River	Sediment
Central Coast	Shingle Mill Creek	Sediment
Central Coast	Fall Creek	Sediment
Central Coast	Zayante Creek	Sediment
Central Coast	Bear Creek (Santa Cruz County)	Sediment
Central Coast	Newell Creek (Upper)	Sediment
Central Coast	Newell Creek (Lower)	Other
Central Coast	Lompico Creek	Sediment
Central Coast	Mountain Charlie Gulch	Sediment
Central Coast	Bean Creek	Sediment
Central Coast	Lockhart Gulch	Nutrients
Central Coast	Camp Evers Creek	Other
Central Coast	Arana Gulch	Other
Central Coast	Branciforte Creek	Sediment
Central Coast	Carbonera Creek	Nutrients
Central Coast	Porter Gulch Creek	Fecal Indicator Bacteria
Central Coast	Rodeo Creek Gulch	Sediment
Central Coast	Soquel Creek	Fecal Indicator Bacteria
Central Coast	Nobel Gulch Creek	Fecal Indicator Bacteria
Central Coast	Valencia Creek	Sediment
Central Coast	Trout Creek Gulch	Fecal Indicator Bacteria
Central Coast	Aptos Creek	Fecal Indicator Bacteria
Central Coast	Rider Creek	Sediment
Central Coast	Corralitos Creek	Other
Central Coast	Harkins Slough	Nutrients
Central Coast	Watsonville Slough	Nutrients
Central Coast	Salsipuedes Creek (Santa Cruz County)	Other
Central Coast	Beach Road Ditch	Nutrients
Central Coast	Struve Slough	Nutrients
Central Coast	Gallighan Slough	Fecal Indicator Bacteria
Central Coast	Hanson Slough	Fecal Indicator Bacteria
Central Coast	McGowan Ditch	Nutrients
Central Coast	Uvas Creek (above Uvas Reservoir)	Other
Central Coast	Llagas Creek (above Chesbro Reservoir)	Other
Central Coast	Uvas Creek (below Uvas Reservoir)	Sediment
Central Coast	San Benito River	Fecal Indicator Bacteria
Central Coast	Furlong Creek	Fecal Indicator Bacteria
Central Coast	Carnadero Creek (Uvas Creek below Bloomfield Road)	Nutrients
Central Coast	Tequisquita Slough	Fecal Indicator Bacteria
Central Coast	Pacheco Creek	Nutrients
Central Coast	Tres Pinos Creek	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Central Coast	Carneros Creek (Monterey County)	Nutrients
Central Coast	Bennett Slough	Nutrients
Central Coast	Tularcitos Creek	Other
Central Coast	Big Creek (Big Sur Coast)	Other
Central Coast	Willow Creek (Monterey County)	Other
Central Coast	Salinas Reclamation Canal	Fecal Indicator Bacteria
Central Coast	Tembladero Slough	Fecal Indicator Bacteria
Central Coast	Blanco Drain	Other
Central Coast	Espinosa Slough	Other
Central Coast	Salinas River (middle, near Gonzales Rd crossing to confluence with Nacimiento River)	Other
Central Coast	Salinas River (lower, estuary to near Gonzales Rd crossing, watersheds 30910 and 30920)	Other
Central Coast	Natividad Creek	Nutrients
Central Coast	Merrit Ditch	Other
Central Coast	Alisal Slough (Monterey County)	Nutrients
Central Coast	San Lorenzo Creek (Monterey County)	Fecal Indicator Bacteria
Central Coast	Gabilan Creek	Nutrients
Central Coast	Santa Rita Creek (Monterey County)	Nutrients
Central Coast	Majors Creek (Monterey County)	Other
Central Coast	Arroyo Seco River	Fecal Indicator Bacteria
Central Coast	Alisal Creek (Monterey County)	Fecal Indicator Bacteria
Central Coast	San Antonio River (below San Antonio Reservoir)	Fecal Indicator Bacteria
Central Coast	Atascadero Creek (San Luis Obispo County)	Nutrients
Central Coast	Salinas River (upper, confluence of Nacimiento River to Santa Margarita Reservoir)	Other
Central Coast	Las Tablas Creek, North Fork	Other
Central Coast	Las Tablas Creek, South Fork	Other
Central Coast	Las Tablas Creek	Other
Central Coast	Arroyo De La Cruz Lagoon	Fecal Indicator Bacteria
Central Coast	San Simeon Creek	Nutrients
Central Coast	Villa Creek	Fecal Indicator Bacteria
Central Coast	Old Creek (above Whale Rock Reservoir)	Fecal Indicator Bacteria
Central Coast	Toro Creek	Fecal Indicator Bacteria
Central Coast	Morro Creek	Fecal Indicator Bacteria
Central Coast	Dairy Creek	Fecal Indicator Bacteria
Central Coast	Pennington Creek	Fecal Indicator Bacteria
Central Coast	San Luisito Creek	Fecal Indicator Bacteria
Central Coast	Chumash Creek	Fecal Indicator Bacteria
Central Coast	Walters Creek	Fecal Indicator Bacteria
Central Coast	San Bernardo Creek	Fecal Indicator Bacteria
Central Coast	Los Osos Creek Estuary	Sediment
Central Coast	Los Osos Creek (Los Osos to Los Osos Creek Estuary)	Nutrients
Central Coast	Warden Creek	Fecal Indicator Bacteria

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Central Coast	Los Osos Creek (upstream of Los Osos)	Nutrients
Central Coast	Stenner Creek	Fecal Indicator Bacteria
Central Coast	Prefumo Creek	Nutrients
Central Coast	San Luis Obispo Creek (below Osos Street)	Nutrients
Central Coast	Pismo Creek	Other
Central Coast	Arroyo Grande Creek (below Lopez Lake)	Fecal Indicator Bacteria
Central Coast	Nipomo Creek	Fecal Indicator Bacteria
Central Coast	Santa Maria River	Nutrients
Central Coast	Oso Flaco Creek	Nutrients
Central Coast	Sisquoc River	Other
Central Coast	Main Street Canal	Nutrients
Central Coast	Little Oso Flaco Creek	Fecal Indicator Bacteria
Central Coast	Greene Valley Creek (Santa Barbara County)	Other
Central Coast	Unnamed tributary to Orcutt Creek	Other
Central Coast	Casmalia Canyon Creek	Sediment
Central Coast	Shuman Canyon Creek	Sediment
Central Coast	San Miguelito Creek	Other
Central Coast	Sloans Canyon Creek	Sediment
Central Coast	Santa Ynez River (below city of Lompoc to Ocean)	Sediment
Central Coast	Santa Ynez River (Cachuma Lake to below city of Lompoc)	Sediment
Central Coast	Santa Rosa Creek (San Luis Obispo County)	Fecal Indicator Bacteria
Central Coast	Salsipuedes Creek (Santa Barbara County)	Fecal Indicator Bacteria
Central Coast	Santa Ynez River (above Lake Cachuma)	Other
Central Coast	Dos Pueblos Canyon Creek	Other
Central Coast	Bell Creek (Santa Barbara Co)	Nutrients
Central Coast	Tecolote Creek (Santa Barbara County)	Other
Central Coast	Canada Del Capitan	Other
Central Coast	Canada Del Refugio	Fecal Indicator Bacteria
Central Coast	Canada De La Gaviota	Other
Central Coast	Jalama Creek	Other
Central Coast	Tecolotito Creek	Other
Central Coast	Glen Annie Canyon Creek	Other
Central Coast	San Jose Creek (Santa Barbara County)	Other
Central Coast	Atascadero Creek (Santa Barbara county)	Fecal Indicator Bacteria
Central Coast	Cieneguitas Creek	Other
Central Coast	Carneros Creek (Santa Barbara County)	Fecal Indicator Bacteria
Central Coast	Devereux Creek	Fecal Indicator Bacteria
Central Coast	San Pedro Creek (Santa Barbara County)	Fecal Indicator Bacteria
Central Coast	Maria Ygnacio Creek	Sediment
Central Coast	Arroyo Burro Creek	Fecal Indicator Bacteria
Central Coast	Mission Creek (Santa Barbara County)	Fecal Indicator Bacteria
Central Coast	Sycamore Creek	Other
Central Coast	Romero Creek	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Central Coast	Carpinteria Creek (below Gobernador Creek)	Fecal Indicator Bacteria
Central Coast	Arroyo Paredon	Other
Central Coast	Rincon Creek	Other
Central Coast	Franklin Creek (Santa Barbara County)	Nutrients
Central Coast	Santa Monica Creek	Fecal Indicator Bacteria
Central Coast	Estrella River	Other
Central Coast	Cholame Creek	Fecal Indicator Bacteria
Central Coast	Old Salinas River	Fecal Indicator Bacteria
Central Coast	Bradley Canyon Creek	Nutrients
Central Coast	North Main Street Channel	Nutrients
Central Coast	Pacific Ocean at New Brighton Beach (Santa Cruz County)	Fecal Indicator Bacteria
Central Coast	McEnery Spring	Other
Central Coast	Rincon Beach	Fecal Indicator Bacteria
Central Coast	Los Berros Creek	Nutrients
Central Coast	Chualar Creek, South Branch	Sediment
Central Coast	Chorro Creek	Sediment
Central Coast	Llagas Creek (below Chesbro Reservoir)	Other
Central Coast	Pacific Ocean at Goleta Beach (Santa Barbara County)	Fecal Indicator Bacteria
Central Coast	Pajaro River	Other
Central Coast	Chualar Creek	Nutrients
Central Coast	Toro Canyon Creek	Fecal Indicator Bacteria
Central Coast	Pacific Ocean at East Beach (mouth of Mission Creek, Santa Barbara County)	Fecal Indicator Bacteria
Central Coast	La Brea Creek	Fecal Indicator Bacteria
Central Coast	Pico Creek	Nutrients
Central Coast	Blosser Channel	Nutrients
Central Coast	Orcutt Creek	Fecal Indicator Bacteria
Central Coast	Alamo Creek	Fecal Indicator Bacteria
Central Coast	San Juan Creek (San Benito County)	Nutrients
Central Coast	Millers Canal	Nutrients
Central Coast	Moore Creek	Other
Central Coast	Pacific Ocean at Leadbetter Beach (Santa Barbara County)	Fecal Indicator Bacteria
Central Coast	Bradley Channel	Fecal Indicator Bacteria
Central Coast	Cuyama River (above Twitchell Reservior)	Other
Central Coast	Quail Creek	Nutrients
Central Coast	Watsonville Creek	Fecal Indicator Bacteria
Central Coast	San Antonio Creek (San Antonio Watershed, Rancho del las Flores Bridge at Hwy 135 to downstream at Railroad Bridge)	Other
Central Coast	Scott Creek Lagoon	Other
South Coast	Port Hueneme Harbor (Back Basins)	Pesticides

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	Los Angeles Harbor - Inner Cabrillo Beach Area	Pesticides
South Coast	Los Angeles/Long Beach Outer Harbor (inside breakwater)	Other
South Coast	Anaheim Bay	Other
South Coast	Dominguez Channel Estuary (unlined portion below Vermont Ave)	Other
South Coast	Pyramid Lake	Metals/Metalloids
South Coast	Echo Park Lake	Other
South Coast	Lincoln Park Lake	Other
South Coast	Huntington Harbour	Pesticides
South Coast	Malibu Lagoon	Other
South Coast	Los Angeles River Estuary (Queensway Bay)	Pesticides
South Coast	Malibou Lake	Other
South Coast	Balboa Lake	Other
South Coast	Canyon Lake (Railroad Canyon Reservoir)	Other
South Coast	Ventura Harbor: Ventura Keys	Fecal Indicator Bacteria
South Coast	Newport Bay, Upper (Ecological Reserve)	Other
South Coast	Casitas, Lake	Metals/Metalloids
South Coast	Munz Lake	Other
South Coast	Lake Calabasas	Other
South Coast	Wildlife Lake	Other
South Coast	Puddingstone Reservoir	Metals/Metalloids
South Coast	Prado Park Lake	Other
South Coast	Big Bear Lake	Metals/Metalloids
South Coast	Colorado Lagoon	Other
South Coast	Los Cerritos Channel	Pesticides
South Coast	San Pedro Bay Near/Off Shore Zones	Pesticides
South Coast	Rhine Channel	Other
South Coast	Los Penasquitos Lagoon	Other
South Coast	Elizabeth Lake	Other
South Coast	Machado Lake (Harbor Park Lake)	Pesticides
South Coast	Peck Road Park Lake	Other
South Coast	Los Angeles Harbor - Cabrillo Marina	Other
South Coast	Alamitos Bay	Fecal Indicator Bacteria
South Coast	Downtown Shoreline Marina (part of San Pedro Bay Near/Off Shore Zones)	Other
South Coast	Santa Clara River Estuary	Pesticides
South Coast	Calleguas Creek Reach 1 (was Mugu Lagoon on 1998 303(d) list)	Other
South Coast	Castaic Lagoon	Other
South Coast	Castaic Lake	Metals/Metalloids
South Coast	Crystal Lake	Other
South Coast	Ormond Beach Wetlands	Other
South Coast	Ballona Creek Wetlands	Other
South Coast	Los Angeles Harbor - Consolidated Slip	Metals/Metalloids

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	Marina del Rey Harbor - Back Basins	Fecal Indicator Bacteria
South Coast	Los Angeles Harbor - Fish Harbor	Metals/Metalloids
South Coast	Newport Bay, Lower (entire lower bay, including Rhine Channel, Turning Basin and South Lido Channel to east end of H-J Moorings)	Fecal Indicator Bacteria
South Coast	Bolsa Bay Marsh	Other
South Coast	Lake Hughes	Other
South Coast	Lake Sherwood	Metals/Metalloids
South Coast	El Dorado Lakes	Other
South Coast	Legg Lake	Other
South Coast	Los Angeles/Long Beach Inner Harbor	Pesticides
South Coast	McGrath Lake	Other
South Coast	Prado Flood Control Basin	Other
South Coast	Santa Monica Bay Offshore/Nearshore	Other
South Coast	Bolsa Chica Ecological Reserve	Other
South Coast	Lake Lindero	Other
South Coast	Westlake Lake	Metals/Metalloids
South Coast	Santa Fe Dam Park Lake	Other
South Coast	Elsinore, Lake	Other
South Coast	San Diego Bay Shoreline, near Switzer Creek	Pesticides
South Coast	San Diego Bay Shoreline, near Coronado Bridge	Other
South Coast	Oceanside Harbor	Metals/Metalloids
South Coast	Mission Bay (area at mouth of Rose Creek only)	Other
South Coast	Mission Bay (area at mouth of Tecolote Creek only)	Other
South Coast	San Diego Bay Shoreline, near sub base	Other
South Coast	San Diego Bay Shoreline, at Harbor Island (West Basin)	Metals/Metalloids
South Coast	San Diego Bay Shoreline, 32nd St San Diego Naval Station	Other
South Coast	San Juan Creek (mouth)	Metals/Metalloids
South Coast	Santa Margarita Lagoon	Other
South Coast	Agua Hedionda Lagoon	Other
South Coast	Famosa Slough and Channel	Other
South Coast	Buena Vista Lagoon	Fecal Indicator Bacteria
South Coast	San Elijo Lagoon	Fecal Indicator Bacteria
South Coast	Tijuana River Estuary	Fecal Indicator Bacteria
South Coast	San Diego Bay, Shelter Island Yacht Basin	Metals/Metalloids
South Coast	Loma Alta Slough	Other
South Coast	San Diego Bay Shoreline, at Americas Cup Harbor	Metals/Metalloids
South Coast	San Diego Bay Shoreline, Vicinity of B St and Broadway Piers	Fecal Indicator Bacteria
South Coast	San Diego Bay Shoreline, at Marriott Marina	Metals/Metalloids
South Coast	San Diego Bay Shoreline, at Harbor Island (East Basin)	Metals/Metalloids

