

# Draft Assumptions and Estimates for California Water Plan Update 2018

**April 2017**



California Department of Water Resources

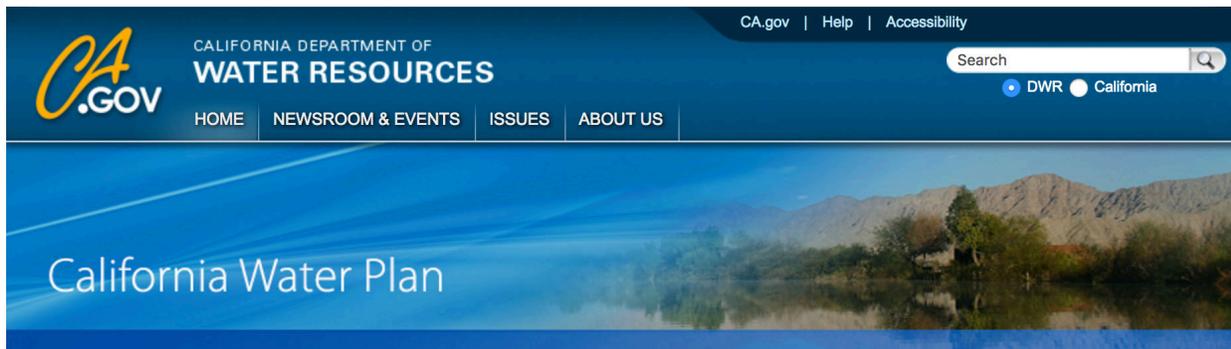
## Let Us Know

The California Department of Water Resources (DWR) is interested in receiving comments about the information presented in the Draft Assumptions and Estimates Report (Draft A&E Report) for California Water Plan Update 2018 (Update 2018). We also welcome suggestions about improving the usefulness of the report.

Please direct your suggestions by June 6, 2017, to DWR at [cwpcom@water.ca.gov](mailto:cwpcom@water.ca.gov) or via fax at (916) 651-9259. You can also mail your comments to Strategic Water Planning Branch, P.O. Box 942836, Sacramento CA, 94236-0001.

## Assumptions and Estimates Online

The Draft A&E Report and its companion material are available online at the California Water Plan website: <http://www.water.ca.gov/waterplan/cwp/update2018/ae/>. DWR will continue to update the Draft A&E Report content online during the remainder of the Update 2018 development process.



# Draft Assumptions and Estimates Report

The Draft Assumptions and Estimates Report (Draft A&E Report) presents key assumptions and estimates, data and data sources, and companion plans which will be considered for the preparation of California Water Plan Update 2018 (Update 2018). The report increases the transparency of the Water Plan process by disclosing the data, tools, methods, and references used to prepare Update 2018. The report also describes the approach the Department of Water Resources (DWR) is taking to improve the analytical tools and data being used to develop Update 2018.

### Draft A&E Report

- » [Table of Water Code Requirements](#)
- » [Draft Companion State Plans List](#)
- » [Draft Glossary](#)

DWR will continue to update the Draft A&E Report content online during the remainder of the Update 2018 development process.

### Public Comment Period and Update 2018 Release Schedule

DWR is interested in receiving comments about the information presented in the Draft A&E Report for Update 2018. We also welcome suggestions about improving the usefulness of the report. Please direct your suggestions to DWR at [cwpcom@water.ca.gov](mailto:cwpcom@water.ca.gov) or via fax at (916) 651-9259. You can also mail your comments to Strategic Water Planning Branch, PO Box 942836, Sacramento CA, 94236-0001.

Comments received by **June 6, 2017**, will be closely considered when DWR adopts the final assumptions and estimates for Update 2018.

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Note: Titles and terms in red within this report correspond to links provided in the section, “Useful Web Links.”

## Acronyms and Abbreviations

Draft A&E Report	Draft Assumptions and Estimates Report
Action Plan	California Water Action Plan
Basin Study	Central Valley Basin Study
BDO	Bay Delta Office
BMP	best management practice
C2VSim	California Central Valley Groundwater-Surface Water Simulation Model
CAWU	California Agricultural Water Use
CCTAC	Climate Change Technical Advisory Committee
Central Coast region	Central Coast Hydrologic Region
DWR	California Department of Water Resources
Framework	Water Management Effectiveness Framework
GSA	groundwater sustainability agency
Interim Update 2016	Bulletin 118 Interim Update 2016
IWFM	Integrated Water Flow Model
LOCA	Localized Constructed Analogues
PA	planning area
Policy AC	Policy Advisory Committee
PWSS	Public Water System Statistics
QA/QC	quality assurance/quality control
RCP	Representative Concentration Pathway
Reclamation	U.S. Bureau of Reclamation
Regional Atlas	California Regional Water Management Atlas
RMS	resource management strategy

RO	Region Office
SASC	State Agency Steering Committee
SGMA	Sustainable Groundwater Management Act
State Water Board	State Water Resources Control Board
Strategic Data Framework	Strategic Vision and Framework for IWM Data and Tools
Tribal AC	Tribal Advisory Committee
Tulare Lake region	Tulare Lake Hydrologic Region
Update 2018	California Water Plan Update 2018
WaDE	Data Integration and Implementation of Water Data Exchange
Water Code	California Water Code
Water Plan	California Water Plan
WBFP	Water Budget Framework Project
WEAP	Water Evaluation and Planning
WY	Water Year



# California Water Plan Update 2018

## DRAFT Assumptions and Estimates

### Introduction

The **California Water Plan** (Water Plan) is the State government’s strategic plan for sustainably managing and developing water resources statewide for current and future generations. The Water Plan development process provides a planning framework for elected officials, agencies, tribes, water and resource managers, businesses, academia, stakeholders, and the public to collaborate on findings and recommendations and make informed decisions regarding California’s water future. The goal for each update of the Water Plan is to receive broad input and support from Californians, meet **California Water Code (Water Code) requirements**, guide State investments, and advance integrated water management and regional sustainability.

This draft report and the related data posted online comprise the *Draft Assumptions and Estimates Report* (Draft A&E Report) for *California Water Plan Update 2018* (Update 2018). The Draft A&E Report presents key assumptions and estimates, data and data sources, and companion plans that will be considered for the preparation of Update 2018. The report increases the transparency of the Water Plan process by disclosing the data, tools, methods, and references used to prepare Update 2018. This report meets Water Code requirements, which stipulate that the California Department of Water Resources (DWR) must publish the Water Plan’s assumptions and estimates one year prior to the plan’s publication, as well as provide an opportunity for public review and comment. Water code requirements for the Draft A&E Report are presented below.

The Draft A&E Report also describes the approach DWR is taking to improve the analytical tools and data being used to develop Update 2018. DWR will continue to update Draft A&E Report content online during the remainder of the Update 2018 development process. A **draft glossary for Update 2018** is included as part of this report, and the final version of that glossary will be published as a component of Update 2018. The final data and data sources will be included in the Update 2018 reference and technical information.

### Update 2018 Builds on the Legacy of Update 2013

For Update 2018, sustainability is envisioned not as an end point, but as an ongoing, resilient, and dynamic balance among four societal values: (1) public health and safety, (2) a healthy economy, (3) ecosystem vitality, and (4) opportunities for enriching experiences. This understanding of sustainability will help guide the efforts necessary for effective integrated water management (IWM) and integrated regional water management (IRWM). Both IWM and IRWM, fostered in *California Water Plan Update 2013* (Update 2013), deliver on the Governor’s *California Water Action Plan* (Water Action Plan) and the landmark *Sustainable Groundwater Management Act* (SGMA). They also advance regional sustainability planning. In these ways, Update 2018 makes a leap in form and content from the foundation established in Update 2013 and in previous updates.

### California Water Action Plan

The Water Action Plan underscores the need to respond to changing conditions and establishes three goals: (1) achieving “more reliable water supplies”; (2) restoring “important species and habitat”; and (3) ensuring “a more resilient, sustainably managed water resources system (water supply, water quality, flood protection,

and environment) that can better withstand inevitable and unforeseen pressures in the coming decades” (California Natural Resources Agency et al. 2016).

### **Sustainable Groundwater Management Act**

SGMA, passed in 2014, requires water- and land-use agencies to come together in governance and develop plans to sustainably manage groundwater — in the context of overall regional water sustainability. The success of SGMA lies primarily with the regional agencies’ effective governance and their ability to balance regional supplies and demands in a more sustainable way. DWR is responsible for implementing SGMA, with the State Water Resources Control Board (State Water Board) intervening when regions are unable to achieve sustainability.

### **Regional Sustainability Planning**

The Water Plan provides a statewide water perspective and describes how various areas of California have specific challenges related to water planning. A regional planning process, which focuses on regional sustainability outcomes, is needed to achieve the statewide sustainability outcomes. For this reason, Update 2018 will be informed by the companion plan *Managing for Regional Sustainability* to provide the regional perspective in developing State-level policy recommendations and priority actions.

Update 2018 will also draw on *Stakeholder Perspectives — Recommendations for Sustaining and Strengthening Integrated Regional Water Management*, to be released by DWR in April, 2017. This report describes a comprehensive set of actions recommended by stakeholders for sustaining and strengthening the practice of IRWM in California. The report is based on extensive stakeholder input received during two intensive rounds of facilitated workshops throughout the state, an assessment of IRWM planning and implementation projects, and interviews with water managers and other experts from multiple State and local organizations. The development of the report was guided by a stakeholder focus group consisting of IRWM practitioners and representatives of California Native American Tribes, disadvantaged communities, and water management associations.

### **Water Management Effectiveness Framework**

Update 2018 is being developed using an integrated set of tools that increases the effectiveness of IWM and IRWM and moves California toward a more sustainable future. The *Water Management Effectiveness Framework* (Framework) is built on shared intent, or *intended outcomes*, of future water management actions and policies. The Framework also recommends priorities for near-term State actions and investments. Effective water management is achieved and sustained by establishing clearly defined, specific outcomes and the proper metrics, or *sustainability indicators*, to track progress toward sustainability.

An important component of effective water management is identification of sustainable funding methods that lead to more stable revenues. In preparing Update 2018, water resource managers, policy-makers, stakeholders, and the public will be apprised of key State initiatives. The initiatives are incorporated into five-year policy recommendations and priority actions, potential funding mechanisms/scenarios, and an accompanying funding plan. An implementation plan will tie funding, actions, and schedule together with implementing entities and performance measures — an innovative approach that builds on the *Finance Planning Framework* and the *Roadmap for Action* of Update 2013.

The Framework is based on four overarching societal values, as well as sustainability indicators and related assessments, which are required to make steady progress toward water sustainability. A legacy set of guiding

principles from Update 2013 is reaffirmed in Update 2018, which help guide the balancing of the societal values when trade-offs are required to achieve outcomes.

The success of the Framework goes hand in hand with planning and implementing actions at appropriate geographic scales. Given the complexity within the flood and water management system and related natural resources, and the fact that many agencies and organizations are responsible for various aspects of resource management, DWR's 2016 *Strategic Business Plan* proposes conducting water management planning and implementation at the watershed (river basin and groundwater basin) scale. This ensures that the interdependent conditions and functions within a watershed — including the physical, biological, economic, and social processes — are understood and considered in an integrated manner.

## California Water Code Requirements

State law (Water Code Section 10004.6) requires DWR to release this preliminary draft of the assumptions and estimates upon which Update 2018 will be based, to interested persons and entities throughout the state for their review and written or oral comments. DWR will closely consider the comments when adopting the final assumptions and estimates for Update 2018. (See the inside front cover for guidance regarding how to submit comments.)

## Major Categories of Information Required by the Water Code

The Water Code requires the following major categories of information:

- Basin hydrology.
- Current and projected water use.
- Groundwater supplies.
- Evapotranspiration rates for major crops.
- Current and projected water supplies provided by water recycling and reuse.
- Current and projected adoption of urban and agricultural water conservation practices.
- Environmental water needs.
- Current and projected land-use patterns.
- Current and projected population.

See detailed information about *Water Code requirements* on DWR's A&E report web page.

## Assumptions and Estimates

This section contains and briefly describes the primary assumptions and estimates of Update 2018, organized according to the technical components below. Details of these components will be provided in the Update 2018 reference and technical information, which will support Update 2018 findings and recommendations.

## Water Management Effectiveness Analysis and Sustainability Outlook

For Update 2018, the Water Plan Team will perform six activities to develop and implement the Framework.

1. **Define sustainability outcomes (level 4) in terms of the four societal values and identify sustainability indicators.** These societal values (Public Health & Safety, Healthy Economy, Ecosystem Vitality, and Enriching Experiences) and the associated intended outcomes, were presented to the State Agency Steering Committee (SASC), Policy Advisory Committee (Policy AC), and Tribal Advisory Committee (Tribal AC) in a series of meetings and webinars and

are summarized in the *California Water Sustainability Brochure*. The Water Plan Team also is identifying indicators for tracking sustainability outcomes.

2. **Develop a Water Management Effectiveness Assessment Survey.** Consistent with level 4 indices, the Water Plan Team has developed survey questions for a Water Management Effectiveness Assessment to evaluate the effectiveness of current water programs and projects at achieving the level 4 outcomes statewide.
3. **Prepare a Water Sustainability Outlook.** Using the survey results and professional judgment, the Water Plan Team will prepare a draft Sustainability Outlook — a narrative and graphical representation of the current status, trends, and gaps for each of the level 4 outcomes.
4. **Identify Resource and Societal Benefits (level 3) and associated indices.** The Water Plan Team will identify level 3 outcomes for each level 4 outcome and its corresponding indices. Indices (indicators) will be used to track and compare actual versus intended outcomes. These indices could be used to assess measurable changes in natural resource conditions and benefits to society.
5. **Develop recommendations to overcome gaps and implementation challenges.** Gaps and implementation challenges that are identified from the Water Management Effectiveness Assessment will inform water policy recommendations, including strategies to align and improve water governance, finance, and regulations.
6. **Present assessment results and draft recommendations.** The Water Plan Team will present early assessment results and preliminary work on the recommendations to the SASC, Policy AC, Tribal AC, and interested members of the public, in preparation for the Update 2018 engagement meetings in early 2017.

## Groundwater Information and SGMA Activities

As required in Water Code Section 10004.6(c)(2), the Water Plan provides the public with information on groundwater supplies. The SGMA effort will include estimates of sustainable yield and supplies necessary for recovery of critically overdrafted basins beginning in 2020 and remaining high- and medium-priority basins beginning in 2022.

DWR is developing a set of statewide data and tools to assist groundwater sustainability agencies (GSAs) to assess water conditions and take appropriate actions toward sustainability. This includes tools for local agencies to report information associated with basin boundary modifications, GSA formation, adjudicated basin water supplies and uses, alternative plans, and groundwater sustainability plans. DWR will provide statewide data sets on groundwater levels, groundwater quality, well completion reports, land use, land subsidence, and water use. All of this information will be available to the public.

*California's Groundwater Update 2013: A Compilation of Enhanced Content for California Water Plan Update 2013* provides a comprehensive characterization of groundwater conditions and governance in each hydrologic region. This update, with SGMA activities, provides a current view of the issues and potential actions/activities that can be undertaken to address regional groundwater challenges.

Update 2013 included more enhanced groundwater content than did previous Water Plans. The related effort was not intended to solve or address all the statewide and regional issues related to groundwater. It was intended as a starting point to bring all the available information together from a statewide and regional perspective.

*Communities That Rely on Contaminated Groundwater Source for Drinking Water*, published by the State Water Board in 2013, identifies the principal contaminants in the groundwater relied on by the affected communities. The report discusses contamination levels, potential solutions, and funding sources to clean up or treat groundwater or to provide alternative water supplies to ensure the provision of safe drinking water to affected communities. The Groundwater Sustainability Program was established by Proposition 1 to prevent and clean up contamination of groundwater and supplies lost to pollution and to help local agencies develop their GSPs.

SGMA significantly expands DWR’s roles and responsibilities related to groundwater management. Essential information and companion plans developed to implement SGMA, and which will support the Draft A&E Report, are described below.

The *Sustainable Groundwater Management Program Draft Strategic Plan* describes DWR’s vision, as well as roles and responsibilities to help implement SGMA. The draft plan outlines actions DWR will undertake over the next several years to develop capacity that will better support local agencies across California in their efforts to achieve sustainable groundwater management.

*Bulletin 118 Interim Update 2016* (Interim Update 2016) discusses critically overdrafted groundwater basins and basin boundaries. An addendum to Interim Update 2016, which is expected to be released in 2017, will include updated basin prioritizations. A comprehensive update of Bulletin 118 will be published in 2020.

DWR has released a set of five documents under the title *Best Management Practices for the Sustainable Management of Groundwater*, which, along with other guidance documents, will inform Update 2018. In this context, “best management practice” (BMP) refers to a practice, or combination of practices, designed to achieve sustainable groundwater management. These BMPs, determined to be technologically and economically effective and practicable, are based on best available science. The BMP categories are:

- **BMP 1: Monitoring Protocols, Standards, and Sites.**
- **BMP 2: Monitoring Networks and Identification of Data Gaps.**
- **BMP 3: Hydrogeologic Conceptual Model.**
- **BMP 4: Water Budget.**
- **BMP 5: Modeling.**

Guidance documents are prepared for topic areas unique to SGMA, for topics where no established practices in the water management industry exist and which may not have been specifically identified in the GSP regulations. The guidance documents currently include:

- **Preparation Checklist for GSP Submittal.**
- **GSP Annotated Outline.**

The *Draft Water Available for Replenishment Report*, published in January, 2017, presents DWR’s best estimate, based on available information, of water available for replenishment of groundwater in the state, consistent with Water Code Section 10729(c).