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	San Diego Bay Shoreline, near Chollas Creek	Other
South Coast	San Diego Bay Shoreline, between Sampson and 28th Streets	Metals/Metalloids
South Coast	San Diego Bay Shoreline, Seventh Street Channel	Other
South Coast	San Diego Bay	Other
South Coast	San Diego Bay Shoreline, at Glorietta Bay	Metals/Metalloids
South Coast	San Diego Bay Shoreline, at Coronado Cays	Metals/Metalloids
South Coast	San Marcos Lake	Other
South Coast	Hodges, Lake	Other
South Coast	Sutherland Reservoir	Other
South Coast	San Vicente Reservoir	Other
South Coast	El Capitan Lake	Other
South Coast	Sweetwater Reservoir	Other
South Coast	Barrett Lake	Other
South Coast	Otay Reservoir, Lower	Other
South Coast	Guajome Lake	Other
South Coast	Loveland Reservoir	Metals/Metalloids
South Coast	Morena Reservoir	Other
South Coast	Batiquitos Lagoon	Other
South Coast	Mission Bay	Metals/Metalloids
South Coast	San Diego Bay Shoreline, Downtown Anchorage	Other
South Coast	Dan Blocker Memorial (Coral) Beach	Fecal Indicator Bacteria
South Coast	Santa Clara River Reach 1 (Estuary to Hwy 101 Bridge)	Other
South Coast	Santa Clara River Reach 4A (A Street, Fillmore to Piru Creek)	Other
South Coast	Santa Clara River Reach 5 (Blue Cut gaging station to West Pier Hwy 99 Bridge) (was named Santa Clara River Reach 7 on 2002 303(d) list)	Other
South Coast	Santa Clara River Reach 6 (W Pier Hwy 99 to Bouquet Cyn Rd) (was named Santa Clara River Reach 8 on 2002 303(d) list)	Other
South Coast	San Jose Creek Reach 1 (SG Confluence to Temple St.)	Other
South Coast	Rio Hondo Reach 3 (above Spreading Grounds)	Metals/Metalloids
South Coast	San Jose Creek Reach 2 (Temple to I-10 at White Ave.)	Fecal Indicator Bacteria
South Coast	Encinitas Creek	Other
South Coast	Mission Bay Shoreline, at Visitors Center	Fecal Indicator Bacteria
South Coast	Mission Bay Shoreline, at Enchanted Cove	Other
South Coast	Calleguas Creek Reach 2 (estuary to Potrero Rd- was Calleguas Creek Reaches 1 and 2 on 1998 303d list)	Pesticides
South Coast	Bell Creek	Fecal Indicator Bacteria
South Coast	Mill Creek Reach 1	Fecal Indicator Bacteria

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	Prima Deshecha Creek	Metals/Metalloids
South Coast	San Luis Rey River, Lower (west of Interstate 15)	Fecal Indicator Bacteria
South Coast	Poggi Canyon Creek	Other
South Coast	Surfers Point at Seaside	Fecal Indicator Bacteria
South Coast	Mission Bay Shoreline, at Leisure Lagoon	Fecal Indicator Bacteria
South Coast	Mission Bay Shoreline, at Ski Beach at Vacation Isle	Fecal Indicator Bacteria
South Coast	Calleguas Creek Reach 4 (was Revolon Slough Main Branch: Mugu Lagoon to Central Avenue on 1998 303d list)	Fecal Indicator Bacteria
South Coast	J Street Drain (Ventura County)	Other
South Coast	Potrero Canyon Creek	Other
South Coast	Bull Creek	Fecal Indicator Bacteria
South Coast	Oso Creek (at Mission Viejo Golf Course)	Other
South Coast	Murrieta Creek	Other
South Coast	San Elijo Creek (San Diego County), unnamed tributary at San Elijo Avenue	Fecal Indicator Bacteria
South Coast	Los Penasquitos Creek	Other
South Coast	Rose Creek	Other
South Coast	Switzer Creek	Metals/Metalloids
South Coast	Steele Canyon	Fecal Indicator Bacteria
South Coast	Jamacha Creek	Fecal Indicator Bacteria
South Coast	Rincon Beach	Fecal Indicator Bacteria
South Coast	Ormond Beach	Fecal Indicator Bacteria
South Coast	Channel Islands Harbor Beach	Fecal Indicator Bacteria
South Coast	Carbon Beach	Pesticides
South Coast	Point Dume Beach	Pesticides
South Coast	San Antonio Creek (Tributary to Ventura River Reach 4)	Other
South Coast	Brown Barranca/Long Canyon	Other
South Coast	Tapo Canyon	Pesticides
South Coast	Triunfo Canyon Creek Reach 1	Metals/Metalloids
South Coast	Los Angeles River Reach 6 (Above Sepulveda Flood Control Basin)	Metals/Metalloids
South Coast	Buck Gully Creek	Fecal Indicator Bacteria
South Coast	Santa Gertrudis Creek	Fecal Indicator Bacteria
South Coast	Green Canyon Creek	Fecal Indicator Bacteria
South Coast	Couser Canyon Creek	Fecal Indicator Bacteria
South Coast	Loma Alta Creek	Metals/Metalloids
South Coast	La Zanja Canyon	Fecal Indicator Bacteria
South Coast	San Vicente Creek (San Diego County)	Other
South Coast	Jamul Creek	Other
South Coast	Malibu Lagoon Beach (Surfrider)	Fecal Indicator Bacteria
South Coast	San Diego Bay Shoreline, G Street Pier	Fecal Indicator Bacteria
South Coast	Ventura River Reach 1 and 2 (Estuary to Weldon Canyon)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	Pole Creek (trib to Santa Clara River Reach 3)	Other
South Coast	Timber Canyon	Pesticides
South Coast	Coyote Creek	Metals/Metalloids
South Coast	Rio Hondo Reach 1 (Confl. LA River to Snt Ana Fwy)	Other
South Coast	Artesia-Norwalk Drain	Metals/Metalloids
South Coast	Santa Ana River Reach 3	Fecal Indicator Bacteria
South Coast	Santa Ysabel Creek (above Sutherland Reservoir)	Other
South Coast	Paradise Cove Beach	Fecal Indicator Bacteria
South Coast	Pacific Ocean Shoreline, Lower San Juan HSA, at surfzone outfall at Doheny State Beach	Fecal Indicator Bacteria
South Coast	Duck Pond Agricultural Drains/Mugu Drain/Oxnard Drain No 2	Pesticides
South Coast	Calleguas Creek Reach 5 (was Beardsley Channel on 1998 303d list)	Other
South Coast	Calleguas Creek Reach 11 (Arroyo Santa Rosa, was part of Conejo Creek Reach 3 on 1998 303d list)	Fecal Indicator Bacteria
South Coast	Dominguez Channel (lined portion above Vermont Ave)	Fecal Indicator Bacteria
South Coast	San Gabriel River Reach 1 (Estuary to Firestone)	Other
South Coast	Los Angeles River Reach 2 (Carson to Figueroa Street)	Other
South Coast	Aliso Canyon Wash	Fecal Indicator Bacteria
South Coast	Bonita Creek	Other
South Coast	Bolsa Chica Channel	Other
South Coast	Talbert Channel (Orange County)	Other
South Coast	Cucamonga Creek Reach 1 (Valley Reach)	Metals/Metalloids
South Coast	Poway Creek	Other
South Coast	Avalon Beach	Fecal Indicator Bacteria
South Coast	Wheeler Canyon/Todd Barranca	Other
South Coast	Calleguas Creek Reach 13 (Conejo Creek South Fork, was Conejo Cr Reach 4 and part of Reach 3 on 1998 303d list)	Other
South Coast	Calleguas Creek Reach 10 (Conejo Creek (Hill Canyon)-was part of Conejo Crk Reaches 2 & 3, and lower Conejo Crk/Arroyo Conejo N Fk on 1998 303d list)	Fecal Indicator Bacteria
South Coast	Calleguas Creek Reach 8 (was Tapo Canyon Reach 1)	Pesticides
South Coast	Los Angeles River Reach 1 (Estuary to Carson Street)	Metals/Metalloids
South Coast	Compton Creek	Other
South Coast	Puente Creek	Metals/Metalloids
South Coast	Rathbone (Rathbun) Creek	Other
South Coast	Bell Canyon Creek	Other
South Coast	San Elijo Creek (San Diego County)	Fecal Indicator Bacteria

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	San Dieguito River, unnamed tributary below Hodges Dam	Fecal Indicator Bacteria
South Coast	Sweetwater River, Upper (above Sweetwater Reservoir)	Metals/Metalloids
South Coast	Inspiration Point Beach	Pesticides
South Coast	Santa Monica Beach	Fecal Indicator Bacteria
South Coast	Santa Paula Creek Reach 1 (confluence w Santa Clara River to Diverson Dam)	Other
South Coast	Las Virgenes Creek	Fecal Indicator Bacteria
South Coast	Bull Creek (Los Angeles County)	Other
South Coast	Alhambra Wash	Other
South Coast	Borrego Creek (from State Route 241 to Irvine Blvd)	Fecal Indicator Bacteria
South Coast	Chino Creek Reach 1A (Santa Ana River R5 confl to just downstream of confl with Mill Creek)	Fecal Indicator Bacteria
South Coast	Mountain Home Creek, East Fork	Fecal Indicator Bacteria
South Coast	Salt Creek	Other
South Coast	Santa Margarita River (Upper)	Other
South Coast	San Marcos Creek	Pesticides
South Coast	Long Beach City Beach	Fecal Indicator Bacteria
South Coast	Canada Larga (Ventura River Watershed)	Fecal Indicator Bacteria
South Coast	Boulder Creek (Ventura County)	Pesticides
South Coast	Stokes Creek	Fecal Indicator Bacteria
South Coast	Sepulveda Canyon	Fecal Indicator Bacteria
South Coast	Santa Monica Canyon	Fecal Indicator Bacteria
South Coast	Los Angeles River Reach 3 (Figueroa St. to Riverside Dr.)	Other
South Coast	San Gabriel River, East Fork	Other
South Coast	Newport Slough	Fecal Indicator Bacteria
South Coast	Mill Creek (Prado Area)	Fecal Indicator Bacteria
South Coast	San Timoteo Creek Reach 1A (Santa Ana River to Confluence to Barton Rd)	Fecal Indicator Bacteria
South Coast	Laguna Canyon Channel	Other
South Coast	Long Canyon Creek (tributary to Murrieta Creek)	Pesticides
South Coast	Keys Creek	Fecal Indicator Bacteria
South Coast	San Marcos, Lake, drain to central southwest fork of lake	Metals/Metalloids
South Coast	Cloverdale Creek	Other
South Coast	Sycamore Canyon	Other
South Coast	Paleta Creek	Metals/Metalloids
South Coast	Sweetwater River, Lower (below Sweetwater Reservoir)	Fecal Indicator Bacteria
South Coast	Santa Clara River Reach 7 (Bouquet Canyon Rd to above Lang Gaging Station) (was named Santa Clara River Reach 9 on 2002 303(d) list)	Fecal Indicator Bacteria
South Coast	Ballona Creek Estuary	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	South San Jose Creek (Los Angeles County)	Other
South Coast	San Diego Creek Reach 1	Other
South Coast	Silverado Creek	Other
South Coast	Cucamonga Creek Reach 2 (Mountain Reach)	Other
South Coast	Santa Ana River Reach 4	Fecal Indicator Bacteria
South Coast	Warm Creek	Fecal Indicator Bacteria
South Coast	Mountain Home Creek	Fecal Indicator Bacteria
South Coast	Arroyo Trabuco Creek	Other
South Coast	Warm Springs Creek (Riverside County)	Fecal Indicator Bacteria
South Coast	Buena Creek	Other
South Coast	Tecolote Creek	Metals/Metalloids
South Coast	Tecolote Creek, South Fork	Fecal Indicator Bacteria
South Coast	Mission Bay Shoreline, at Bahia Point	Fecal Indicator Bacteria
South Coast	Mission Bay Shoreline, at North Cove Beach at Vacation Isle	Fecal Indicator Bacteria
South Coast	Rio De Santa Clara/Oxnard Drain No. 3	Pesticides
South Coast	Malibu Creek	Other
South Coast	Medea Creek Reach 2 (Abv Confl. with Lindero)	Other
South Coast	Palo Comado Creek	Fecal Indicator Bacteria
South Coast	San Gabriel River Reach 2 (Firestone to Whittier Narrows Dam	Metals/Metalloids
South Coast	Monrovia Canyon Creek	Metals/Metalloids
South Coast	Santa Margarita River (Lower)	Fecal Indicator Bacteria
South Coast	Agua Hedionda Creek	Metals/Metalloids
South Coast	Sweetwater River, North Fork, unnamed tributary at Tavern Road	Fecal Indicator Bacteria
South Coast	Robert H. Meyer Memorial Beach	Pesticides
South Coast	Point Fermin Park Beach	Other
South Coast	Venice Beach	Fecal Indicator Bacteria
South Coast	Mission Bay Shoreline, at Bonita Cove	Fecal Indicator Bacteria
South Coast	Triunfo Canyon Creek Reach 2	Other
South Coast	San Gabriel River Estuary	Metals/Metalloids
South Coast	Morning Canyon Creek	Fecal Indicator Bacteria
South Coast	Chino Creek Reach 1B (Mill Creek confl to start of concrete lined channel)	Other
South Coast	Summit Creek	Other
South Coast	English Canyon	Metals/Metalloids
South Coast	Oso Creek (lower)	Other
South Coast	Moosa Canyon, South Fork	Fecal Indicator Bacteria
South Coast	Fox Barranca (tributary to Calleguas Creek Reach 6)	Other
South Coast	Rio Hondo Reach 2 (At Spreading Grounds)	Fecal Indicator Bacteria
South Coast	Arroyo Seco Reach 1 (LA River to West Holly Ave.)	Fecal Indicator Bacteria
South Coast	Verdugo Wash Reach 2 (Above Verdugo Road)	Fecal Indicator Bacteria
South Coast	Chino Creek Reach 2 (Beginning of concrete channel to confl w San Antonio Creek)	Fecal Indicator Bacteria