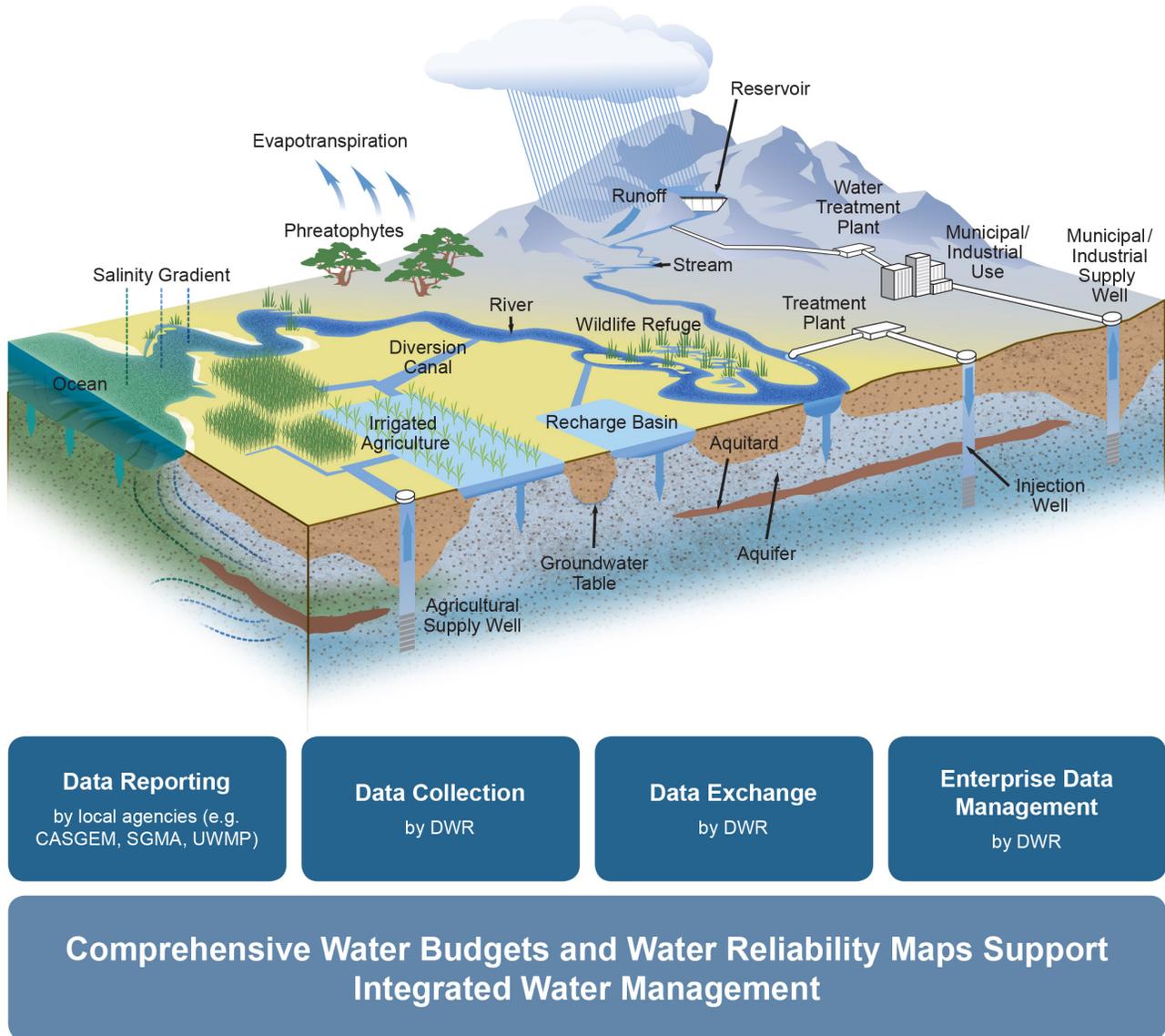
## **Strategic Data Framework**

DWR’s Strategic Vision and Framework for IWM Data and Tools (Strategic Data Framework) is founded on an overarching strategic vision.

“DWR’s water information is organized and integrated such that it is universally accessible and supports watershed-based water budgets for IWM.”

As shown in Figure 1, the Strategic Data Framework includes robust data collection by DWR, transparent data reporting to DWR by local agencies, and enterprise data management and exchange. It documents the associated vision and objectives. It also includes actions that DWR’s Division of Integrated Water Management and Division of Statewide Integrated Water Management can take to implement the Strategic Data Framework. The resulting data, analysis, and tools will help support and track progress toward the ultimate outcome of sustainable water management as articulated in the Water Action Plan and SGMA.

**Figure 1 Strategic Data Framework**



Water budgets and related data collection, reporting, management, and exchange are crucial to the successful implementation of many DWR programs. The Strategic Data Framework aims to connect DWR programs to support achieving the sustainable water management goals of the Water Action Plan and SGMA.

Collaboration and alignment with other federal, State, and local agencies that collect and share data will be essential to the implementation and refinement of the Strategic Data Framework. In summary, the Strategic Data Framework:

- Describes the current conditions for data, tools, and water budget methods used by Division of Integrated Regional Water Management and Division of Statewide Integrated Water Management.
- Summarizes legislation and other drivers, including the Water Action Plan and SGMA.
- Describes key outputs and outcomes that will result from implementing the Strategic Data Framework.
- Defines vision, objectives, and actions included in the Strategic Data Framework to support the implementation of SGMA and the Water Action Plan.
- Identifies the cross-cutting actions, such as standards and protocols, communication and outreach, and long-term funding, for implementing the Strategic Data Framework.

Visions for the four organizing elements of the Strategic Data Framework — data collection, data reporting, data management and exchange, and water budget methods — and their associated objectives and actions were developed through input and validation from DWR staff. A phased implementation timeline of the actions was also developed. Those actions support the key outcomes of sustainable water management.

## **Water Budgets**

DWR has developed the Water Budget Framework, which builds on the Water Plan’s water budget methodology, to implement the vision for water budget methods developed by DWR staff in 2016: “DWR has a defensible method for estimating watershed-based water budgets that allows for flexible spatial and temporal scales; can be utilized by GSAs and local agencies; and leads toward consistent water budgets developed by local, State, and federal agencies, and tribal entities” (California Department of Water Resources 2016).

The Water Budget Framework is developed for the overlying watersheds of groundwater basins and administrative boundaries, such as GSAs, detailed analysis units (DAUs)/counties, and planning areas (PAs) in California. It is a collaborative effort by DWR staff from various programs and offices, including the Water Plan, Sustainable Groundwater Management Program, Bay Delta Office, and Region Offices. The Water Budget Framework will support implementation of SGMA and the transition of the Water Plan’s water supply and balance computations to watershed-based water budget methods. The Water Budget Framework has the following goals:

- Identify inconsistencies in water budget terms and methods used by DWR programs, and make recommendations to resolve these inconsistencies so all DWR water budget terms and methods will align with the GSP regulations.
- Identify a process to improve the Water Portfolio Method used in the Water Plan for estimating water budgets at appropriate spatial and temporal scales relevant to SGMA and future Water Plan updates.
- Develop recommendations on how Region Office staff can best coordinate with and provide technical assistance to local GSAs regarding water budget requirements. Region Office staff should expand knowledge of how existing local water-budget data and information can be utilized to develop preliminary water budgets by groundwater basins.
- Develop a generalized water budget framework for use by DWR, GSAs, and the local agencies to develop total water budgets at different spatial and temporal scales.

Water budget framework development includes two pilot studies: (1) Tulare Lake Hydrologic Region (Tulare Lake region) Pilot and (2) Central Coast Hydrologic Region (Central Coast region) Pilot. The pilot studies will be completed in two phases.

1. Phase I focuses on evaluating the current state of water budget data and methods and developing a consistent water budget method, with a common vocabulary, by using the Tulare Lake region as a test case.
2. Phase II focuses on refining the Tulare Lake region pilot, testing the consistent water budget method on the Central Coast region, and refining the Water Budget Framework for use in other hydrologic regions of California.

The results of Phase I will be included in Update 2018.

**Evaluated Models and Data**

The models and tools listed in Table 1 were evaluated to inform water budget framework development.