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	Gopher Creek	Fecal Indicator Bacteria
South Coast	Alpine Creek	Fecal Indicator Bacteria
South Coast	Cottonwood Creek (Tijuana River watershed)	Metals/Metalloids
South Coast	Portuguese Bend Beach	Pesticides
South Coast	Mission Bay Shoreline, at Campland	Fecal Indicator Bacteria
South Coast	Oxnard Drain	Other
South Coast	Lindero Creek Reach 1	Fecal Indicator Bacteria
South Coast	Wilmington Drain	Fecal Indicator Bacteria
South Coast	Burbank Western Channel	Metals/Metalloids
South Coast	Tujunga Wash (LA River to Hansen Dam)	Other
South Coast	Sawpit Creek	Other
South Coast	San Diego Creek Reach 2	Other
South Coast	San Mateo Creek	Fecal Indicator Bacteria
South Coast	San Diego River (Lower)	Other
South Coast	San Diego River (Upper)	Fecal Indicator Bacteria
South Coast	Harbison Canyon	Fecal Indicator Bacteria
South Coast	Hobie Beach (Channel Islands Harbor)	Fecal Indicator Bacteria
South Coast	Malibu Beach	Fecal Indicator Bacteria
South Coast	Mission Bay Shoreline, at Fanual Park	Fecal Indicator Bacteria
South Coast	Ventura River Reach 3 (Weldon Canyon to Confl. w/ Coyote Cr)	Fecal Indicator Bacteria
South Coast	Ellsworth Barranca	Pesticides
South Coast	Sespe Creek (from 500 ft below confluence with Little Sespe Cr to headwaters)	Other
South Coast	Torrey Canyon Creek	Other
South Coast	Mint Canyon Creek Reach 1 (Confl to Rowler Cyn)	Other
South Coast	Calleguas Creek Reach 12 (was Conejo Creek/Arroyo Conejo North Fork on 1998 303d list)	Pesticides
South Coast	Los Angeles River Reach 4 (Sepulveda Dr. to Sepulveda Dam)	Other
South Coast	Serrano Creek	Other
South Coast	Live Oak Creek (San Diego County)	Fecal Indicator Bacteria
South Coast	Moosa Canyon Creek	Fecal Indicator Bacteria
South Coast	Escondido Creek	Pesticides
South Coast	Nicholas Canyon Beach	Other
South Coast	Honda Barranca	Pesticides
South Coast	Los Angeles River Reach 5 (within Sepulveda Basin)	Other
South Coast	McCoy Canyon Creek	Fecal Indicator Bacteria
South Coast	Peters Canyon Channel	Pesticides
South Coast	San Timoteo Creek Reach 3 (Yucaipa Creek to Headwaters)	Fecal Indicator Bacteria
South Coast	Segunda Deshecha Creek	Other
South Coast	Chocolate Creek	Fecal Indicator Bacteria
South Coast	La Costa Beach	Other
South Coast	Bluff Cove Beach	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	Marina del Rey Harbor Beach	Fecal Indicator Bacteria
South Coast	Mission Bay Shoreline, at Bonita Cove (eastern shore)	Fecal Indicator Bacteria
South Coast	Sanjon Barranca Creek	Other
South Coast	Hueneme Drain	Other
South Coast	Hopper Creek	Other
South Coast	Piru Creek (from gaging station below Santa Felicia Dam to headwaters)	Other
South Coast	Arroyo Seco Reach 2 (West Holly Ave to Devils Gate Dam)	Fecal Indicator Bacteria
South Coast	Aliso Creek	Other
South Coast	Rainbow Creek	Metals/Metalloids
South Coast	Kit Carson Creek	Other
South Coast	Carroll Canyon	Other
South Coast	Mexican Canyon Creek (eastern tributary to Sweetwater River, Upper)	Fecal Indicator Bacteria
South Coast	Mexican Canyon Creek (western tributary to Sweetwater River, Upper)	Fecal Indicator Bacteria
South Coast	Tijuana River	Fecal Indicator Bacteria
South Coast	Tecate Creek	Other
South Coast	San Diego Bay Shoreline, Shelter Island Shoreline Park	Fecal Indicator Bacteria
South Coast	Calleguas Creek Reach 9B (was part of Conejo Creek Reaches 1 and 2 on 1998 303d list)	Fecal Indicator Bacteria
South Coast	Topanga Canyon Creek	Metals/Metalloids
South Coast	San Antonio Creek	Other
South Coast	Grout Creek	Other
South Coast	Moro Canyon Creek	Other
South Coast	Sandia Creek	Metals/Metalloids
South Coast	Soledad Canyon	Other
South Coast	Paradise Creek, HSA 908.320	Other
South Coast	Las Flores Beach	Fecal Indicator Bacteria
South Coast	Arundell Barranca (Ventura County)	Fecal Indicator Bacteria
South Coast	Santa Clara River Reach 11 (Piru Creek, from confluence with Santa Clara River Reach 4 to gaging station below Santa Felicia Dam)	Other
South Coast	Ballona Creek	Metals/Metalloids
South Coast	Coyote Creek, North Fork	Fecal Indicator Bacteria
South Coast	Verdugo Wash Reach 1 (LA River to Verdugo Rd.)	Fecal Indicator Bacteria
South Coast	San Gabriel River Reach 3 (Whittier Narrows to Ramona)	Fecal Indicator Bacteria
South Coast	San Juan Creek	Pesticides
South Coast	Temecula Creek	Other
South Coast	Long Canyon Creek (Lower Sweetwater Watershed)	Fecal Indicator Bacteria
South Coast	Campo Creek	Fecal Indicator Bacteria

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	Ventura River Reach 4 (Coyote Creek to Camino Cielo Rd)	Other
South Coast	Walnut Creek Wash (Drains from Puddingstone Res)	Other
South Coast	Wood Canyon (Orange County)	Other
South Coast	Cristianitos Creek	Metals/Metalloids
South Coast	Telegraph Canyon Creek	Other
South Coast	Mission Bay Shoreline, at De Anza Cove	Fecal Indicator Bacteria
South Coast	Calleguas Creek Reach 3 (Potrero Road upstream to confluence with Conejo Creek on 1998 303d list)	Other
South Coast	Medea Creek Reach 1 (Lake to Confl. with Lindero)	Fecal Indicator Bacteria
South Coast	Lindero Creek Reach 2 (Above Lake)	Metals/Metalloids
South Coast	Goldenstar Creek	Fecal Indicator Bacteria
South Coast	Santa Ana River Reach 6	Metals/Metalloids
South Coast	Malaga Cove Beach	Pesticides
South Coast	Will Rogers Beach	Fecal Indicator Bacteria
South Coast	Pacific Ocean Shoreline, Lower San Juan HSA, at North Beach Creek	Fecal Indicator Bacteria
South Coast	Los Trancos Creek (Crystal Cove Creek)	Fecal Indicator Bacteria
South Coast	East Garden Grove Wintersburg Channel	Other
South Coast	Santiago Creek Reach 4	Other
South Coast	Knickerbocker Creek	Fecal Indicator Bacteria
South Coast	Buena Vista Creek	Metals/Metalloids
South Coast	Felicita Creek	Other
South Coast	Eucalyptus Hills Creek	Pesticides
South Coast	Pine Valley Creek (Lower)	Fecal Indicator Bacteria
South Coast	Abalone Cove Beach	Other
South Coast	Dry Canyon Creek	Metals/Metalloids
South Coast	San Timoteo River Reach 2 (Gage at San Timoteo to confluence with Yucaipa Creek)	Fecal Indicator Bacteria
South Coast	Forester Creek	Other
South Coast	Escondido Beach	Fecal Indicator Bacteria
South Coast	Ventura River Estuary	Fecal Indicator Bacteria
South Coast	Calleguas Creek Reach 9A (was lower part of Conejo Creek Reach 1 on 1998 303d list)	Fecal Indicator Bacteria
South Coast	Santa Clara River Reach 3 (Freeman Diversion to A Street)	Other
South Coast	Calleguas Creek Reach 7 (was Arroyo Simi Reaches 1 and 2 on 1998 303d list)	Other
South Coast	Torrance Carson Channel	Metals/Metalloids
South Coast	Redhawk Channel	Fecal Indicator Bacteria
South Coast	Cottonwood Creek (San Marcos Creek watershed)	Pesticides
South Coast	Chollas Creek	Metals/Metalloids
South Coast	Santa Clara River Reach 10 (Sespe Creek, from confl with Santa Clara River Reach 3 to above gaging station - 500 ft downstream from Little Sespe Cr)	Other

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
South Coast	Bouquet Canyon Creek (below Bouqet Reservoir)	Other
South Coast	Calleguas Creek Reach 6 (was Arroyo Las Posas Reaches 1 and 2 on 1998 303d list)	Fecal Indicator Bacteria
South Coast	De Luz Creek	Metals/Metalloids
South Coast	East Channel Creek	Fecal Indicator Bacteria
South Coast	San Luis Rey River, Upper (east of Interstate 15)	Fecal Indicator Bacteria
South Coast	Reidy Canyon Creek	Fecal Indicator Bacteria
South Coast	San Dieguito River	Other
South Coast	Green Valley Creek	Other
South Coast	Alvarado Creek	Other
South Coast	Los Coches Creek	Fecal Indicator Bacteria
South Coast	Topanga Beach	Fecal Indicator Bacteria
South Coast	San Diego Bay Shoreline, Chula Vista Marina	Metals/Metalloids
South Coast	San Diego Bay Shoreline, Tidelands Park	Fecal Indicator Bacteria
South Coast	Las Tunas Beach	Fecal Indicator Bacteria
Tulare Lake	Mendota Pool	Metals/Metalloids
Tulare Lake	Pine Flat Reservoir	Metals/Metalloids
Tulare Lake	Isabella Lake	Other
Tulare Lake	Hume Lake	Other
Tulare Lake	Success Lake	Other
Tulare Lake	Kaweah Lake	Metals/Metalloids
San Joaquin/Tulare Lake	San Joaquin River (Friant Dam to Mendota Pool)	Other
Tulare Lake	Tule River, Lower	Toxicity
Tulare Lake	Bates Slough (from Avenue 200 to Deep Creek, Tulare County)	Toxicity
Tulare Lake	Mill Creek (Tulare County)	Toxicity
Tulare Lake	Main Drain (Kern County)	Pesticides
Tulare Lake	Los Gatos Creek (Fresno County)	Metals/Metalloids
Tulare Lake	Kaweah River (below Terminus Dam, Tulare County)	Toxicity
Tulare Lake	Elbow Creek (from Mathews Ditch to Cottonwood Creek, Tulare County)	Pesticides
Tulare Lake	Kings River, Lower (Pine Flat Reservoir to Island Weir)	Toxicity
Tulare Lake	Mill Creek (Fresno County)	Toxicity
Tulare Lake	Deer Creek (Tulare County)	Toxicity
Tulare Lake	Kings River, Lower (Island Weir to Stinson and Empire Weirs)	Metals/Metalloids
Tulare Lake	Packwood Creek (Tulare County)	Toxicity
Tulare Lake	Fresno Slough (from Graham Road to James Bypass, Fresno County)	Toxicity
Tulare Lake	Cross Creek (Kings and Tulare Counties)	Toxicity
Tulare Lake	Cantua Creek	Pesticides
Tulare Lake	Kaweah River, Lower (includes St Johns River)	Toxicity
Tulare Lake	Panoche Creek (Silver Creek to Belmont Avenue)	Metals/Metalloids

Table A-17. Impaired Water Bodies in the Hydrologic Regions (contd.)

Hydrologic Region	Water Body Name	Constituent of Concern
Tulare Lake	San Carlos Creek (downstream of New Idria Mine)	Metals/Metalloids
Tulare Lake	James Bypass (Fresno County)	Toxicity
Tulare Lake	Outside Creek (Tulare County)	Toxicity
Tulare Lake	Elk Bayou (Tulare County)	Other
South Lahontan	Mesquite Springs (Inyo County)	Metals/Metalloids
South Lahontan	Pleasant Valley Reservoir	Other Inorganics
South Lahontan	Searles Lake	Other Inorganics
South Lahontan	Haiwee Reservoir	Metals/Metalloids
South Lahontan	Littlerock Reservoir	Metals/Metalloids
South Lahontan	Arrowhead, Lake	Metals/Metalloids
South Lahontan	Gregory, Lake	Metals/Metalloids
South Lahontan	Silverwood Reservoir	Metals/Metalloids
South Lahontan	Mono Lake	Other Inorganics
South Lahontan	Crowley Lake	Other Inorganics
South Lahontan	Mammoth Creek, unamed tributary (confluence is near Old Mammoth Rd)	Metals/Metalloids
South Lahontan	Hilton Creek	Other Inorganics
South Lahontan	Rock Creek (tributary to Owens River)	Other Inorganics
South Lahontan	Amargosa River (Willow Creek confluence to Badwater)	Metals/Metalloids
South Lahontan	Amargosa River (Nevada border to Tecopa)	Metals/Metalloids
South Lahontan	Holcomb Creek	Other Inorganics
South Lahontan	Mammoth Creek (Twin Lakes outlet to Old Mammoth Road)	Metals/Metalloids
South Lahontan	Mammoth Creek (Headwaters to Twin Lakes outlet)	Other Inorganics
South Lahontan	Mammoth Creek (Old Mammoth Road to Highway 395)	Metals/Metalloids
South Lahontan	Amargosa River (Tecopa to Upper Canyon)	Metals/Metalloids
South Lahontan	Mojave River (Upper Narrows to Lower Narrows)	Other Inorganics
South Lahontan	Sheep Creek	Other Inorganics
South Lahontan	Crab Creek	Other Inorganics
South Lahontan	Mojave River (Mojave Forks Reservoir outlet to Upper Narrows)	Other Inorganics

Source: "Impaired Water Bodies – 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. April 11, 2018.

Ecosystem Vitality

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV 6: California Stream Condition Index

Table A-18 presents the data from Figure 4-18 in the main body.

Table A-18. California Stream Condition Indices Across California Watersheds

HUC 8 ID	HUC 8 Watershed Name	HUC-8 CSCI Score	Monitoring Station CSCI Score				
			< 0.25	0.25 - 0.50	0.50 - 0.75	0.75 - 1.00	> 1.00
17100311	Illinois	80 - 100	0	0	0	0	2
17100312	Chetco	80 - 100	0	0	0	1	0
17100309	Applegate	80 - 100	0	0	0	0	1
18020001	Goose Lake	80 - 100	0	0	0	2	6
18010206	Upper Klamath	80 - 100	0	1	0	6	8
18010204	Lost	40 - 60	0	1	5	5	0
18010101	Smith	80 - 100	0	1	2	13	10
18010205	Butte	80 - 100	0	0	4	3	4
18010207	Shasta	40 - 60	0	2	6	4	2
18010209	Lower Klamath	80 - 100	1	5	6	19	12
18080001	Surprise Valley	60 - 80	0	0	0	1	0
18010208	Scott	80 - 100	0	0	1	3	4
18020002	Upper Pit	80 - 100	0	6	6	21	17
18010210	Salmon	80 - 100	0	0	0	5	20
18020004	McCloud	80 - 100	0	0	3	5	8
18020005	Sacramento Headwaters	80 - 100	0	0	0	3	5
18020003	Lower Pit	80 - 100	0	0	0	5	9
18010211	Trinity	80 - 100	0	0	0	13	25
18010102	Mad-Redwood	80 - 100	1	0	3	17	5
16040203	Smoke Creek Desert	40 - 60	0	0	1	0	0
18020151	Cow Creek	80 - 100	0	0	2	3	6
18020154	Clear Creek-Sacramento River	80 - 100	0	1	1	4	5
18010212	South Fork Trinity	80 - 100	0	1	1	9	19
18020153	Battle Creek	80 - 100	0	0	0	7	11
18080003	Honey-Eagle Lakes	80 - 100	1	1	2	5	6
18020152	Cottonwood Creek	60 - 80	0	0	0	1	0
18010107	Mattole	80 - 100	0	0	0	2	1

Table A-18. California Stream Condition Indices Across California Watersheds (contd.)

HUC 8 ID	HUC 8 Watershed Name	HUC-8 CSCI Score	Monitoring Station CSCI Score				
			< 0.25	0.25 - 0.50	0.50 - 0.75	0.75 - 1.00	> 1.00
18010105	Lower Eel	80 - 100	0	0	5	13	2
18020155	Paynes Creek-Sacramento River	80 - 100	0	0	0	3	1
18020121	North Fork Feather	80 - 100	0	3	2	14	24
18020156	Thomes Creek-Sacramento River	80 - 100	0	0	6	17	20
18020122	East Branch North Fork Feather	60 - 80	0	6	6	7	11
18010106	South Fork Eel	80 - 100	0	0	6	8	10
18020157	Big Chico Creek-Sacramento River	80 - 100	0	0	7	18	21
18010104	Middle Fork Eel	80 - 100	0	2	1	4	7
18020123	Middle Fork Feather	80 - 100	0	2	1	15	17
18020158	Butte Creek	80 - 100	0	2	4	17	10
18020115	Upper Stony	80 - 100	0	2	3	5	6
18010103	Upper Eel	80 - 100	0	3	0	17	30
16050102	Truckee	80 - 100	0	2	6	18	25
18020125	Upper Yuba	80 - 100	0	0	3	14	14
18010108	Big-Navarro-Garcia	80 - 100	0	1	8	30	23
18020159	Honcut Headwaters-Lower Feather	20 - 40	0	1	4	0	0
18020104	Sacramento-Stone Corral	20 - 40	0	2	4	0	0
18020126	Upper Bear	40 - 60	0	2	7	7	0
18020128	North Fork American	80 - 100	0	0	1	6	13
16050101	Lake Tahoe	80 - 100	0	2	10	58	52
18020116	Upper Cache	40 - 60	1	3	8	11	2
18020161	Upper Coon-Upper Auburn	40 - 60	0	3	3	3	0
16050201	Upper Carson	80 - 100	0	1	4	20	56
18020129	South Fork American	80 - 100	0	0	4	10	18
18010110	Russian	60 - 80	0	2	15	17	3
18020111	Lower American	20 - 40	5	9	21	3	0
16050302	West Walker	80 - 100	0	0	3	28	37
18010109	Gualala-Salmon	40 - 60	0	1	2	1	1
18040013	Upper Cosumnes	80 - 100	0	1	0	1	10
18020163	Lower Sacramento	20 - 40	5	14	4	0	0

Table A-18. California Stream Condition Indices Across California Watersheds (contd.)