**Table 1 Models Evaluated for Developing the Water Budget Framework**

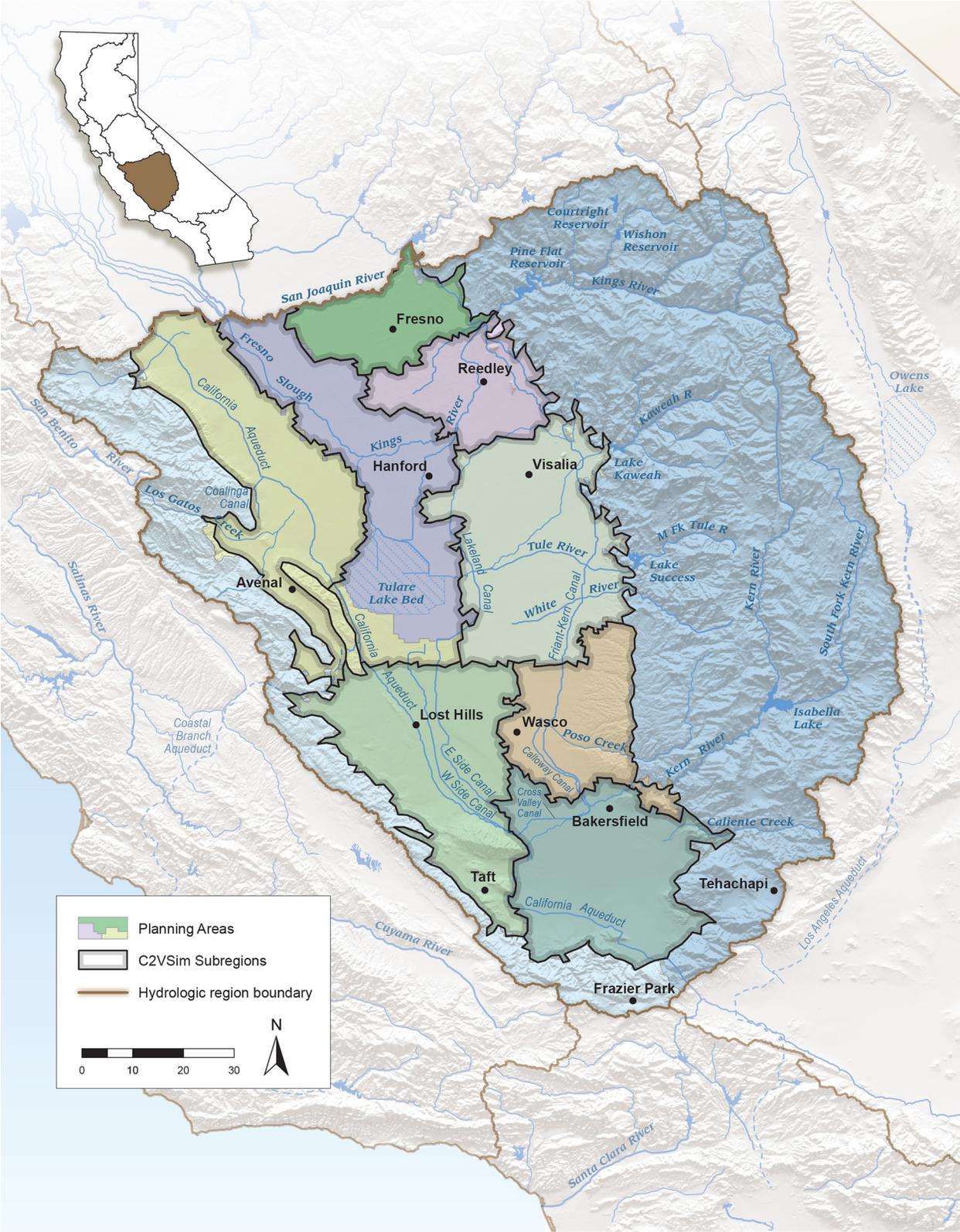
Name	Description	Source
IWFM	IWFM (Integrated Water Flow Model) is a water resources management and planning model that simulates groundwater, surface water, stream-groundwater interaction, and other components of the hydrologic system.	DWR
C2VSim	The California Central Valley Groundwater-Surface Water Simulation Model (C2VSim) is an IWFM integrated numerical model that simulates water movement through the linked land surface, groundwater and surface water flow systems in California’s Central Valley.	DWR
Water portfolio	Developed as part of the Water Plan, the water portfolio paints a picture of the water supply and use for a given year statewide or by region, subject to availability of data. It includes a flow diagram and table, a developed water supply and use balances, and a summary table. Data are developed for DAU/County subareas, PA, and hydrologic regions.	DWR
Cal-SIMETAW	The Cal-SIMETAW model estimates the daily soil water balance to determine crop evapotranspiration for use in the Water Plan. The model requires weather data, soils, crop coefficients, rooting depths, seepage, etc., which influence crop water balance.	DWR
CAWU	The California Agricultural Water Use (CAWU) Model uses monthly reference evaporation or evapotranspiration, crop coefficient, crop irrigation data to simulate monthly volumes of on-farm crop consumptive use and applied water for 20 crop categories by DAU/County for the Water Plan.	DWR

Notes:

C2VSim = California Central Valley Groundwater-Surface Water Simulation Model, CAWU = California Agricultural Water Use, DAU = detailed analysis unit, IWFM = Integrated Water Flow Model, PA = planning area, Water Plan = California Water Plan

The California Central Valley Groundwater-Surface Water Simulation Model (C2VSim) model covers Central Valley’s groundwater basins extending from Redding to Bakersfield, including the valley floor within the Tulare Lake region. The C2VSim model area is divided into 21 model subregions, eight of which are within the Tulare Lake region. The C2VSim water budget outputs are generated by model subregions. Figure 2 shows a close relationship between the C2VSim model subregions and the Water Portfolio PA, thus facilitating water budget comparisons and assessments. Data in the C2VSim model come from multiple sources, including the Water Plan, reported numbers, and historic calibrations by the Bay Delta Office.

Figure 2 Water Plan Water Portfolio Planning Areas and C2VSim Model Subregions



## **Data Mapping Between C2VSim and Water Plan Water Portfolio**

During development of the Strategic Data Framework, the data elements for water budget components used by DWR programs were identified through a series of workshops that included input from about 60 DWR staff. This effort concluded that the Bay Delta Office (developers of the Integrated Water Flow Model [IWF] and C2VSim) and the Water Plan (developers of the Water Portfolio Method) are the two programs that include all relevant water budget terms.

A work team of representatives from the Water Plan and the Bay Delta Office examined the water budget components of water portfolios and IWF/C2VSim to develop mapping and transformation formulas between the water budget components of each method. This effort focused on water budget component and data parameter similarities and differences to develop recommendations for necessary components of a total water budget framework.

Water portfolios provide a detailed annual assessment of developed water supplies and uses for three sectors: agricultural, urban, and environmental. C2VSim extends the concepts used in water portfolios by adding exchanges and interactions among water subsystems on a monthly time scale. It does this by generating four water budgets for user-defined model subregions.

1. Land and Water Use Budget.
2. Root Zone Budget.
3. Groundwater Budget.
4. Stream Budget.

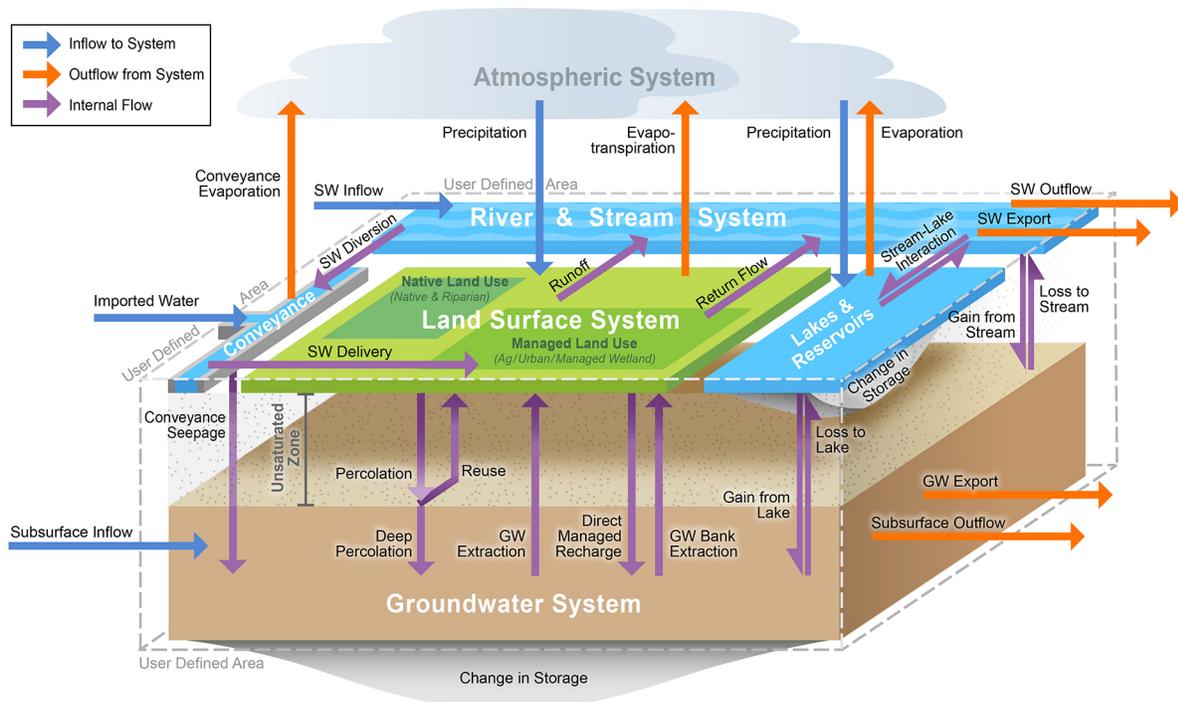
These four water budgets comprise the total water budget for the watershed and underlying groundwater basins.

To correlate between the two methods, data mapping between C2VSim and water portfolios was conducted for the four water budgets from C2VSim. This process identified inconsistencies in the definitions of the water-budget-related terms and how they are used in C2VSim and water portfolios. In addition, the data requirements and output needed for water portfolios formed the basis for several recommendations to enhance the IWF.

## **Common Schematic and Vocabulary for the Water Budget Framework**

The inconsistencies and incompleteness of definitions for water-budget-related terms in both C2VSim and water portfolios are addressed by creating the total water-budget system schematic shown in Figure 3, to depict interrelationships among different components of the total water budget.

**Figure 3 Total Water Budget Schematic**



**Water Budget Dashboards**

Graphical and map-based visualization dashboards are implemented for communicating water budget data and information to stakeholders. Water budget dashboards offer a visual representation of water budget components to enhance understanding of the physical processes in a watershed and underlying groundwater basins. It also allows the flexibility to visualize important water budget components in an interactive manner and develop shared understanding. Water budget data from future scenario analysis by both DWR and GSAs can also be visualized in such dashboards, and used by GSAs for planning purposes.

**Water Portfolios**

The Water Plan presents information about recent statewide and regional water conditions through water portfolios and water balances. Water portfolios and balances describe the distribution of water throughout the hydrologic cycle, water use by the urban and agricultural sectors, water in the environment, and water supply sources used to meet these uses. A primary reason for water portfolio and balance data is to estimate an accounting of all water that enters and leaves the state and how it is used in and exchanged between the regions. This information is foundational for all water planning activities, including IRWM. The information also will assist regions with developing and pursuing relevant and achievable water management objectives.

Water portfolio data support programs and agencies responsible for performing water analysis and planning, and disseminating water-related information. Water portfolios provide detailed information about statewide water supply sources and estimates for the primary uses of the state’s supplies. Water portfolios and balances are developed by DAU/Counties and aggregated to PA, hydrologic region, and statewide summaries. Maps of these areas are available on DWR’s [GIS and Maps](#) web page.

Update 2018 will include information for Water Years (WYs) 1998–2015, expanding Update 2013’s water portfolio information by five water years. The five-year period of WYs 2011–2015 began with a wet year, then became dry, and then critical, based on the eight-river index, with a drought declared during WY 2014. Water portfolio data provide information for comparison about how water uses and sources of supply can vary among wet, average, and dry hydrologic conditions for each of the hydrologic regions. Water portfolio data will be presented in Update 2018 reference and technical information. The following major categories of water portfolio content are included in the Water Plan:

- Local deliveries.
- Residential interior and exterior water use.
- Large landscape water use.
- Local imported deliveries.
- Commercial and industrial water use.
- Reuse of water.
- Colorado River deliveries.
- Large landscape water use.
- Recycled water.
- Central Valley Project deliveries.
- Evaporation and evapotranspiration of applied water for agriculture.
- Evaporation and evapotranspiration of applied water for managed wetlands.
- Other federal deliveries.
- Groundwater recharge of applied water.
- Required instream flow.
- State Water Project deliveries.
- Deep percolation to a salt sink.
- Required Sacramento-San Joaquin River Delta outflow.
- Groundwater extraction.
- Conveyance system irrecoverable water.
- Wild and Scenic River flows.

For Update 2018 and beyond, water supply and use teams are working on pilot projects related to water portfolio data and technological improvements. For WY 2014, land use and irrigated acres information derived by means of remote sensing will be compared with existing land-use survey data for agricultural water-use analysis. Staff continues to improve the agricultural water-use model, Cal-SIMETAW, with updated and improved input data, including crop coefficients. A recycled water sub-group has been formed and is collaborating regularly with the State Water Board to incorporate more current municipal recycled water data and information to the water portfolios by using the 2015 Recycled Water Use Survey.

A pilot project is also underway for urban water-use analysis. Because of increased State Water Board requirements beginning in WY 2013, public water system (reported) data has increased substantially. A more automated process is being implemented for WY 2014 urban per-capita water use analysis, which uses Python scripting to dynamically access public water system data straight from a database instead of extracting data in spreadsheets. This process allows for quality assurance/quality control (QA/QC) directly in the database, as well as linking the system service areas directly to the Public Water System Statistics (PWSS) data in a geo-database.

A database development pilot project is underway for WY 2010 water portfolio inflow-outflow data entry worksheets. DWR is working in partnership with the Western States Water Council and the U.S.

Environmental Protection Agency on the Data Integration and Implementation of Water Data Exchange (WaDE) Dataflow project, which provides a platform for additional coordination and shared meaning in conjunction with California’s priorities, U.S. Geological Survey (Water Availability and Use Science Program), and the SECURE Water Act (Section 9508, Public Law 111-11). This DWR database pilot project, in collaboration with the San Diego Supercomputer Center, uses the PostgreSQL database management system and the WaDE database schema.

The WY 2010 data currently are served publicly through the WaDE database, using an API (application programming interface) as well as web-services for integration with contemporary geographic information systems. Integration with other databases will depend on the semantics of each database, but PostgreSQL has export/import capabilities that facilitate a high degree of interoperability with other systems. There are no current plans for integration with other databases, though that could be a natural extension of this work and part of the Strategic Data Framework and the Water Budget Framework. Database advancements will lead to more efficient and effective data exchange; QA/QC; and querying and reporting of data, including data reporting/translation at numerous spatial scales. The Strategic Data Framework includes having DWR’s water information organized and integrated such that it is universally accessible and supports watershed-based water budgets for IWM. These advances will also help implementation of Assembly Bill 1755 — Open Data Platform.

Visit DWR’s [Water Portfolio](#) web page for more information and data about water portfolios and water balances. Detailed information for WYs 1998–2010 is available in the [Update 2013 Technical Guide](#). Data for WYs 1998–2015 will be available in Update 2018 reference and technical information.

## Climate Change

The climate change analysis for Update 2018 consists of developing climate data inputs (monthly temperature, precipitation, and wind speed) for 20 new climate scenarios to be run using the Water Evaluation and Planning (WEAP) PA model for California’s Central Valley, as well as a hydrologic region model for seven non-Central Valley hydrologic regions. These 20 climate scenarios were recommended by DWR’s Climate Change Technical Advisory Committee (CCTAC). Ten global climate models have been selected that best simulate climate conditions important for California water management and planning. Each of the 10 models is run with two greenhouse gas forcing scenarios or Representative Concentration Pathways (RCPs), one representing an optimistic future in which large-scale greenhouse gas mitigation efforts are implemented (RCP 4.5) and one business-as-usual future (RCP 8.5).

Climate scenarios use the newest statistical downscaling methodology, Localized Constructed Analogues (LOCA), which has been endorsed for use by the California 4th Climate Change Assessment. Climate scenarios provide monthly time-series information for the years 1950–2099. The 20 projections explore a range of temperature change by late-century (2070) conditions of 3.1 to 9.2 degrees Fahrenheit and precipitation change from a decrease of 13.9 percent to an increase of 36.7 percent throughout the Central Valley.