HUC 8 ID	HUC 8 Watershed Name	HUC-8 CSCI Score	Monitoring Station CSCI Score				
			< 0.25	0.25 - 0.50	0.50 - 0.75	0.75 - 1.00	> 1.00
16050301	East Walker	80 - 100	0	0	2	9	16
18040012	Upper Mokelumne	80 - 100	0	0	1	3	8
18050002	San Pablo Bay	40 - 60	2	16	9	9	8
18040011	Upper Calaveras California	20 - 40	0	2	1	1	0
18040010	Upper Stanislaus	80 - 100	0	0	3	12	15
18050001	Suisun Bay	20 - 40	0	13	8	3	1
16060010	Fish Lake-Soda Spring Valleys	20 - 40	0	0	1	0	0
18050005	Tomales-Drake Bays	80 - 100	0	1	1	14	22
18090101	Mono Lake	80 - 100	0	0	0	4	9
18040009	Upper Tuolumne	80 - 100	0	0	4	9	17
18040051	Rock Creek-French Camp Slough	20 - 40	0	4	2	0	0
18040003	San Joaquin Delta	20 - 40	0	3	1	0	0
18040008	Upper Merced	80 - 100	0	0	3	8	12
18050004	San Francisco Bay	40 - 60	1	15	6	9	3
18090102	Crowley Lake	80 - 100	0	3	16	39	48
18040002	Lower San Joaquin River	40 - 60	0	0	1	0	0
18040006	Upper San Joaquin	80 - 100	0	0	1	12	17
18050006	San Francisco Coastal South	80 - 100	0	2	4	15	33
18050003	Coyote	60 - 80	1	5	18	10	11
18040007	Fresno River	80 - 100	0	0	2	2	8
18040001	Middle San Joaquin-Lower Chowchilla	20 - 40	1	4	4	2	0
18030010	Upper King	80 - 100	0	0	9	4	7
18060015	Monterey Bay	60 - 80	0	2	13	18	7
18060002	Pajaro	40 - 60	0	5	6	4	5
18090202	Upper Amargosa	40 - 60	0	0	1	0	0
18090103	Owens Lake	80 - 100	0	0	1	4	9
18030007	Upper Kaweah	80 - 100	0	0	0	5	9
18030001	Upper Kern	80 - 100	0	0	0	6	14
18030006	Upper Tule	40 - 60	0	1	0	0	1
18090204	Panamint Valley	20 - 40	0	0	1	0	0
18060005	Salinas	60 - 80	0	3	19	16	11

Table A-18. California Stream Condition Indices Across California Watersheds (contd.)

HUC 8 ID	HUC 8 Watershed Name	HUC-8 CSCI Score	Monitoring Station CSCI Score				
			< 0.25	0.25 - 0.50	0.50 - 0.75	0.75 - 1.00	> 1.00
18030012	Tulare Lake Bed	60 - 80	0	0	0	1	0
18030002	South Fork Kern	80 - 100	0	1	4	2	4
18060006	Central Coastal	80 - 100	0	5	30	57	39
18090205	Indian Wells-Searles Valleys	80 - 100	0	0	0	1	0
18030004	Upper Poso	80 - 100	0	0	0	0	1
18030003	Middle Kern-Upper Tehachapi-Grapevine	60 - 80	0	0	1	1	0
18060007	Cuyama	60 - 80	0	0	5	2	1
18090206	Antelope-Fremont Valleys	80 - 100	0	0	0	1	4
18060008	Santa Maria	80 - 100	0	0	3	7	6
18090208	Mojave	80 - 100	0	0	3	2	5
18060009	San Antonio	40 - 60	0	1	1	1	0
18060010	Santa Ynez	80 - 100	0	1	5	10	6
18070102	Santa Clara	80 - 100	0	5	36	78	53
18060013	Santa Barbara Coastal	60 - 80	0	4	10	14	10
18070101	Ventura	60 - 80	1	7	15	34	21
18100100	Southern Mojave	60 - 80	0	0	0	1	0
18070103	Calleguas	40 - 60	0	11	29	11	1
18070105	Los Angeles	40 - 60	2	24	29	17	8
18070203	Santa Ana	80 - 100	4	12	49	66	53
18070104	Santa Monica Bay	40 - 60	0	12	31	24	11
18070106	San Gabriel	60 - 80	8	15	29	20	32
18100201	Whitewater River	80 - 100	0	0	6	29	8
18070202	San Jacinto	60 - 80	1	1	15	22	4
18070204	Newport Bay	40 - 60	1	12	6	8	3
18070302	Santa Margarita	80 - 100	0	1	21	47	18
18070301	Aliso-San Onofre	60 - 80	0	5	36	24	10
18070303	San Luis Rey-Escondido	60 - 80	0	9	50	50	22
18100203	San Felipe Creek	80 - 100	0	0	2	10	1
18070304	San Diego	80 - 100	1	12	57	98	48
18070305	Cottonwood-Tijuana	80 - 100	0	0	11	51	42

Source: Bioassessment Scores Map. State Water Resources Control Board. 2017.

Ecosystem Vitality

Intended Outcome: Achieved designated beneficial uses for water bodies throughout the state

EV 7: Impaired Water Bodies – Count by Watershed

Table A-19 presents the data from Figure 4-19 in the main body.

Table A-19. Number of Impaired Water Bodies by Watershed

HUC 8 ID	HUC 8 Watershed Name	Number of Impaired Water Bodies
18010206	Upper Klamath	6 - 15
18010204	Lost	0 - 2
18010101	Smith	0 - 2
18010205	Butte	0 - 2
18010207	Shasta	0 - 2
18010209	Lower Klamath	3 - 5
18080001	Surprise Valley	0 - 2
18010208	Scott	0 - 2
18020002	Upper Pit	6 - 15
18010210	Salmon	3 - 5
18020004	McCloud	0 - 2
18020005	Sacramento Headwaters	3 - 5
18020003	Lower Pit	6 - 15
18010211	Trinity	6 - 15
18010102	Mad-Redwood	16 - 25
18020151	Cow Creek	3 - 5
18020154	Clear Creek-Sacramento River	6 - 15
18010212	South Fork Trinity	0 - 2
18080003	Honey-Eagle Lakes	6 - 15
18020152	Cottonwood Creek	0 - 2
18010107	Mattole	0 - 2
18010105	Lower Eel	6 - 15
18020155	Paynes Creek-Sacramento River	0 - 2
18020121	North Fork Feather	3 - 5
18020156	Thomes Creek-Sacramento River	0 - 2
18020122	East Branch North Fork Feather	0 - 2
18010106	South Fork Eel	0 - 2
18020157	Big Chico Creek-Sacramento River	3 - 5
18010104	Middle Fork Eel	3 - 5
18020123	Middle Fork Feather	3 - 5
18020158	Butte Creek	6 - 15
18020115	Upper Stony	3 - 5
18010103	Upper Eel	0 - 2
16050102	Truckee	3 - 5

Table A-19. Number of Impaired Water Bodies by Watershed (contd.)

HUC 8 ID	HUC 8 Watershed Name	Number of Impaired Water Bodies
18020125	Upper Yuba	6 - 15
18010108	Big-Navarro-Garcia	6 - 15
18020159	Honcut Headwaters-Lower Feather	16 - 25
18020104	Sacramento-Stone Corral	6 - 15
18020126	Upper Bear	6 - 15
18020128	North Fork American	3 - 5
16050101	Lake Tahoe	16 - 25
18020116	Upper Cache	6 - 15
18020161	Upper Coon-Upper Auburn	6 - 15
16050201	Upper Carson	6 - 15
18020129	South Fork American	3 - 5
18010110	Russian	16 - 25
18020111	Lower American	6 - 15
18020162	Upper Putah	3 - 5
16050302	West Walker	0 - 2
18010109	Gualala-Salmon	0 - 2
18040013	Upper Cosumnes	6 - 15
18020163	Lower Sacramento	16 - 25
16050301	East Walker	6 - 15
18040012	Upper Mokelumne	6 - 15
18050002	San Pablo Bay	> 25
18040011	Upper Calaveras California	3 - 5
18040010	Upper Stanislaus	3 - 5
18050001	Suisun Bay	16 - 25
18050005	Tomales-Drake Bays	16 - 25
18090101	Mono Lake	0 - 2
18040009	Upper Tuolumne	6 - 15
18040051	Rock Creek-French Camp Slough	6 - 15
18040003	San Joaquin Delta	> 25
18040008	Upper Merced	3 - 5
18050004	San Francisco Bay	> 25
18090102	Crowley Lake	6 - 15
18040002	Lower San Joaquin River	16 - 25
18040006	Upper San Joaquin	3 - 5
18050006	San Francisco Coastal South	16 - 25
18050003	Coyote	16 - 25
18040007	Fresno River	3 - 5
18040001	Middle San Joaquin-Lower Chowchilla	> 25
18030010	Upper King	0 - 2
18060015	Monterey Bay	> 25

Table A-19. Number of Impaired Water Bodies by Watershed (contd.)

HUC 8 ID	HUC 8 Watershed Name	Number of Impaired Water Bodies
18060002	Pajaro	> 25
18030009	Upper Dry	3 - 5
18090202	Upper Amargosa	3 - 5
18090103	Owens Lake	0 - 2
18040014	Panoche-San Luis Reservoir	0 - 2
18030007	Upper Kaweah	6 - 15
18030001	Upper Kern	0 - 2
18030006	Upper Tule	3 - 5
18090203	Death Valley-Lower Amargosa	0 - 2
18060005	Salinas	16 - 25
18030012	Tulare Lake Bed	3 - 5
18030002	South Fork Kern	0 - 2
18030005	Upper Deer-Upper White	0 - 2
18060006	Central Coastal	> 25
18090205	Indian Wells-Searles Valleys	0 - 2
18060004	Estrella	3 - 5
18060003	Carrizo Plain	0 - 2
15030101	Havasu-Mohave Lakes	0 - 2
18060007	Cuyama	3 - 5
18090206	Antelope-Fremont Valleys	0 - 2
18060008	Santa Maria	6 - 15
18090208	Mojave	6 - 15
18060009	San Antonio	3 - 5
18060010	Santa Ynez	3 - 5
18070102	Santa Clara	16 - 25
18060013	Santa Barbara Coastal	> 25
18070101	Ventura	16 - 25
18070103	Calleguas	16 - 25
18070105	Los Angeles	> 25
18070203	Santa Ana	> 25
18070104	Santa Monica Bay	> 25
18070106	San Gabriel	> 25
18100201	Whitewater River	0 - 2
18070202	San Jacinto	3 - 5
18070201	Seal Beach	6 - 15
18070204	Newport Bay	16 - 25
15030104	Imperial Reservoir	0 - 2
18070302	Santa Margarita	6 - 15
18070301	Aliso-San Onofre	> 25
18070303	San Luis Rey-Escondido	16 - 25
18100203	San Felipe Creek	0 - 2

Table A-19. Number of Impaired Water Bodies by Watershed (contd.)

HUC 8 ID	HUC 8 Watershed Name	Number of Impaired Water Bodies
18070107	San Pedro Channel Islands	0 - 2
18100204	Salton Sea	3 - 5
18070304	San Diego	> 25
18070305	Cottonwood-Tijuana	6 – 15

Source: "Impaired Water Bodies – 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. April 11, 2018.

Ecosystem Vitality

Intended Outcome: Achieved designated beneficial uses for water bodies throughout the state

EV 8: Number of Harmful Algae Blooms

Table A-20 presents the data from Figure 4-20 in the main body.

Table A-20. Contact Exposure Warnings Issued for Harmful Algal Blooms

County	Number of Reported Harmful Algae Blooms with HAB Advisory Posted	Number of Reported Harmful Algae Blooms without HAB Advisory Posted
Alameda	8	12
Alpine	0	0
Amador	0	0
Butte	0	2
Calaveras	0	0
Colusa	0	0
Contra Costa	2	3
Del Norte	0	0
El Dorado	0	1
Fresno	0	0
Glenn	2	1
Humboldt	1	1
Imperial	0	0
Inyo	3	0
Kern	3	9
Kings	0	0
Lake	2	8
Lassen	0	2
Los Angeles	5	4
Madera	0	0
Marin	0	2
Mariposa	0	0
Mendocino	0	0
Merced	1	2
Modoc	0	0
Mono	0	0
Monterey	0	1
Napa	1	7

Table A-20. Contact Exposure Warnings Issued for Harmful Algal Blooms (contd.)

County	Number of Reported Harmful Algae Blooms with HAB Advisory Posted	Number of Reported Harmful Algae Blooms without HAB Advisory Posted
Nevada	0	0
Orange	0	1
Placer	0	10
Plumas	0	0
Riverside	9	4
Sacramento	0	3
San Benito	0	0
San Bernardino	2	2
San Diego	2	1
San Francisco	0	0
San Joaquin	4	19
San Luis Obispo	1	1
San Mateo	0	0
Santa Barbara	2	1
Santa Clara	0	2
Santa Cruz	2	1
Shasta	12	1
Sierra	0	0
Siskiyou	0	0
Solano	0	1
Sonoma	0	0
Stanislaus	0	0
Sutter	0	0
Tehama	0	0
Trinity	0	0
Tulare	0	0
Tuolumne	0	0
Ventura	0	0
Yolo	0	1
Yuba	0	0

Source: "Where are harmful algal blooms occurring in California?" California Water Quality Monitoring Council. February 6, 2018.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.

HE 1: Delivery Reliability of SWP, CVP, Colorado River Aqueduct Systems

Data for Figure 4-21 is summarized within the alternative text. This figure is sourced from DWR's 2017 State Water Project Draft Delivery Capability Report.

Data for Figure 4-22 is summarized within the alternative text. This figure is sourced from Reclamation's 2015 Central Valley Contract Water Delivery Information.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply.

HE 2: Comparison of Actual Water Use to Proposed Statewide Water Use Targets

No GIS figures or charts included in main body.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 3: Distribution System Leaks and Losses

No GIS figures or charts included in main body.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 4: Groundwater Basins with Stable or Recovering Groundwater Levels

Tables A-21 and A-22 presents the data from Figure 4-23 in the main body.

Table A-21. Change in Groundwater Levels from Spring 2012 to Spring 2017 in the Central Valley

Groundwater Level Change	Percentage of Central Valley Groundwater Basin
No Data	22%
Decrease/Increase Between -2.5 to 2.5 Feet	19%
Decrease of 2.5 to 25 Feet	30%
Increase of 2.5 to 25 Feet	11%
Decrease > 25 Feet	18%
Increase of > 25 Feet	0%

Table A-22. Change in Groundwater Levels from Spring 2012 to Spring 2017

Subbasin ID	Subbasin Name	Decrease of > 25 Feet	Decrease of 2.5 to 25 Feet	Decrease or Increase Between -2.5 to 2.5 Feet	Increase of 2.5 to 25 Feet	Increase of > 25 Feet
1-001	Smith River Plain	0	0	5	0	0
1-002.01	Klamath River Valley - Tulelake	0	35	18	3	0
1-002.02	Klamath River Valley - Lower Klamath	0	0	1	0	0
1-003	Butte Valley	0	10	5	1	0
1-004	Shasta Valley	0	0	5	4	0
1-005	Scott River Valley	0	1	4	4	0
1-008.01	Mad River Valley - Mad River Lowland	0	0	3	0	0
1-009	Eureka Plain	0	0	4	0	0
1-010	Eel River Valley	0	0	4	0	0
1-012	Laytonville Valley	0	1	1	0	0
1-013	Little Lake Valley	0	0	4	0	0
1-019	Anderson Valley	0	0	7	0	0
1-026	Redwood Creek Area	0	0	0	1	0
1-027	Big Lagoon Area	0	0	0	1	0
1-051	Potter Valley	0	0	1	0	0
1-052	Ukiah Valley	0	0	3	1	0
1-053	Sanel Valley	0	0	4	1	0
1-054.01	Alexander Valley - Alexander Area	0	1	7	2	0
1-054.02	Alexander Valley - Cloverdale Area	0	0	0	1	0
1-055.01	Santa Rosa Valley - Santa Rosa Plain	0	1	16	10	0
1-055.02	Santa Rosa Valley - Healdsburg Area	0	0	1	3	0
1-055.03	Santa Rosa Valley - Rincon Valley	0	1	1	0	0
1-059	Wilson Grove Formation Highlands	0	1	5	7	0
1-060	Lower Russian River Valley	0	0	1	2	0
2-001	Petaluma Valley	0	1	1	6	1
2-002.01	Napa-Sonoma Valley - Napa Valley	0	0	7	3	0
2-002.02	Napa-Sonoma Valley - Sonoma Valley	1	7	5	6	0

Table A-22. Change in Groundwater Levels from Spring 2012 to Spring 2017 (contd.)

Subbasin ID	Subbasin Name	Decrease of > 25 Feet	Decrease of 2.5 to 25 Feet	Decrease or Increase Between -2.5 to 2.5 Feet	Increase of 2.5 to 25 Feet	Increase of > 25 Feet
2-002.03	Napa-Sonoma Valley - Napa-Sonoma Lowlands	0	1	1	1	1
2-003	Suisun-Fairfield Valley	0	0	10	7	0
2-004	Pittsburg Plain	0	0	1	0	0
2-005	Clayton Valley	0	0	1	2	0
2-009.01	Santa Clara Valley - Niles Cone	0	0	5	17	0
2-009.02	Santa Clara Valley - Santa Clara	0	18	25	28	3
2-009.04	Santa Clara Valley - East Bay Plain	0	1	3	7	0
2-010	Livermore Valley	0	0	2	7	1
2-019	Kenwood Valley	0	0	2	2	0
2-022	Half Moon Bay Terrace	0	0	1	5	0
3-003.01	Gilroy-Hollister Valley - Llagas Area	0	0	3	9	0
3-003.02	Gilroy-Hollister Valley - Bolsa Area	1	9	2	0	1
3-003.03	Gilroy-Hollister Valley - Hollister Area	1	5	8	11	2
3-003.04	Gilroy-Hollister Valley - San Juan Bautista Area	5	18	2	3	1
3-004.01	Salinas Valley - 180/400 Foot Aquifer	0	0	0	1	0
3-004.06	Salinas Valley - Paso Robles Area	0	1	1	0	0
3-004.11	Salinas Valley - Atascadero Area	1	0	3	1	0
3-007	Carmel Valley	0	0	0	1	0
3-008	Los Osos Valley	0	0	1	0	1
3-012	Santa Maria	0	0	0	1	0
3-013	Cuyama Valley	8	6	1	1	0
3-014	San Antonio Creek Valley	1	8	3	2	0
3-015	Santa Ynez River Valley	4	23	17	5	1
3-017	Santa Barbara	6	1	1	0	0
3-018	Carpinteria	5	2	1	0	0
3-025	Tres Pinos Valley	1	0	1	0	0

Table A-22. Change in Groundwater Levels from Spring 2012 to Spring 2017 (contd.)

Subbasin ID	Subbasin Name	Decrease of > 25 Feet	Decrease of 2.5 to 25 Feet	Decrease or Increase Between -2.5 to 2.5 Feet	Increase of 2.5 to 25 Feet	Increase of > 25 Feet
3-028	San Benito River Valley	0	1	0	0	1
3-049	Montecito	1	1	0	0	0
3-053	Foothill	3	1	0	0	0
4-001	Upper Ojai Valley	0	0	0	2	0
4-002	Ojai Valley	11	1	2	2	0
4-003.01	Ventura River Valley - Upper Ventura River	1	1	2	5	1
4-003.02	Ventura River Valley - Lower Ventura River	0	0	0	2	0
4-004.02	Santa Clara River Valley - Oxnard	91	36	4	0	0
4-004.03	Santa Clara River Valley - Mound	6	6	0	0	0
4-004.04	Santa Clara River Valley - Santa Paula	2	23	9	1	0
4-004.05	Santa Clara River Valley - Fillmore	3	9	1	0	0
4-004.06	Santa Clara River Valley - Piru	14	2	0	0	0
4-006	Pleasant Valley	17	2	0	0	0
4-007	Arroyo Santa Rosa Valley	0	1	0	2	0
4-008	Las Posas Valley	6	12	4	3	1
4-009	Simi Valley	0	2	3	0	0
4-010	Conejo	0	0	0	1	0
4-011.03	Coastal Plain Of Los Angeles - West Coast	0	0	3	8	0
4-011.04	Coastal Plain Of Los Angeles - Central	1	13	3	0	0
4-012	San Fernando Valley	1	1	0	0	0
4-013	San Gabriel Valley	26	9	3	2	1
4-015	Tierra Rejada	1	1	0	1	0
4-016	Hidden Valley	0	1	0	0	0
4-017	Lockwood Valley	0	1	0	0	0
4-023	Raymond	1	0	1	1	1
5-001.01	Goose Lake - Goose Valley	0	6	1	0	0
5-001.02	Goose Lake - Fandango Valley	0	0	1	2	0

Table A-22. Change in Groundwater Levels from Spring 2012 to Spring 2017 (contd.)

Subbasin ID	Subbasin Name	Decrease of > 25 Feet	Decrease of 2.5 to 25 Feet	Decrease or Increase Between -2.5 to 2.5 Feet	Increase of 2.5 to 25 Feet	Increase of > 25 Feet
5-002.01	Alturas Area - South Fork Pitt River	0	3	6	2	0
5-002.02	Alturas Area - Warm Springs Valley	0	2	1	3	0
5-004	Big Valley	0	6	5	3	0
5-005	Fall River Valley	0	2	6	3	0
5-006.01	Redding Area - Bowman	0	0	8	4	0
5-006.02	Redding Area - Rosewood	0	0	0	1	0
5-006.03	Redding Area - Anderson	0	3	6	14	0
5-006.04	Redding Area - Enterprise	0	1	0	3	0
5-006.05	Redding Area - Millville	0	0	1	1	0
5-011	Mohawk Valley	0	0	1	0	0
5-012.01	Sierra Valley - Sierra Valley	0	21	5	5	0
5-012.02	Sierra Valley - Chilcoot	0	0	2	4	0
5-013	Upper Lake Valley	0	0	5	0	0
5-014	Scotts Valley	0	0	2	0	0
5-015	Big Valley	0	1	7	12	0
5-016	High Valley	0	0	1	2	0
5-017	Burns Valley	0	0	0	1	0
5-018	Coyote Valley	0	0	1	1	0
5-019	Collayomi Valley	0	1	2	0	0
5-021.50	Sacramento Valley - Red Bluff	0	9	8	6	0
5-021.51	Sacramento Valley - Corning	0	30	17	28	0
5-021.52	Sacramento Valley - Colusa	15	60	94	41	0
5-021.54	Sacramento Valley - Antelope	0	0	0	5	0
5-021.55	Sacramento Valley - Dye Creek	0	1	3	1	0
5-021.56	Sacramento Valley - Los Molinos	0	1	2	4	0
5-021.57	Sacramento Valley - Vina	0	9	26	25	0
5-021.58	Sacramento Valley - West Butte	0	7	25	23	0

Table A-22. Change in Groundwater Levels from Spring 2012 to Spring 2017 (contd.)

Subbasin ID	Subbasin Name	Decrease of > 25 Feet	Decrease of 2.5 to 25 Feet	Decrease or Increase Between -2.5 to 2.5 Feet	Increase of 2.5 to 25 Feet	Increase of > 25 Feet
5-021.59	Sacramento Valley - East Butte	1	16	38	16	0
5-021.60	Sacramento Valley - North Yuba	0	1	10	13	0
5-021.61	Sacramento Valley - South Yuba	0	7	23	21	0
5-021.62	Sacramento Valley - Sutter	0	5	23	32	0
5-021.64	Sacramento Valley - North American	3	64	38	36	0
5-021.65	Sacramento Valley - South American	0	6	5	7	0
5-021.66	Sacramento Valley - Solano	0	14	45	33	1
5-021.67	Sacramento Valley - Yolo	2	55	43	68	1
5-021.69	Sacramento Valley - Wyandotte Creek	0	5	1	2	0
5-022.01	San Joaquin Valley - Eastern San Joaquin	1	54	12	8	0
5-022.02	San Joaquin Valley - Modesto	3	55	4	0	0
5-022.03	San Joaquin Valley - Turlock	7	33	15	2	1
5-022.04	San Joaquin Valley - Merced	11	24	4	6	2
5-022.05	San Joaquin Valley - Chowchilla	2	1	1	0	0
5-022.06	San Joaquin Valley - Madera	3	1	0	0	0
5-022.07	San Joaquin Valley - Delta-Mendota	7	31	19	12	3
5-022.08	San Joaquin Valley - Kings	39	50	5	6	4
5-022.09	San Joaquin Valley - Westside	18	13	1	2	1
5-022.11	San Joaquin Valley - Kaweah	5	2	0	0	1
5-022.12	San Joaquin Valley - Tulare Lake	15	9	0	1	3
5-022.13	San Joaquin Valley - Tule	19	8	0	0	2
5-022.14	San Joaquin Valley - Kern County	127	24	4	4	2
5-022.15	San Joaquin Valley - Tracy	0	2	7	17	0
5-022.16	San Joaquin Valley - Cosumnes	1	15	3	0	0
5-022.17	San Joaquin Valley - Kettleman Plain	4	22	0	1	1
5-022.18	San Joaquin Valley - White Wolf	9	1	0	0	0
5-023	Panoche Valley	0	17	5	5	2

Table A-22. Change in Groundwater Levels from Spring 2012 to Spring 2017 (contd.)

Subbasin ID	Subbasin Name	Decrease of > 25 Feet	Decrease of 2.5 to 25 Feet	Decrease or Increase Between -2.5 to 2.5 Feet	Increase of 2.5 to 25 Feet	Increase of > 25 Feet
5-025	Kern River Valley	0	1	2	4	1
5-026	Walker Basin Creek Valley	0	1	1	2	2
5-036	Round Valley	0	0	1	1	0
5-050	North Fork Battle Creek	0	0	0	1	0
6-001	Surprise Valley	0	11	11	7	3
6-002	Madeline Plains	0	1	0	0	0
6-003	Willow Creek Valley	0	1	3	0	0
6-004	Honey Lake Valley	0	4	13	9	0
6-005.01	Tahoe Valley - Tahoe South	0	0	3	19	0
6-012.01	Owens Valley - Owens Valley	0	0	2	0	0
6-018	Death Valley	0	0	6	0	0
6-020	Middle Amargosa Valley	0	0	8	0	0
6-040	Lower Mojave River Valley	0	1	0	0	0
6-042	Upper Mojave River Valley	1	1	0	0	0
6-044	Antelope Valley	2	8	13	4	0
6-056	Rose Valley	0	4	1	4	0
6-067	Martis Valley	0	2	0	1	0
6-100	Secret Valley	0	1	1	0	0
6-104	Long Valley	0	1	7	4	0
6-108	Olympic Valley	0	0	0	7	0
7-021.01	Coachella Valley - Indio	1	2	5	33	1
7-021.02	Coachella Valley - Mission Creek	0	1	0	1	0
7-021.03	Coachella Valley - Desert Hot Springs	1	0	3	2	0
7-024.01	Borrego Valley - Borrego Springs	0	5	2	0	0
8-002.03	Upper Santa Ana Valley - Riverside-Arlington	0	10	2	0	0
8-002.04	Upper Santa Ana Valley - Rialto-Colton	0	6	0	1	0
8-002.06	Upper Santa Ana Valley - Bunker Hill	24	12	1	2	1

Table A-22. Change in Groundwater Levels from Spring 2012 to Spring 2017 (contd.)

Subbasin ID	Subbasin Name	Decrease of > 25 Feet	Decrease of 2.5 to 25 Feet	Decrease or Increase Between -2.5 to 2.5 Feet	Increase of 2.5 to 25 Feet	Increase of > 25 Feet
8-002.07	Upper Santa Ana Valley - Yucaipa	0	1	0	0	0
8-002.09	Upper Santa Ana Valley - Temescal	0	2	0	0	0
8-004.01	Elsinore - Elsinore Valley	2	1	0	5	3
8-004.02	Elsinore - Bedford-Coldwater	0	0	4	0	0
8-005	San Jacinto	10	56	48	90	21
8-009	Bear Valley	5	2	0	0	0
9-001	San Juan Valley	0	0	4	1	0
9-005	Temecula Valley	2	9	5	9	1
9-008	Warner Valley	2	3	0	0	0
n/a	N/A	5	23	29	20	3

Source: "Groundwater Information Center." California Department of Water Resources. December 21, 2017.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 5: Groundwater Extraction Rates and Subsidence Rates

No GIS figures or charts included in main body.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 6: Change in Groundwater Storage

No GIS figures or charts included in main body.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 7: Percentage of Groundwater Basin Areas in Compliance with SGMA

Table A-23 presents the data from Figure 4-24 in the main body.

Table A-23. Current Progress of Exclusive Groundwater Sustainability Agency Formation in High and Medium Priority Basins

Basin	Groundwater Basin Name (Ground Subbasin Name)	Percentage of Basin Area with No Exclusive GSA	Percentage of Basin Area with Exclusive GSA
1-001	Smith River Plain	50%	50%
1-002.01	Klamath River Valley (Tulelake)	50%	50%
1-003	Butte Valley	50%	50%
1-004	Shasta Valley	50%	50%
1-005	Scott River Valley	50%	50%
1-010	Eel River Valley	100%	0%
1-052	Ukiah Valley	50%	50%
1-055.01	Santa Rosa Valley (Santa Rosa Plain)	50%	50%
2-001	Petaluma Valley	50%	50%
2-002.01	Napa-Sonoma Valley (Napa Valley)	100%	0%
2-002.02	Napa-Sonoma Valley (Sonoma Valley)	50%	50%

Table A-23. Current Progress of Exclusive Groundwater Sustainability Agency Formation in High and Medium Priority Basins (contd.)

Basin	Groundwater Basin Name (Ground Subbasin Name)	Percentage of Basin Area with No Exclusive GSA	Percentage of Basin Area with Exclusive GSA
2-009.01	Santa Clara Valley (Niles Cone)	50%	50%
2-009.02	Santa Clara Valley (Santa Clara)	50%	50%
2-009.04	Santa Clara Valley (East Bay Plain)	50%	50%
2-010	Livermore Valley	50%	50%
3-001	Santa Cruz Mid-County	50%	50%
3-002.01	Corralitos (Pajaro Valley)	53%	47%
3-002.02	Corralitos (Purisima Highlands)	50%	50%
3-003.01	Gilroy-Hollister Valley (Llagas Area)	50%	50%
3-003.02	Gilroy-Hollister Valley (Bolsa Area)	50%	50%
3-003.03	Gilroy-Hollister Valley (Hollister Area)	50%	50%
3-003.04	Gilroy-Hollister Valley (San Juan Bautista Area)	50%	50%
3-004.01	Salinas Valley (180/400 Foot Aquifer)	100%	0%
3-004.02	Salinas Valley (East Side Aquifer)	50%	50%
3-004.04	Salinas Valley (Forebay Aquifer)	100%	0%
3-004.05	Salinas Valley (Upper Valley Aquifer)	50%	50%
3-004.06	Salinas Valley (Paso Robles Area)	50%	50%
3-004.08	Salinas Valley (Seaside)	100%	0%
3-004.09	Salinas Valley (Langley Area)	50%	50%
3-004.10	Salinas Valley (Monterey)	95%	5%
3-007	Carmel Valley	50%	50%
3-008	Los Osos Valley	74%	26%
3-009	San Luis Obispo Valley	50%	50%
3-012	Santa Maria	89%	11%
3-013	Cuyama Valley	50%	50%
3-014	San Antonio Creek Valley	50%	50%
3-015	Santa Ynez River Valley	50%	50%
3-016	Goleta	100%	0%
3-026	West Santa Cruz Terrace	50%	50%
4-002	Ojai Valley	50%	50%
4-003.01	Ventura River Valley (Upper Ventura River)	50%	50%
4-004.02	Santa Clara River Valley (Oxnard)	50%	50%
4-004.03	Santa Clara River Valley (Mound)	50%	50%
4-004.04	Santa Clara River Valley (Santa Paula)	89%	11%
4-004.05	Santa Clara River Valley (Fillmore)	50%	50%
4-004.06	Santa Clara River Valley (Piru)	50%	50%
4-004.07	Santa Clara River Valley (Santa Clara River Valley East)	50%	50%

Table A-23. Current Progress of Exclusive Groundwater Sustainability Agency Formation in High and Medium Priority Basins (contd.)