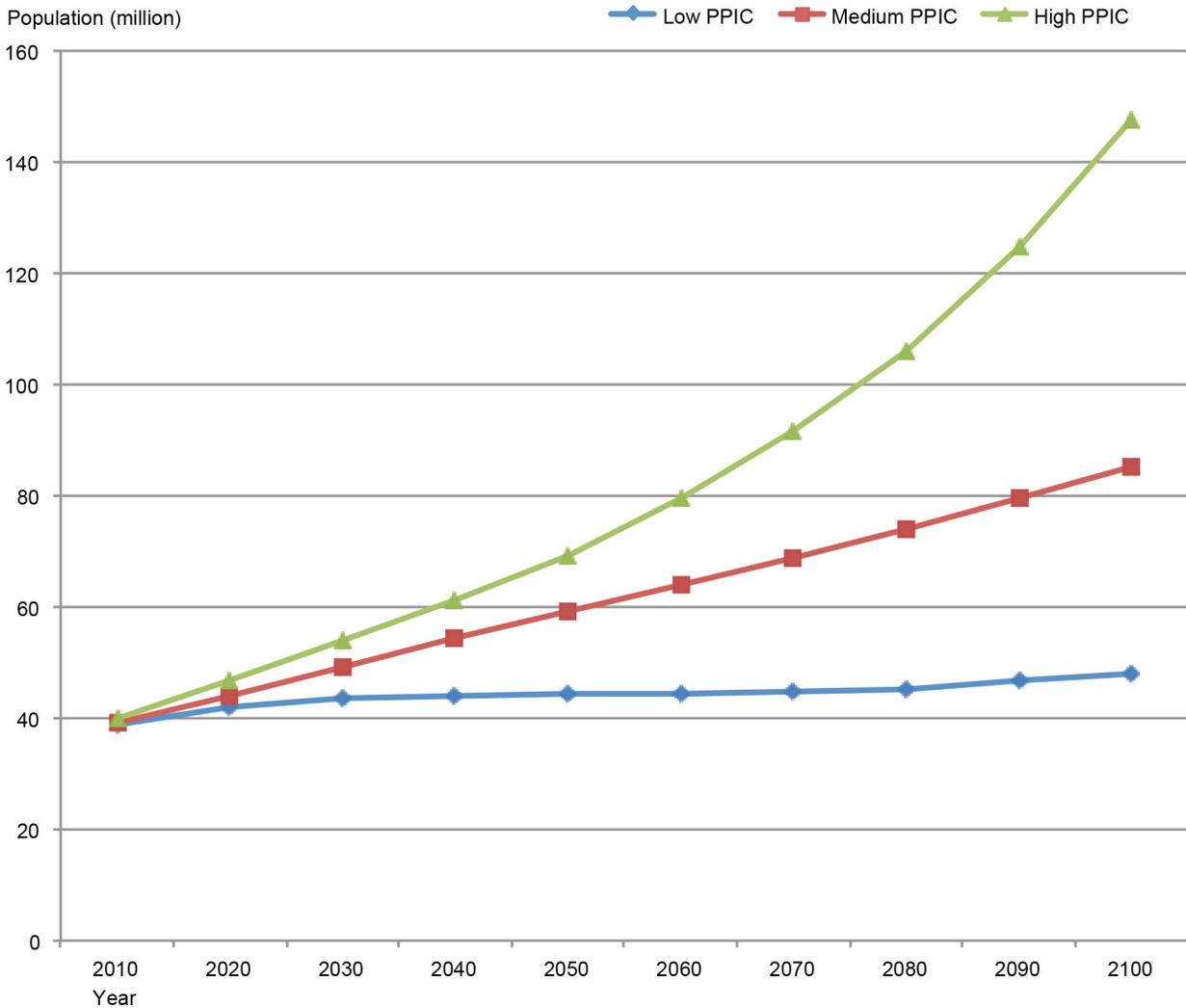
## Future Scenarios

In previous Water Plan updates, most of the future water supply and demand scenarios were limited to mid-century projections (2050). In Update 2018, the plan is to extend the projections to the end of the century (2100). The future water conditions will be evaluated under multiple scenarios of future demographics, land use, and new updated climate projections. The new climate scenarios, as explained above

in the “Climate Change” section, will be based on the results of 10 Global Circulation Models driven by two RCP greenhouse gas radiative-forcing scenarios: 4.5 W/m<sup>2</sup> and 8.5 W/m<sup>2</sup>. The resulting 20 future climate scenarios include a range of future temperature and precipitation conditions.

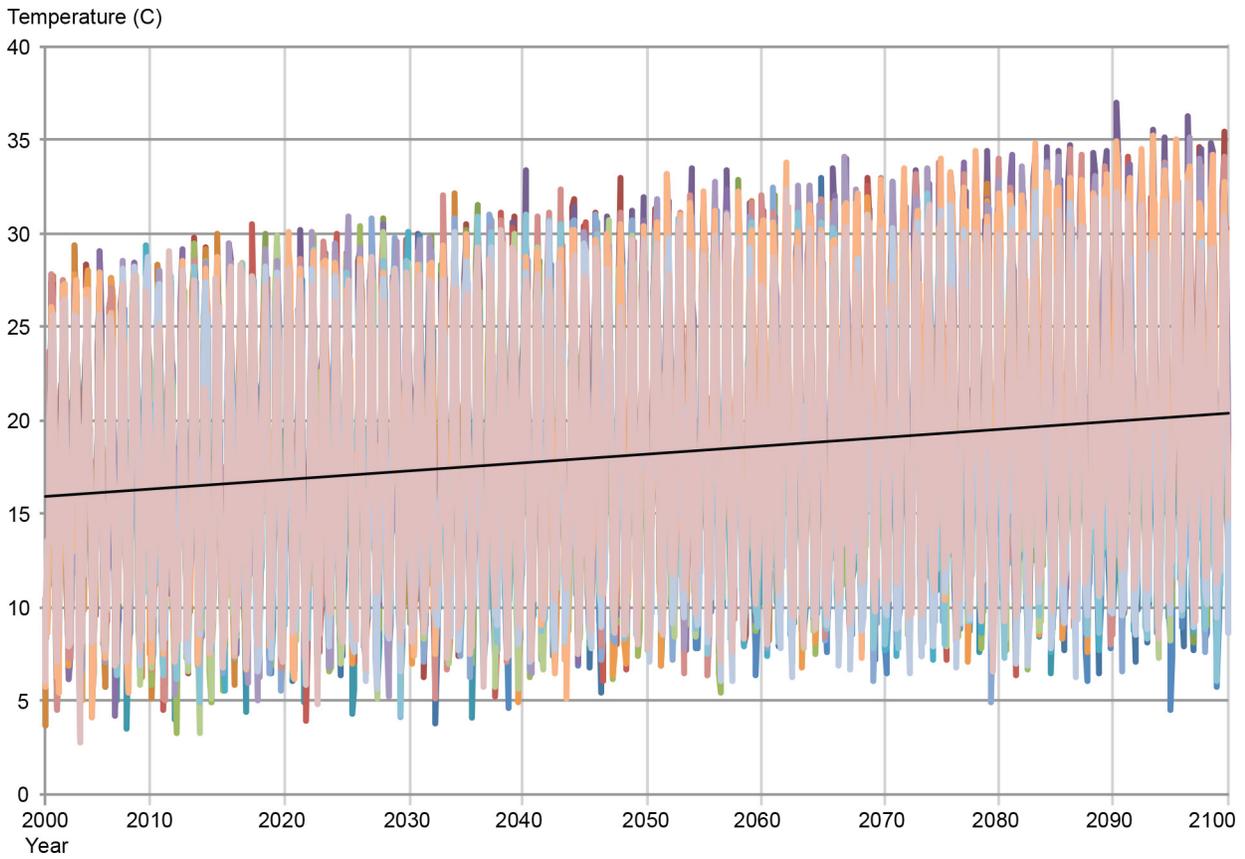
The urban population growth and land use scenarios in Central Valley will be based on the Central Valley Basin Study (Basin Study) conducted by U.S. Bureau of Reclamation (Reclamation). Figure 4 shows long-term future statewide population projections under three Public Policy Institute of California scenarios — low, medium, and high — from the years 2010 to 2100.