Basin	Groundwater Basin Name (Ground Subbasin Name)	Percentage of Basin Area with No Exclusive GSA	Percentage of Basin Area with Exclusive GSA
4-006	Pleasant Valley	50%	50%
4-007	Arroyo Santa Rosa Valley	50%	50%
4-008	Las Posas Valley	50%	50%
4-011.01	Coastal Plain Of Los Angeles (Santa Monica)	50%	50%
4-011.03	Coastal Plain Of Los Angeles (West Coast)	100%	0%
4-011.04	Coastal Plain Of Los Angeles (Central)	100%	0%
4-012	San Fernando Valley	99%	1%
4-013	San Gabriel Valley	97%	3%
4-023	Raymond	100%	0%
5-004	Big Valley	50%	50%
5-006.01	Redding Area (Bowman)	50%	50%
5-006.03	Redding Area (Anderson)	50%	50%
5-006.04	Redding Area (Enterprise)	50%	50%
5-012.01	Sierra Valley (Sierra Valley)	50%	50%
5-014	Scotts Valley	77%	23%
5-015	Big Valley	100%	0%
5-021.50	Sacramento Valley (Red Bluff)	50%	50%
5-021.51	Sacramento Valley (Corning)	50%	50%
5-021.52	Sacramento Valley (Colusa)	50%	50%
5-021.54	Sacramento Valley (Antelope)	50%	50%
5-021.55	Sacramento Valley (Dye Creek)	50%	50%
5-021.56	Sacramento Valley (Los Molinos)	50%	50%
5-021.57	Sacramento Valley (Vina)	50%	50%
5-021.58	Sacramento Valley (West Butte)	69%	31%
5-021.59	Sacramento Valley (Sutter)	67%	33%
5-021.60	Sacramento Valley (North Yuba)	100%	0%
5-021.61	Sacramento Valley (South Yuba)	50%	50%
5-021.62	Sacramento Valley (Sutter)	50%	50%
5-021.64	Sacramento Valley (North American)	50%	50%
5-021.65	Sacramento Valley (South American)	55%	45%
5-021.66	Sacramento Valley (Solano)	53%	47%
5-021.67	Sacramento Valley (Yolo)	50%	50%
5-022.01	San Joaquin Valley (Eastern San Joaquin)	50%	50%
5-022.02	San Joaquin Valley (Modesto)	50%	50%
5-022.03	San Joaquin Valley (Turlock)	50%	50%
5-022.04	San Joaquin Valley (Merced)	50%	50%
5-022.05	San Joaquin Valley (Chowchilla)	53%	47%

Table A-23. Current Progress of Exclusive Groundwater Sustainability Agency Formation in High and Medium Priority Basins (contd.)

Basin	Groundwater Basin Name (Ground Subbasin Name)	Percentage of Basin Area with No Exclusive GSA	Percentage of Basin Area with Exclusive GSA
5-022.06	San Joaquin Valley (Madera)	50%	50%
5-022.07	San Joaquin Valley (Delta-Mendota)	50%	50%
5-022.08	San Joaquin Valley (Kings)	50%	50%
5-022.09	San Joaquin Valley (Westside)	50%	50%
5-022.11	San Joaquin Valley (Kaweah)	50%	50%
5-022.12	San Joaquin Valley (Tulare Lake)	50%	50%
5-022.13	San Joaquin Valley (Tule)	50%	50%
5-022.14	San Joaquin Valley (Kern County)	50%	50%
5-022.15	San Joaquin Valley (Tracy)	50%	50%
5-022.16	San Joaquin Valley (Cosumnes)	52%	48%
5-022.18	San Joaquin Valley (White Wolf)	50%	50%
5-027	Cummings Valley	100%	0%
5-028	Tehachapi Valley West	100%	0%
6-005.01	Tahoe Valley (Tahoe South)	50%	50%
6-012.01	Owens Valley (Owens Valley)	50%	50%
6-012.02	Owens Valley (Fish Slough)	50%	50%
6-040	Lower Mojave River Valley	100%	0%
6-042	Upper Mojave River Valley	100%	0%
6-043	El Mirage Valley	100%	0%
6-044	Antelope Valley	97%	3%
6-054	Indian Wells Valley	50%	50%
6-067	Martis Valley	100%	0%
7-012	Warren Valley	100%	0%
7-021.01	Coachella Valley (Indio)	50%	50%
7-021.02	Coachella Valley (Mission Creek)	51%	49%
7-021.04	Coachella Valley (San Gorgonio Pass)	52%	48%
7-024.01	Borrego Valley (Borrego Springs)	50%	50%
7-024.02	Borrego Valley (Ocotillo Wells)	43%	57%
8-001	Coastal Plain Of Orange County	96%	4%
8-002.01	Upper Santa Ana Valley (Chino)	96%	4%
8-002.02	Upper Santa Ana Valley (Cucamonga)	100%	0%
8-002.03	Upper Santa Ana Valley (Riverside-Arlington)	77%	23%
8-002.04	Upper Santa Ana Valley (Rialto-Colton)	100%	0%
8-002.06	Upper Santa Ana Valley (Bunker Hill)	100%	0%
8-002.07	Upper Santa Ana Valley (Yucaipa)	50%	50%
8-002.08	Upper Santa Ana Valley (San Timoteo)	57%	43%
8-002.09	Upper Santa Ana Valley (Temescal)	50%	50%

Table A-23. Current Progress of Exclusive Groundwater Sustainability Agency Formation in High and Medium Priority Basins (contd.)

Basin	Groundwater Basin Name (Ground Subbasin Name)	Percentage of Basin Area with No Exclusive GSA	Percentage of Basin Area with Exclusive GSA
8-004.01	Elsinore (Elsinore Valley)	50%	50%
8-004.02	Elsinore (Bedford-Coldwater)	50%	50%
8-005	San Jacinto	66%	34%
8-009	Bear Valley	50%	50%
9-004	Santa Margarita Valley	100%	0%
9-005	Temecula Valley	100%	0%
9-006	Cahuilla Valley	100%	0%
9-007	San Luis Rey Valley	74%	26%
9-010	San Pasqual Valley	50%	50%
9-015	San Diego River Valley	50%	50%

Source: "GSA Map" SGMA Public Portal. California Department of Water Resources. December 12, 2017.

Healthy Economy

Intended Outcome: Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply

HE 8: Contaminated Groundwater Wells

Table A-24 presents the data from Figure 4-25 in the main body.

Table A-24. Wells Where Contaminated Groundwater Has Been Detected (Feb 2017–Jan 2018)

County	Percent of Groundwater Well Samples within the Past Year with Constituents Above the Comparison Concentration
Alameda	80 - 100%
Alpine	20 - 40%
Amador	40 - 60%
Butte	40 - 60%
Calavaras	20 - 40%
Colusa	20 - 40%
Contra Costa	20 - 40%
Del Norte	0 - 20%
El Dorado	20 - 40%
Fresno	40 - 60%

Table A-24. Wells Where Contaminated Groundwater Has Been Detected (Feb 2017–Jan 2018) (contd.)

County	Percent of Groundwater Well Samples within the Past Year with Constituents Above the Comparison Concentration
Glenn	20 - 40%
Humboldt	0 - 20%
Imperial	80 - 100%
Inyo	20 - 40%
Kern	40 - 60%
Kings	20 - 40%
Lake	20 - 40%
Lassen	20 - 40%
Los Angeles	60 - 80%
Madera	40 - 60%
Marin	20 - 40%
Mariposa	0 - 20%
Mendocino	0 - 20%
Merced	40 - 60%
Modoc	0 - 20%
Mono	60 - 80%
Monterey	60 - 80%
Napa	20 - 40%
Nevada	0 - 20%
Orange	40 - 60%
Placer	20 - 40%
Plumas	0 - 20%
Riverside	40 - 60%
Sacramento	40 - 60%
San Benito	60 - 80%
San Bernardino	60 - 80%
San Diego	40 - 60%
San Francisco	0 - 20%
San Joaquin	40 - 60%
San Luis Obispo	60 - 80%
San Mateo	60 - 80%
Santa Barbara	60 - 80%
Santa Clara	20 - 40%
Santa Cruz	60 - 80%
Shasta	0 - 20%
Sierra	20 - 40%
Siskiyou	20 - 40%
Solano	60 - 80%

Table A-24. Wells Where Contaminated Groundwater Has Been Detected (Feb 2017–Jan 2018) (contd.)

County	Percent of Groundwater Well Samples within the Past Year with Constituents Above the Comparison Concentration
Sonoma	20 - 40%
Stanislaus	40 - 60%
Sutter	40 - 60%
Tehama	20 - 40%
Trinity	0 - 20%
Tulare	40 - 60%
Tuolumne	20 - 40%
Ventura	60 - 80%
Yolo	40 - 60%
Yuba	20 - 40%

Source: GeoTracker GAMA. State Water Resources Control Board. February 8, 2018.

Healthy Economy

Intended Outcome: Consideration of economic risks and rewards on floodplains, rivers, and coastal areas.

HE 9: Socioeconomic Vulnerability to Sea Level Rise Impacts

Tables A-25 and A-26 presents the data from Figure 4-26 in the main body.

Table A-25. Coastal Areas at Risk of Sea Level Rise Evaluated with the Social Vulnerability Index of the Coastal Areas

County	Percentage of County with a Low Score (%)	Percentage of County with a Medium Score (%)	Percentage of County with a High Score (%)
Alameda	74	19	8
Contra Costa	61	25	14
Del Norte	-	4	96
Humboldt	-	52	48
Los Angeles	41	44	14
Marin	68	30	2
Mendocino	-	44	56
Monterey	73	25	2
Napa	81	16	4
Orange	73	25	3
San Diego	26	22	52
San Francisco	60	27	12
San Luis Obispo	45	47	7
San Mateo	77	21	2
Santa Barbara	66	34	0
Santa Clara	91	8	1
Santa Cruz	92	8	0
Solano	41	27	32
Sonoma	39	53	9
Ventura	23	73	4

Table A-26. Percent of Coastal Counties at Risk of Sea Level Rise and Percent of Additional Low-Lying Areas

County	Percentage of Area at Risk of Sea Level Rise (%)	Percentage of Low-Lying Areas at Risk (%)
Alameda	14.69	0.49
Contra Costa	8.77	-
Del Norte	0.38	0.56
Humboldt	0.99	0.13
Los Angeles	0.14	0.03
Marin	16.03	0.24
Mendocino	0.08	0.01
Monterey	0.25	0.15
Napa	2.90	0.09
Orange	1.31	0.69
San Diego	0.20	0.02
San Francisco	56.73	0.11
San Luis Obispo	0.06	0.01
San Mateo	21.66	0.28
Santa Barbara	0.16	0.03
Santa Clara	2.34	0.18
Santa Cruz	0.18	0.32
Solano	19.51	0.16
Sonoma	3.76	0.03
Ventura	0.19	0.22

Source: Sea Level Rise Viewer. National Oceanic and Atmospheric Administration. February 9, 2018.

Healthy Economy

Intended Outcome: Consideration of economic risks and rewards on floodplains, rivers, and coastal areas.

HE 10: Areas Covered by Local Coastal Program Vulnerability Assessments Updated for Sea Level Rise

Table A-25 (above) and Table A-27 present the data used within Figure 4-27 in the main body.

Table A-27. Status of Local Coastal Programs Sea Level Rise Vulnerability Assessments Coastal Areas at Risk of Sea Level Rise

County	Status of Local Coastal Programs Sea Level Rise Vulnerability Assessments
Del Norte	No Vulnerability Assessment
Humboldt	Vulnerability Assessment not Updated for SLR
Los Angeles	Vulnerability Assessment not Updated for SLR
Marin	Vulnerability Assessment Updated for SLR
Mendocino	No Vulnerability Assessment
Monterey	Vulnerability Assessment Updated for SLR
Orange	Vulnerability Assessment in Progress
San Diego	Vulnerability Assessment Updated for SLR
San Francisco	Vulnerability Assessment Updated for SLR
San Luis Obispo	Vulnerability Assessment Mentions SLR
San Mateo	Vulnerability Assessment in Progress
Santa Barbara	Vulnerability Assessment Updated for SLR
Santa Cruz	Vulnerability Assessment Updated for SLR
Sonoma	Vulnerability Assessment Updated for SLR
Ventura	Vulnerability Assessment Updated for SLR

Source: California Coastal Commission. Sea Level Rise Vulnerability Synthesis. April 17, 2018.

Healthy Economy

Intended Outcome: More benefits from economic activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)

HE 11: Regional Trend in Cost of Water for Municipal and Industrial, and Agricultural Purposes; Cost Compared to State Average for these Same Supplies

No GIS figures or charts included in main body.

Healthy Economy

Intended Outcome: More benefits from economic activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)

HE 12: Volume of Water Transferred on the Open Market; Cost of Water on the Transfer Market

Data for Figure 4-28 is summarized within the alternative text. This figure is sourced from Public Policy Institute of California's California's Water Market fact sheet.

Healthy Economy

Intended Outcome: More benefits from economic activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)

HE 13: Percent of Average Annual Power Demand Satisfied by Hydropower

Table A-28 present the data used within Figure 4-29 in the main body.

Table A-28. Average Hydroelectric Power Percent of Total Annual Power Production from 2013 to 2016

County	Percent of Average Annual Energy Production that is Hydropower
Alameda	0 - 10
Alpine	N/A
Amador	80 - 100
Butte	80 - 100
Calaveras	80 - 100
Colusa	0 - 10
Contra Costa	0 - 10
Del Norte	N/A
El Dorado	80 - 100
Fresno	20 - 50
Glenn	80 - 100
Humboldt	0 - 10
Imperial	0 - 10
Inyo	10 - 20
Kern	0 - 10
Kings	0 - 10
Lake	0 - 10
Lassen	10 - 20
Los Angeles	0 - 10
Madera	80 - 100
Marin	0 - 10
Mariposa	80 - 100
Mendocino	50 - 80
Merced	20 - 50
Modoc	N/A
Mono	10 - 20
Monterey	0 - 10

Table A-28. Average Hydroelectric Power Percent of Total Annual Power Production from 2013 to 2016 (contd.)

County	Percent of Average Annual Energy Production that is Hydropower
Napa	0 - 10
Nevada	80 - 100
Orange	0 - 10
Placer	50 - 80
Plumas	80 - 100
Riverside	0 - 10
Sacramento	0 - 10
San Benito	0 - 10
San Bernardino	0 - 10
San Diego	0 - 10
San Francisco	0 - 10
San Joaquin	0 - 10
San Luis Obispo	0 - 10
San Mateo	0 - 10
Santa Barbara	0 - 10
Santa Clara	0 - 10
Santa Cruz	0 - 10
Shasta	80 - 100
Sierra	80 - 100
Siskiyou	80 - 100
Solano	0 - 10
Sonoma	0 - 10
Stanislaus	0 - 10
Sutter	0 - 10
Tehama	50 - 80
Trinity	80 - 100
Tulare	10 - 20
Tuolumne	80 - 100
Ventura	0 - 10
Yolo	10 - 20
Yuba	N/A

Source: "Energy Maps of California." California Energy Commission. December 20, 2017.

Table A-29 present the data used within Figure 4-30 in the main body.

Table A-29. Energy Production by County, Annual Average (2013-2016)

County	Average Hydropower Annual Energy Production	Average Non-Hydropower Annual Energy Production
Alameda	0	2,263,045
Alpine	696,135	66,854
Amador	2,202,133	45,664
Butte	341,971	2,838
Calaveras	0	3,019,868
Colusa	0	16,254,457
Contra Costa	1,196,440	0
Del Norte	1,900,912	2,110,001
El Dorado	8,391	623
Fresno	0	620,030
Glenn	252,290	6,821,754
Humboldt	191,577	1,297,800
Imperial	239,658	30,490,612
Inyo	0	561,022
Kern	2,675	1,572,949
Kings	36,961	213,082
Lake	877,605	21,744,754
Lassen	600,803	131,960
Los Angeles	0	479,228
Madera	0	2,598
Marin	130,411	0
Mariposa	17,497	5,827
Mendocino	133,699	170,734
Merced	50,553	206,129
Modoc	0	5,277,673
Mono	0	9,306
Monterey	318,779	0
Napa	22,271	1,589,338
Nevada	1,126,446	854,197
Orange	1,132,465	176,460
Placer	88,774	6,722,480
Plumas	400,518	6,107,729
Riverside	0	4,892
Sacramento	1,088,965	13,140,764
San Benito	20,114	9,484,222
San Bernardino	0	45,777
San Diego	11,132	2,012,476
San Francisco	2,989	19,429,026
San Joaquin	0	120,680
San Luis Obispo	0	298,452

Table A-29. Energy Production by County, Annual Average (2013-2016) (contd.)

County	Average Hydropower Annual Energy Production	Average Non-Hydropower Annual Energy Production
San Mateo	0	4,847,289
Santa Barbara	0	45,704
Santa Clara	5,056,965	1,194,777
Santa Cruz	19,303	0
Shasta	278,300	60,157
Sierra	0	2,009,150
Siskiyou	10,636	5,199,841
Solano	40,422	2,263,242
Sonoma	0	1,328,607
Stanislaus	0	103,312
Sutter	63,785	28,544
Tehama	341,564	0
Trinity	58,090	405,295
Tulare	2,461,663	161,899
Tuolumne	1,855	1,712,798
Ventura	38,734	219,948
Yolo	0	2,263,045
Yuba	696,135	66,854

Source: "Energy Maps of California." California Energy Commission. December 20, 2017.

Healthy Economy

Intended Outcome: Reduced likelihood or occurrence of significant social disruption following a disaster.

HE 14: Value of Assets within Floodplains with Equal to or Greater than a 1 Percent Chance of Flooding in any Given Year

Table A-30 present the data used within Figure 4-31 in the main body.

Table A-30. Value of Exposed Assets, Including Structures and Contents and Agricultural Crops, in the 100-Year Floodplains

County	Value of Assets in 100-year Floodplain
Alameda	Greater than $5 billion
Alpine	Less than $0.5 billion
Amador	Less than $0.5 billion
Butte	$1 billion to $2.5 billion
Calaveras	Less than $0.5 billion
Colusa	Less than $0.5 billion
Contra Costa	$2.5 billion to $5 billion
Del Norte	Less than $0.5 billion
El Dorado	Less than $0.5 billion
Fresno	$1 billion to $2.5 billion
Glenn	Less than $0.5 billion
Humboldt	$0.5 billion to $1 billion
Imperial	Less than $0.5 billion
Inyo	Less than $0.5 billion
Kern	$2.5 billion to $5 billion
Kings	$0.5 billion to $1 billion
Lake	$0.5 billion to $1 billion
Lassen	Less than $0.5 billion
Los Angeles	Greater than $5 billion
Madera	$0.5 billion to $1 billion
Marin	Greater than $5 billion
Mariposa	Less than $0.5 billion
Mendocino	$0.5 billion to $1 billion
Merced	$2.5 billion to $5 billion
Modoc	Less than $0.5 billion
Mono	Less than $0.5 billion
Monterey	$1 billion to $2.5 billion
Napa	$1 billion to $2.5 billion
Nevada	Less than $0.5 billion
Orange	Greater than $5 billion
Placer	$1 billion to $2.5 billion
Plumas	Less than $0.5 billion

Table A-30. Value of Exposed Assets, Including Structures and Contents and Agricultural Crops, in the 100-Year Floodplains (contd.)

County	Value of Assets in 100-year Floodplain
Riverside	$2.5 billion to $5 billion
Sacramento	$2.5 billion to $5 billion
San Benito	Less than $0.5 billion
San Bernardino	$2.5 billion to $5 billion
San Diego	Greater than $5 billion
San Francisco	Less than $0.5 billion
San Joaquin	$2.5 billion to $5 billion
San Luis Obispo	$1 billion to $2.5 billion
San Mateo	Greater than $5 billion
Santa Barbara	$2.5 billion to $5 billion
Santa Clara	Greater than $5 billion
Santa Cruz	$2.5 billion to $5 billion
Shasta	$0.5 billion to $1 billion
Sierra	Less than $0.5 billion
Siskiyou	Less than $0.5 billion
Solano	$2.5 billion to $5 billion
Sonoma	$1 billion to $2.5 billion
Stanislaus	$0.5 billion to $1 billion
Sutter	$0.5 billion to $1 billion
Tehama	$0.5 billion to $1 billion
Trinity	Less than $0.5 billion
Tulare	$2.5 billion to $5 billion
Tuolumne	Less than $0.5 billion
Ventura	Greater than $5 billion
Yolo	Greater than $5 billion
Yuba	$1 billion to $2.5 billion

Source: Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

Opportunities for Enriching Experience

Intended Outcome: Preserved or enhanced culturally or historically significant sites and communities, including continued and enhanced access to water and land used for sacred ceremonies or cultural practices

OEE 1: Number of Historically and Culturally Significant Sites at Risk of Flooding or Sea Level Rise

Table A-31 present the data used within Figure 4-32 in the main body.

Table A-31. Number of Historically and Culturally Significant Sites at Risk of Flooding or Sea Level Rise Impacts

County	At Risk of Sea Level Rise and 100-year Flood	At Risk of Sea Level Rise	At Risk of 100-year Flood	No Risk of Sea Level Rise or 100-year Flood
Alameda	4	2	3	128
Alpine	0	0	0	6
Amador	0	0	8	12
Butte	0	0	5	22
Calaveras	0	0	1	24
Colusa	0	0	0	8
Contra Costa	5	0	5	30
Del Norte	2	0	3	5
El Dorado	0	0	3	13
Fresno	0	0	4	60
Glenn	0	0	1	2
Humboldt	3	1	8	57
Imperial	0	0	2	2
Inyo	0	0	3	16
Kern	0	0	8	22
Kings	0	0	1	3
Lake	0	0	5	3
Lassen	0	0	4	29
Los Angeles	1	6	4	426
Madera	0	0	0	28
Marin	0	8	1	24
Mariposa	0	0	13	22
Mendocino	3	0	9	33
Merced	0	0	9	4
Modoc	0	0	9	38
Mono	0	0	16	3
Monterey	2	0	1	44
Napa	1	0	22	53
Nevada	0	0	4	15
Orange	2	0	2	102
Placer	0	0	4	25
Plumas	0	0	4	10
Riverside	0	0	12	40
Sacramento	0	0	2	68
San Benito	0	0	1	10
San Bernardino	0	0	7	37
San Diego	3	4	12	127
San Francisco	3	21	0	137

Table A-31. Number of Historically and Culturally Significant Sites at Risk of Flooding or Sea Level Rise Impacts (contd.)

County	At Risk of Sea Level Rise and 100-year Flood	At Risk of Sea Level Rise	At Risk of 100-year Flood	No Risk of Sea Level Rise or 100-year Flood
San Joaquin	0	0	2	34
San Luis Obispo	2	0	3	20
San Mateo	0	0	5	35
Santa Barbara	2	0	5	20
Santa Clara	1	1	12	80
Santa Cruz	1	0	12	21
Shasta	0	0	14	54
Sierra	0	0	3	5
Siskiyou	0	0	32	22
Solano	6	0	2	17
Sonoma	1	0	6	50
Stanislaus	0	0	1	22
Sutter	0	0	0	0
Tehama	0	0	3	11
Trinity	0	0	1	7
Tulare	0	0	5	30
Tuolumne	0	0	0	18
Ventura	0	1	2	27
Yolo	0	0	5	17
Yuba	0	0	0	11

Sources: "National Register for Historical Places." National Park Service. December 14, 2017.
Statewide Flood Management Planning Program – Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.
Sea Level Rise Viewer. National Oceanic and Atmospheric Administration. February 9, 2018.

Opportunities for Enriching Experience

Intended Outcome: Preserved and increased natural areas with aesthetic or intrinsic value (including viewshed)

OEE 2: Change in Natural Area

Table A-32 present the data used within Figure 4-33 in the main body.

Table A-32. Acreage of California Department of Fish and Wildlife Owned and Operated Lands and Conservation Easements (as of January 2018)

County	Ecological Reserve	Fish Hatchery	Miscellaneous	Public Access	Undesignated	Wildlife Area
Alameda	5,952	-	-	2	5,393	-
Alpine	-	-	-	43	721	5,870
Amador	37	-	-	-	207	-
Butte	4,728	12	-	0	12,007	28,028
Calaveras	-	-	-	1	16,159	-
Colusa	-	-	-	-	427	2,355
Contra Costa	4	-	1	1	6,635	833
Del Norte	-	-	-	10	233	6,269
El Dorado	837	-	-	-	133	-
Fresno	6,191	52	-	524	1,201	12,142
Glenn	-	-	-	-	437	6,125
Humboldt	10,359	47	-	208	1,842	5,806
Imperial	1,933	-	-	582	4,332	7,855
Inyo	1,230	137	41	-	895	558
Kern	35,916	28	-	116	17,999	1,110
Kings	-	-	-	-	-	-
Lake	62	-	-	2	137	6,328
Lassen	-	-	-	-	3,708	40,859
Los Angeles	590	-	-	150	2,524	-
Madera	0	-	-	-	715	519
Marin	1,387	-	-	106	12	12,981
Mariposa	122	-	-	-	-	-
Mendocino	5,075	-	-	55	115	-
Merced	-	11	-	-	5,152	25,657
Modoc	-	-	3	15	1,376	11,974
Mono	1,114	215	-	-	793	18,734
Monterey	7,732	-	-	-	1,671	1,087
Napa	949	-	12	2	2,811	30,990
Nevada	29	-	-	74	1,615	7,562
Orange	2,909	-	-	1	397	-
Placer	-	-	-	217	74	1

Table A-32. Acreage of California Department of Fish and Wildlife Owned and Operated Lands and Conservation Easements (as of January 2018) (contd.)

County	Ecological Reserve	Fish Hatchery	Miscellaneous	Public Access	Undesignated	Wildlife Area
Plumas	-	-	-	14	1,159	3,477
Riverside	24,607	-	-	1	5,176	120,634
Sacramento	4,663	47	0	90	9,826	3,216
San Benito	-	-	-	-	-	-
San Bernardino	19,242	18	2	915	19,275	160,584
San Diego	18,326	-	-	-	14,988	24,791
San Francisco	-	-	-	3	-	-
San Joaquin	568	30	-	-	5,921	734
San Luis Obispo	40,661	-	-	3	25,111	2,162
San Mateo	2,311	-	-	55	1,011	-
Santa Barbara	5,612	-	-	-	35	-
Santa Clara	8,839	-	-	-	29	297
Santa Cruz	1,457	-	-	68	291	-
Shasta	45	121	1	276	1,248	1,889
Sierra	-	-	-	-	-	17,649
Siskiyou	236	39	8	43	23,455	23,803
Solano	5,674	-	-	35	2,762	19,580
Sonoma	916	11	-	68	554	13,261
Stanislaus	-	-	37	44	1,156	270
Sutter	392	-	-	24	478	6,362
Tehama	885	-	1	6	2,923	44,804
Trinity	-	20	-	142	-	-
Tulare	7,803	-	-	-	34	234
Tuolumne	115	21	-	90	41	-
Ventura	61	25	-	1	211	-
Yolo	-	-	-	276	10,162	18,643
Yuba	-	-	-	13	7,585	15,857

Sources: "CDFW Lands Inventory Fact Sheet." California Department of Fish and Wildlife. January 26, 2018.

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced access to resources that support education and learning

OEE 3: Number of School Districts Using Water and Environmental Curriculum in K-12 Programs

Table A-33 present the data used within Figure 4-34 in the main body.

Table A-33. Estimated Number of Students Reached by California Department of Water Resources Educator Workshops

County	Estimated Number of Students Reached by California Department of Water Resources Educator Workshops
Alameda	2,501 - 5,000
Alpine	-
Amador	-
Butte	1 - 2,500
Calaveras	1 - 2,500
Colusa	-
Contra Costa	1 - 2,500
Del Norte	-
El Dorado	1 - 2,500
Fresno	1 - 2,500
Glenn	-
Humboldt	1 - 2,500
Imperial	-
Inyo	-
Kern	> 10,000
Kings	-
Lake	-
Lassen	-
Los Angeles	> 10,000
Madera	-
Marin	-
Mariposa	-
Mendocino	-
Merced	1 - 2,500
Modoc	-
Mono	-
Monterey	1 - 2,500
Napa	-
Nevada	1 - 2,500
Orange	2,501 - 5,000
Placer	1 - 2,500

Table A-33. Estimated Number of Students Reached by California Department of Water Resources Educator Workshops (contd.)

County	Estimated Number of Students Reached by California Department of Water Resources Educator Workshops
Plumas	-
Riverside	5,001 - 10,000
Sacramento	2,501 - 5,000
San Benito	1 - 2,500
San Bernardino	> 10,000
San Diego	-
San Francisco	1 - 2,500
San Joaquin	2,501 - 5,000
San Luis Obispo	-
San Mateo	1 - 2,500
Santa Barbara	-
Santa Clara	5,001 - 10,000
Santa Cruz	1 - 2,500
Shasta	1 - 2,500
Sierra	-
Siskiyou	-
Solano	2,501 - 5,000
Sonoma	1 - 2,500
Stanislaus	1 - 2,500
Sutter	-
Tehama	1 - 2,500
Trinity	-
Tulare	> 10,000
Tuolumne	-
Ventura	1 - 2,500
Yolo	1 - 2,500
Yuba	1 - 2,500

Source: Schultz K. Feb. 5, 2018.

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced access to resources that support education and learning

OEE 4: Number of Students Enrolled in Water and Environmental Resources Management Programs Within the UC and CSU Systems

Table A-34 present the data used within Figure 4-35 in the main body.

Table A-34. Number of Awards from Water and Environmental Resources Management Programs in University of California and California State University Systems and Four-year Public Universities

School	Students Receiving Awards	Percent of Total Student Body Receiving Awards
California Polytechnic State University-San Luis Obispo	141	3.1%
California State Polytechnic University-Pomona	6	0.0%
California State University-Bakersfield	33	1.9%
California State University-Channel Islands	25	1.7%
California State University-Chico	141	3.1%
California State University-Dominguez Hills	0	0.0%
California State University-East Bay	20	0.6%
California State University-Fresno	11	0.1%
California State University-Fullerton	61	0.0%
California State University-Long Beach	61	0.8%
California State University-Los Angeles	5	0.0%
California State University-Monterey Bay	73	3.5%
California State University-Northridge	0	0.0%
California State University-Sacramento	44	0.8%
California State University-San Bernardino	19	0.5%
California State University-San Marcos	1	0.0%
California State University-Stanislaus	0	0.0%
Humboldt State University	368	18.8%
San Diego State University	83	1.1%
San Francisco State University	48	0.8%
San Jose State University	74	1.1%
Sonoma State University	76	3.9%
University of California-Berkeley	411	4.5%
University of California-Davis	211	2.6%
University of California-Irvine	84	0.8%
University of California-Los Angeles	80	0.9%
University of California-Merced	31	2.2%
University of California-Riverside	74	1.5%
University of California-San Diego	90	1.5%
University of California-Santa Barbara	318	4.5%
University of California-Santa Cruz	1290	5.6%

Source: College Navigator. National Center for Education Statistics. October 30, 2017.

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced access to resources that support education and learning

OEE 5: Number of Water Agencies that Have Educational Programs for Customers

No GIS figures or charts included in main body.

Opportunities for Enriching Experience

Intended Outcome: Continued and enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces

OEE 6: Change in Visitor Days at Water Related Park Lands

No GIS figures or charts included in main body.

Ecosystem Vitality – Advanced Indicator

Intended Outcome: Maintained and improved ecological functions and processes vital for sustaining ecosystems in California.