**Figure 4 Statewide Future Population Projections (2010–2100)**

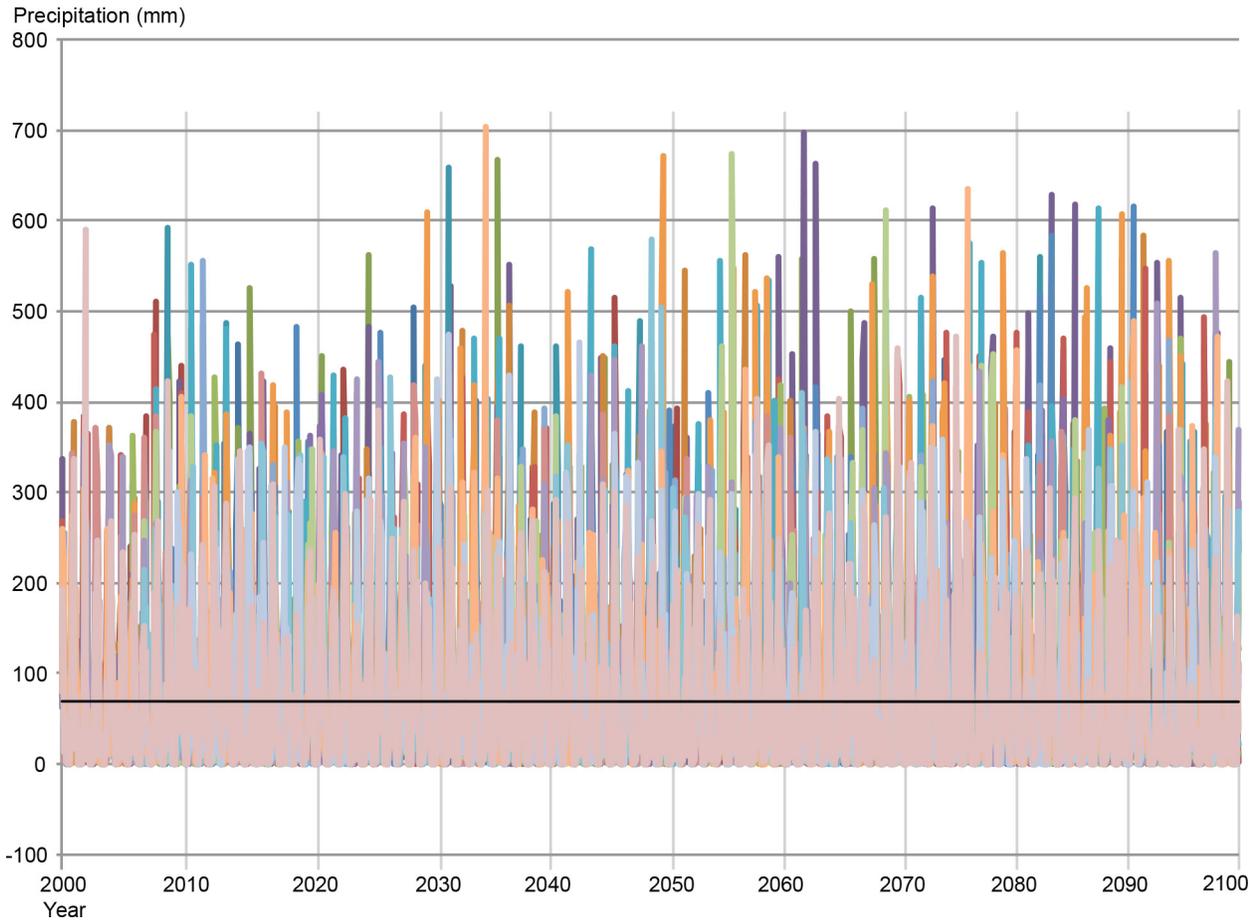


Figures 5 and 6 show long-term time series (2000–2100) and ranges of future temperature and precipitation variations for the 20 climate scenarios in a sample location within the Sacramento River Hydrologic Region.

**Figure 5 Future Temperature Projections for the Sacramento River Hydrologic Region (2000–2100)**



**Figure 6 Future Precipitation Projections for the Sacramento River Hydrologic Region (2000–2100)**



In Update 2013, several management response packages were evaluated for a range of future water supply and demand conditions by using robust decision-making for Central Valley regions at mid-century (year 2050 level). In Update 2018, an analysis of long-term water supply and demand conditions (year 2100 level), along with statistical occurrences of the demand-not-met (likelihood of unmet demand), will be performed. The analysis for the remaining seven hydrologic regions in California will be at the hydrologic region level and will focus on quantifying long-term projections (2100) of future water demand.

These key activities related to future scenarios:

- Develop long-term scenarios of future climate conditions (precipitations, temperature, etc.), extended to year 2100 for the Central Valley hydrologic regions (Sacramento, San Joaquin, and Tulare Lake) PAs, with advice from DWR’s CCTAC.
- Develop long-term scenarios (year 2100) of future urban growth and land use in Central Valley PAs, based on Reclamation’s Basin Study.
- Quantify future water supply and demand conditions and statistical occurrences of potential unmet demands for the Central Valley PAs under the 20 future climate and five urban growth and land use scenarios.

This additional analysis may also be conducted:

- Develop similar long-term future climate, urban growth, and land use scenarios for the remaining seven hydrologic regions. Quantify long-term future water demand conditions for the seven non-Central Valley hydrologic regions.

## California Regional Water Management Planning

The Update 2013 regional reports provide a comprehensive description of each hydrologic region. The effort was intended as a starting point to bring all of the available information together from a regional perspective. Update 2018 will be informed by this previous work. These regional reports, along with the California Regional Water Management Atlas (Regional Atlas) described below, will provide an up-to-date view of the issues involved, as well as the potential actions/activities that can be performed, to address regional challenges and meet Water Code Section 10013.

Update 2018 will contain a Regional Atlas, as an online information platform for local entities to continuously update information about projects in their representative area. Representative areas can include various governance entities, such as IRWM planning regions, GSA service areas, flood management agencies, and counties/cities. The initial focus will be on developing the platform and receiving content from IRWM planning regions.

The Regional Atlas will also summarize each of the area's unique information on the current water supplies and uses, as well as a discussion of water issues, current and proposed regional water projects, accomplishments, and challenges. In particular, it will include steps that have been taken to improve water supplies to meet municipal, agricultural, and environmental water needs, and to minimize the need to import water from other hydrologic regions and the Delta.

The potential content for each IRWM region includes:

- **Description of the IRWM region.** This section includes a description of the location, regional boundaries, total population, and total area of the region. In addition, it includes their type of governance and a summary their grant program history.
- **Water resource management challenges and objectives.** Descriptions of the biggest challenges of the region and the planning strategy for achieving objectives and goals. This includes water supply, demand, and issues, as well as such issues as water quality, groundwater management, environmental stewardship, climate change, and flood management.
- **IRWM region's demographics.** Descriptions of disadvantaged communities, stakeholders, and California Native American Tribes within the region.

## Resource Management Strategies

The Water Plan provides a broad set of resource management strategies (RMSs) that can help local agencies and governments manage their water and related resources. An RMS can be a technique, program, or policy used to meet water-related management needs of a region and the state as a whole. While recognizing interdependencies among many of the strategies, the Water Plan's 30-plus RMSs provide a comprehensive suite of tools that can be used to achieve a variety of intended outcomes by utilizing a diverse mix of strategies.

Just as the mix of tools in any given kit depends on the job to be accomplished, the combination of strategies will vary from region to region, depending on climate, projected growth, existing water system(s),

environmental and social conditions, and regional goals. At the local level, it is important that the proposed strategies complement the operation of existing water systems. Some strategies may have little value in certain regions. For example, because of geology, the opportunity for groundwater development in the Sierra Nevada is not nearly as significant as in the Sacramento Valley. Other strategies may have little value under particular conditions. For example, precipitation enhancement may not be effective during droughts. Water managers at different geographical scales will have different perspectives on the assortment and cost-effectiveness of RMSs for meeting the needs and priorities of the locality or the region, or the entire state.

In Table 2, the RMSs are organized alphabetically under eight water management objectives, with descriptions of their primary objective and emphasis.

**Table 2 Resource Management Strategies and Management Objectives**

<b>Reduce Water Demand</b>	<b>Improve Water Quality</b>
Agricultural Water Use Efficiency	Drinking Water Treatment and Distribution
Urban Water Use Efficiency	Groundwater/Aquifer Remediation
<b>Improve Operational Efficiency &amp; Transfers</b>	Matching Water Quality to Use
Conveyance — Delta	Pollution Prevention
Conveyance — Regional/Local	Salt and Salinity Management
System Reoperation	Urban Stormwater Runoff Management
Water Transfers	<b>Practice Resource Stewardship</b>
<b>Increase Water Supply</b>	Agricultural Land Stewardship
Conjunctive Management and Groundwater Storage	Ecosystem Restoration
Desalination (Brackish and Sea Water)	Forest Management
Precipitation Enhancement	Land Use Planning and Management
Municipal Recycled Water	Recharge Area Protection
Surface Storage — CALFED	Sediment Management
Surface Storage — Regional/Local	Watershed Management
<b>Improve Flood Management</b>	<b>People &amp; Water</b>
Flood Management	Economic Incentives — Loans, Grants, and Water Pricing
<b>Other Strategies</b>	Outreach and Education
Crop idling, dewvaporation, fog collection, irrigated land retirement, rainfed agriculture, and waterbag transport	Water and Culture
	Water-Dependent Recreation

### Companion State Plans

The Water Plan’s [list of State government plans](#) related to water resources has grown to more than 190. From that list, the featured plans most pertinent to the Water Plan will be identified. As in Update 2013, the featured companion State plans will be used to inform policy recommendations and short- and long-term actions in Update 2018. The Water Plan committees will work collaboratively to develop the key policy recommendations and actions that will be set forth in Update 2018.