EV 9: Number of Fish Consumption Advisories (Advanced Indicator)

Table A-35 present the data used within Figure 4-36 in the main body.

Table A-35. Number of Fish Consumption Advisories

HUC 8 ID	HUC 8 Watershed Name	Number of Fish Consumption Advisories
17120007	Warner Lakes	0
17100311	Illinois	0
17100312	Chetco	1 - 2
17100309	Applegate	0
18020001	Goose Lake	0
18010206	Upper Klamath	0
18010204	Lost	0
18010101	Smith	1 - 2
18010205	Butte	0
18010207	Shasta	0
18010209	Lower Klamath	0
18080001	Surprise Valley	0
18010208	Scott	0
16040204	Massacre Lake	0
18020002	Upper Pit	0
18010210	Salmon	0

Table A-35. Number of Fish Consumption Advisories (contd.)

HUC 8 ID	HUC 8 Watershed Name	Number of Fish Consumption Advisories
18020004	McCloud	1 - 2
18020005	Sacramento Headwaters	1 - 2
18020003	Lower Pit	1 - 2
18010211	Trinity	3 - 5
18080002	Madeline Plains	0
18010102	Mad-Redwood	1 - 2
16040203	Smoke Creek Desert	0
18020151	Cow Creek	0
18020154	Clear Creek-Sacramento River	1 - 2
18010212	South Fork Trinity	0
18020153	Battle Creek	0
18080003	Honey-Eagle Lakes	0
18020152	Cottonwood Creek	0
18010107	Mattole	1 - 2
18010105	Lower Eel	1 - 2
18020155	Paynes Creek-Sacramento River	1 - 2
18020121	North Fork Feather	1 - 2
18020156	Thomes Creek-Sacramento River	1 - 2
18020122	East Branch North Fork Feather	1 - 2
18010106	South Fork Eel	0
18020157	Big Chico Creek-Sacramento River	1 - 2
18010104	Middle Fork Eel	0
18020123	Middle Fork Feather	3 - 5
18020158	Butte Creek	0
18020115	Upper Stony	3 - 5
18010103	Upper Eel	1 - 2
16050102	Truckee	1 - 2
18020125	Upper Yuba	1 - 2
18010108	Big-Navarro-Garcia	1 - 2
18020159	Honcut Headwaters-Lower Feather	3 - 5
18020104	Sacramento-Stone Corral	1 - 2
18020126	Upper Bear	3 - 5
18020128	North Fork American	3 - 5
16050101	Lake Tahoe	0
18020116	Upper Cache	3 - 5
18020161	Upper Coon-Upper Auburn	3 - 5
16050201	Upper Carson	0
18020129	South Fork American	1 - 2
18010110	Russian	3 - 5
18020111	Lower American	3 - 5

Table A-35. Number of Fish Consumption Advisories (contd.)

HUC 8 ID	HUC 8 Watershed Name	Number of Fish Consumption Advisories
18020162	Upper Putah	3 - 5
16050302	West Walker	0
18010109	Gualala-Salmon	1 - 2
18040013	Upper Cosumnes	3 - 5
18020163	Lower Sacramento	3 - 5
16050301	East Walker	0
18040012	Upper Mokelumne	3 - 5
18050002	San Pablo Bay	> 5
18040011	Upper Calaveras California	1 - 2
18040010	Upper Stanislaus	1 - 2
18050001	Suisun Bay	3 - 5
16060010	Fish Lake-Soda Spring Valleys	0
18050005	Tomales-Drake Bays	> 5
18090101	Mono Lake	0
18040009	Upper Tuolumne	1 - 2
18040051	Rock Creek-French Camp Slough	0
18040003	San Joaquin Delta	> 5
18040008	Upper Merced	1 - 2
18050004	San Francisco Bay	3 - 5
18090102	Crowley Lake	0
18040002	Lower San Joaquin River	1 - 2
18040006	Upper San Joaquin	0
18050006	San Francisco Coastal South	3 - 5
18050003	Coyote	> 5
18040007	Fresno River	0
18040001	Middle San Joaquin-Lower Chowchilla	3 - 5
18090201	Eureka-Saline Valleys	0
18030010	Upper King	0
18060015	Monterey Bay	1 - 2
18060002	Pajaro	1 - 2
18030009	Upper Dry	0
18090202	Upper Amargosa	0
18090103	Owens Lake	0
18040014	Panoche-San Luis Reservoir	0
18030007	Upper Kaweah	0
18030001	Upper Kern	0
18030006	Upper Tule	0
18090203	Death Valley-Lower Amargosa	0
18090204	Panamint Valley	0
18060005	Salinas	1 - 2

Table A-35. Number of Fish Consumption Advisories (contd.)

HUC 8 ID	HUC 8 Watershed Name	Number of Fish Consumption Advisories
18030012	Tulare Lake Bed	0
18030002	South Fork Kern	0
16060015	Ivanpah-Pahrump Valleys	0
18030005	Upper Deer-Upper White	0
18060006	Central Coastal	1 - 2
18090205	Indian Wells-Searles Valleys	0
18030004	Upper Poso	0
18060004	Estrella	0
18060003	Carrizo Plain	0
15030102	Piute Wash	0
18030003	Middle Kern-Upper Tehachapi-Grapevine	0
18090207	Coyote-Cuddeback Lakes	0
15030101	Havasu-Mohave Lakes	1 - 2
15030103	Sacramento Wash	0
18060007	Cuyama	0
18090206	Antelope-Fremont Valleys	1 - 2
18060008	Santa Maria	1 - 2
18090208	Mojave	1 - 2
18060009	San Antonio	1 - 2
18060010	Santa Ynez	1 - 2
18070102	Santa Clara	3 - 5
18060013	Santa Barbara Coastal	1 - 2
18070101	Ventura	1 - 2
15030204	Bill Williams	1 - 2
18100100	Southern Mojave	0
18070103	Calleguas	1 - 2
18070105	Los Angeles	1 - 2
18070203	Santa Ana	1 - 2
18070104	Santa Monica Bay	3 - 5
18070106	San Gabriel	> 5
18060014	Santa Barbara Channel Islands	1 - 2
18100201	Whitewater River	1 - 2
18070202	San Jacinto	0
18070201	Seal Beach	1 - 2
18070204	Newport Bay	3 - 5
15030104	Imperial Reservoir	1 - 2
18070302	Santa Margarita	1 - 2
18070301	Aliso-San Onofre	3 - 5
18070303	San Luis Rey-Escondido	1 - 2

Table A-35. Number of Fish Consumption Advisories (contd.)

HUC 8 ID	HUC 8 Watershed Name	Number of Fish Consumption Advisories
18100203	San Felipe Creek	1 - 2
18070107	San Pedro Channel Islands	1 - 2
18100204	Salton Sea	3 - 5
18070304	San Diego	3 - 5
18100202	Carrizo Creek	0
18070305	Cottonwood-Tijuana	1 - 2
15030107	Lower Colorado	0

Source: "Fish Advisories." Office of Environmental Health Hazard Assessment. November 14, 2017.

Table A-36 lists the fish consumption advisories shown on Figure 4-36 in the main body.

Table A-36. Fish Consumption Advisory Locations

Advisory
Alamitos Creek
Alamo River
Almaden Reservoir
American River, Lower
Anderson Reservoir
Bear Creek
Black Butte Lake
Bon Tempe Reservoir
Cache Creek
Calero Reservoir
Camanche Reservoir
Camp Far West Reservoir
Carville Pond
Castaic Lagoon
Castaic Lake
Clear Lake
Cosumnes River, Lower
Del Valle Reservoir
Delta, Central and South
Donner Lake
East Park Reservoir
Elkhorn Slough
Englebright Lake
Feather River, Lower
Feather River, Upper
Folsom Lake
French Meadows Reservoir

Table A-36. Fish Consumption Advisory Locations (contd.)

Advisory
Grasslands Area
Guadalupe Creek
Guadalupe Reservoir
Hell Hole Reservoir
Jenkinson Lake
Lafayette Reservoir
Lake Berryessa
Lake Chabot
Lake Combie
Lake Evans
Lake Gregory
Lake Havasu
Lake Herman
Lake McClure
Lake McSwain
Lake Mendocino
Lake Merced
Lake Nacimiento
Lake Natoma
Lake Oroville
Lake Pillsbury
Lake Piru
Lake San Antonio
Lake Sonoma
Lauritzen Channel
Lewiston Lake
Lexington Reservoir
Little Rock Reservoir
Magic Johnson Lakes
Mission Bay
Mokelumne River at Lodi Lake
Mokelumne River, Lower
New Bullards Bar Reservoir
New Hogan Lake
New Melones Reservoir
New River
Nicasio Reservoir
O'Neill Forebay
Oso Flaco Lake
Port of Stockton

Table A-36. Fish Consumption Advisory Locations (contd.)

Advisory
Putah Creek including Lake Solano
Pyramid Lake
Rollins Reservoir
Sacramento River and Northern Delta
Salton Sea
San Diego Bay
San Francisco Bay
San Joaquin River from Friant Dam to the Port of Stockton
San Luis Reservoir
San Pablo Reservoir
Santa Monica Beach south of Santa Monica Pier to Seal Beach Pier
Shadow Cliffs Lake
Shasta Lake
Silverwood Lake
Soulajule Reservoir
South of Seal Beach Pier to San Mateo Point
Stevens Creek Reservoir
Stony Gorge Reservoir
Thermalito Forebay and Afterbay
Tomales Bay
Trinity Lake and the East Fork Trinity River
Trinity River upstream of Trinity Lake
Vasona Lake and Camden Ponds
Ventura Harbor to Santa Monica Pier
Wiest Lake
California Coastal Locations without Site-Specific Advice
Lake Alamor

References

California Coastal Commission. 2016. Statewide Sea Level Rise Vulnerability Synthesis. Viewed online at: https://documents.coastal.ca.gov/assets/climate/slr/vulnerability/FINAL_Statewide_Report.pdf

California Department of Fish and Wildlife. “CDFW Lands Inventory Fact Sheet.” California Department of Fish and Wildlife. Viewed online at: https://www.wildlife.ca.gov/Lands/Inventory. Last accessed: January 26, 2018.

California Department of Transportation. “CalTrans GIS Data.” Viewed online at: http://www.dot.ca.gov/hq/tsip/gis/datalibrary/. Last accessed: December 12, 2017.

California Department of Water Resources. “Best Available Maps.” California Department of Water Resources. Viewed online at: http://gis.bam.water.ca.gov/bam/. Last accessed: February 12, 2018.

California Department of Water Resources. “Groundwater Information System.” CASGEM Public Portal. Viewed online at: http://water.ca.gov/groundwater/gwinfo/. Last accessed: December 21, 2017.

California Department of Water Resources. “GSA Map.” SGMA Public Portal. Viewed online at: http://water.ca.gov/groundwater/sgm/gsa_map.cfm. Last accessed: December 12, 2017.

California Department of Water Resources. “Levee Flood Protection Zone.” California Department of Water Resources. Viewed online at: http://gis.lfpz.water.ca.gov/lfpz/. Last accessed: February 12, 2018.

California Department of Water Resources. 2013. Statewide Flood Management Planning Program Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

California Department of Water Resources. 2016. Statewide Flood Management Planning Program Attachment F: Flood Hazard Exposure Analysis. California Department of Water Resources.

California Department of Water Resources. 2017. The State Water Project Draft Delivery Capability Report 2017. Viewed online at: https://msb.water.ca.gov/documents/86800/e00836f7-68f5-4f00-aeb8-450dc475436b

California Energy Commission. “Energy Maps of California.” California Energy Commission. Viewed online at: http://www.energy.ca.gov/maps/. Last accessed: December 20, 2017.

California Water Quality Monitoring Council. “Where are harmful algal blooms occurring in California?” My Water Quality. Viewed online at: http://www.mywaterquality.ca.gov/habs/where/freshwater_events.html. Last accessed: February 6, 2018.

Governor's Office of Emergency Services. “Local Hazard Mitigation Program - Local Mitigation Planning.” Cal OES. Viewed online at: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program. Last accessed: December 7, 2017.

Hazards & Vulnerability Research Institute. "SoVI® - Social Vulnerability Index for the United States – 2010-2014." University of South Carolina. Viewed online at: http://artsandsciences.sc.edu/geog/hvri/sovi%C2%AE-0. Last accessed: February 8, 2018.

Heal the Bay. "Beach Grades." Beach Report Card. Viewed online at: http://brc.healthebay.org/?st=CA&f=1. Last accessed: February 2, 2018.

Moyle, P.B. 1976. Inland Fishes of California. University of California Press, Berkeley.

Moyle, P.B., J.E. Williams, and E. Wikramanayake. 1989. Fish species of special concern of California. California Department of Fish and Game, Sacramento.

Moyle, P.B., R.M. Quiñones, J.V. Katz, and J. Weaver. 2015. Fish Species of Special Concern in California. Third edition. University of California, Davis and California Department of Fish and Wildlife. Viewed online at: https://www.wildlife.ca.gov/Conservation/SSC/Fishes

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. Fish species of special concern of California. Second edition. California Department of Fish and Game, Inland Fisheries Division. Rancho Cordova, CA.

National Center for Education Statistics. College Navigator. Viewed online at: https://nces.ed.gov/collegenavigator. Last accessed: October 30, 2017.

National Oceanic and Atmospheric Administration. Sea Level Rise Viewer. Viewed online at: http://bit.ly/2Etz45E. Last accessed: February 9, 2018.

Public Policy Institute of California. "California's Water Market." Public Policy Institute of California. Viewed online at: http://www.ppic.org/publication/californias-water-market/. Last accessed: February 9, 2018.

Schultz K, Water education specialist, Water Education Branch, California Department of Water Resources, Sacramento (CA). Feb. 5, 2018 – email correspondence with Marshall P, Principal Engineer, Stantec, Sacramento (CA).

State Water Resources Control Board. "Bioassessment Scores Map." State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/csci_scores_map.shtml. Last accessed: December 1, 2017.

State Water Resources Control Board. "eWRIMS - Electronic Water Rights Information Management System." State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/. Last accessed: January 23, 2018.

State Water Resources Control Board. "Human Right to Water Portal." State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/hr2w/index.html. Last accessed: January 29, 2018.

State Water Resources Control Board. 2014/2016 Integrated Report Approval Documents." State Water Resources Control Board. Viewed online at: https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2014_2016.shtml. Last accessed: April 11, 2018.

State Water Resources Control Board. California Environmental Data Exchange Network (CEDEN). Viewed online at: http://www.ceden.org/. Last accessed: January 23, 2018.

State Water Resources Control Board. GeoTracker GAMA. Viewed online at: http://geotracker.waterboards.ca.gov/gama/. Last accessed: February 8, 2018.

U.S. Census Bureau. "TIGER Products." Viewed online at: https://www.census.gov/geo/maps-data/data/tiger.html. Last accessed: December 12, 2017.

U.S. Department of Agriculture, U.S. Forest Service. "Download National Datasets." U.S. Department of Agriculture. Viewed online at: https://data.fs.usda.gov/geodata/edw/datasets.php. Last accessed: December 12, 2017.

U.S. Department of the Interior, Bureau of Reclamation. November 2015. "CVP Contract Water Delivery Information." Viewed online at: https://www.usbr.gov/mp/cvp-water/docs/cvp-water-deliveries.pdf. Last Accessed: May 10, 2018.

U.S. Department of the Interior, National Park Service. "National Register of Historical Places." National Park Service. Viewed online at: https://www.nps.gov/nr/. Last accessed: December 14, 2017.

U.S. Department of the Interior, U.S. Geologic Survey. "Hydrography." Viewed online at: https://nhd.usgs.gov/. Last accessed: December 12, 2017.

U.S. Fish and Wildlife Service. 2018. "National Wetlands Inventory." Viewed online at: https://www.fws.gov/wetlands/Data/Wetlands-Product-Summary.html. Last accessed: April 12, 2018.

U.S. Geological Survey. 2018. Nonindigenous Aquatic Species Database. Viewed online at: https://nas.er.usgs.gov/. Last accessed: April 24, 2018.