### Funding Plan

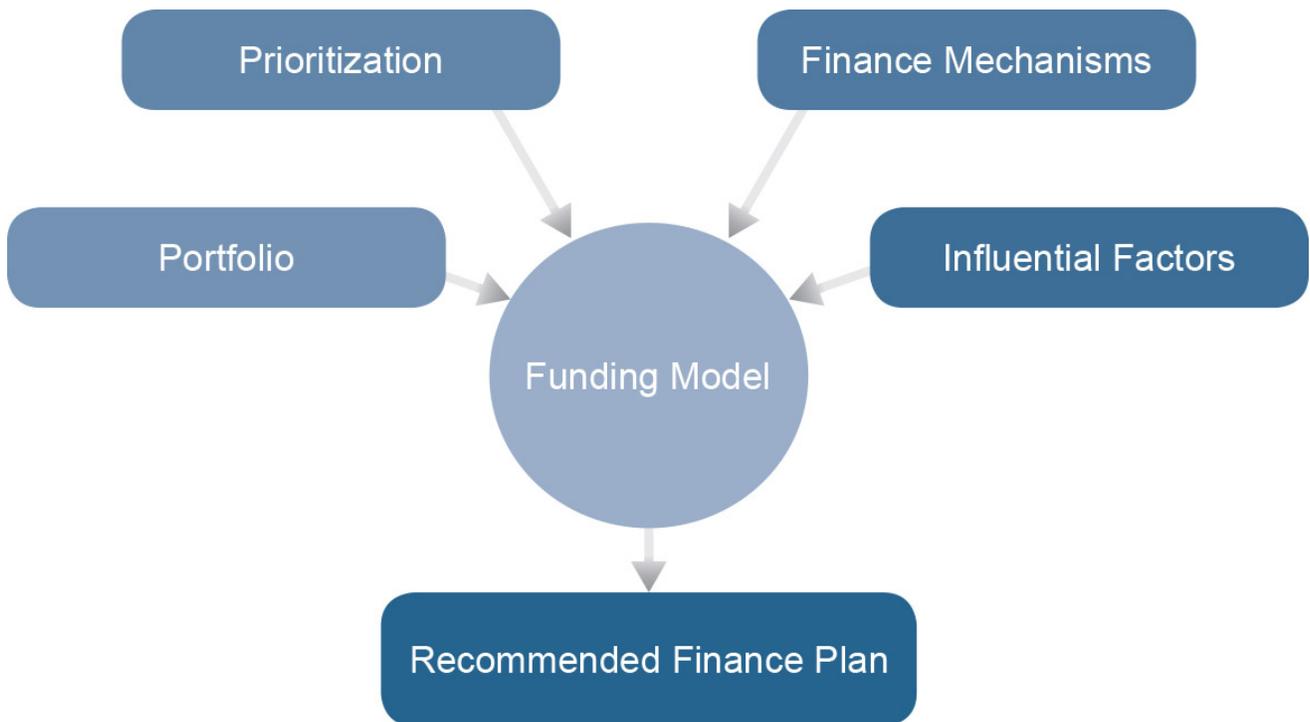
The funding plan will be developed using tools to prioritize near-term investment needs leading to recommended opportunities and options for sustainable funding. The plan will include analysis of potential

funding scenarios on a geographic basis, to prioritize action types (high, medium, or low) based on applicability, reliability, and political viability.

Many uncertainties will affect future water management investments; the financial analysis will consider these uncertainties as constraints. The funding plan explores ways to fund proposed capital and ongoing investments with varied assumptions about these factors: prioritized management types; the availability of existing and new funding mechanisms; and other influencing factors, such as ability to pay or cost-share agreements. The resulting investment portfolio will be organized and presented by thematic area and management action type.

The spreadsheet funding model, shown in Figure 7, will identify the most viable, reliable, and applicable funding mechanisms. The tool maximizes overall funding subject to the constraints for each scenario. Each scenario is based on a different set of assumptions, from a continuation of historical trends to a more optimistic future.

**Figure 7 Development of a Funding Plan**





## Useful Web Links

Best Management Practices for the Sustainable Management of Groundwater (DWR 2016)

<http://www.water.ca.gov/groundwater/sgm/bmps.cfm>

Bulletin 118 Interim Update 2016 (DWR 2017)

[http://www.water.ca.gov/groundwater/bulletin118/docs/Bulletin\\_118\\_Interim\\_Update\\_2016.pdf](http://www.water.ca.gov/groundwater/bulletin118/docs/Bulletin_118_Interim_Update_2016.pdf)

California's Groundwater Update 2013: A Compilation of Enhanced Content for California Water Plan Update 2013 (DWR 2014)

<http://www.water.ca.gov/waterplan/topics/groundwater/index.cfm>

California Water Action Plan

[http://resources.ca.gov/california\\_water\\_action\\_plan/](http://resources.ca.gov/california_water_action_plan/)

California Water Code requirements

<http://www.water.ca.gov/waterplan/technical/waterplancode.cfm>

California Water Plan Update 2013

<http://www.water.ca.gov/waterplan/cwpu2013/final/>

California Water Plan Update 2013 Technical Guide

<http://www.water.ca.gov/waterplan/technical/cwpu2013/index.cfm>

California Water Plan Update 2018

<http://www.water.ca.gov/waterplan/cwp/update2018/index.cfm>

California Water Sustainability Brochure (Water Plan)

[http://www.water.ca.gov/waterplan/docs/cwpu2018/01\\_Update2018\\_Sustainability\\_Brochure\\_Letter.PDF](http://www.water.ca.gov/waterplan/docs/cwpu2018/01_Update2018_Sustainability_Brochure_Letter.PDF)

Communities That Rely on Contaminated Groundwater Source for Drinking Water (State Water Board 2013)

<http://www.waterboards.ca.gov/gama/ab2222/docs/ab2222.pdf>

Draft Assumptions and Estimates Report (Update 2018)

<http://www.water.ca.gov/waterplan/cwp/update2018/ae/>

Draft Glossary for Update 2018

<http://www.water.ca.gov/waterplan/cwp/update2018/ae/>

Draft Water Available for Replenishment Report (DWR 2017)

[http://www.water.ca.gov/groundwater/sgm/pdfs/Draft\\_Water\\_Available\\_For\\_Replenishment\\_Report.pdf](http://www.water.ca.gov/groundwater/sgm/pdfs/Draft_Water_Available_For_Replenishment_Report.pdf)

Draft Water Plan Companion Plan List (Update 2018)

[http://www.water.ca.gov/waterplan/docs/cwpu2018/ae/04\\_Update2018\\_Draft\\_CompanionPlan\\_List.pdf](http://www.water.ca.gov/waterplan/docs/cwpu2018/ae/04_Update2018_Draft_CompanionPlan_List.pdf)

Finance Planning Framework (Update 2013)

[http://www.water.ca.gov/waterplan/docs/cwpu2013/Final/08\\_Vol1\\_Ch07\\_Finance\\_Planning\\_Framework.pdf](http://www.water.ca.gov/waterplan/docs/cwpu2013/Final/08_Vol1_Ch07_Finance_Planning_Framework.pdf)

GIS and Maps (Water Plan)

<http://www.water.ca.gov/waterplan/gis/index.cfm>

Managing for Regional Sustainability (DWR 2017)

Unpublished.

Recommended Actions — Stakeholder Perspectives on Sustaining and Strengthening Integrated Regional Water Management (DWR 2017)

Unpublished.

Road Map for Action (Update 2013)

[http://www.water.ca.gov/waterplan/docs/cwpu2013/Final/09\\_Vol1\\_Ch08\\_Roadmap-For-Action.pdf](http://www.water.ca.gov/waterplan/docs/cwpu2013/Final/09_Vol1_Ch08_Roadmap-For-Action.pdf)

Strategic Business Plan (DWR 2016)

[http://www.water.ca.gov/docs/Strategic%20Business%20Plan\\_Final.pdf](http://www.water.ca.gov/docs/Strategic%20Business%20Plan_Final.pdf)

Sustainable Groundwater Management Act

<http://groundwater.ca.gov/>

Sustainable Groundwater Management Program Draft Strategic Plan

[http://www.water.ca.gov/groundwater/sgm/pdfs/DWR\\_GSP\\_DraftStrategicPlanMarch2015.pdf](http://www.water.ca.gov/groundwater/sgm/pdfs/DWR_GSP_DraftStrategicPlanMarch2015.pdf)

Water Management Effectiveness Framework

[http://www.water.ca.gov/waterplan/docs/cwpu2018/01\\_Update2018\\_WMEF\\_Overview.pdf](http://www.water.ca.gov/waterplan/docs/cwpu2018/01_Update2018_WMEF_Overview.pdf)

Water Portfolios (Water Plan)

[http://www.water.ca.gov/waterplan/topics/water\\_portfolios/index.cfm](http://www.water.ca.gov/waterplan/topics/water_portfolios/index.cfm)

## References

California Department of Water Resources. Unpub. *Water Budget Framework*. Sacramento (CA): California Department of Water Resources. California Natural Resources Agency.

California Natural Resources Agency. 2016. *California Water Action Plan*. Sacramento (CA): California Natural Resources Agency. 25pp. Viewed online at:  
[http://resources.ca.gov/docs/california\\_water\\_action\\_plan/Final\\_California\\_Water\\_Action\\_Plan.pdf](http://resources.ca.gov/docs/california_water_action_plan/Final_California_Water_Action_Plan.pdf).





