Regional Water Reliability Plan

May 2019

Stantec

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Abbreviations

ARBS	American River Basin Study
ASR	aquifer storage and recovery
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
MGD	million gallons per day
M&I	municipal and industrial
RDCP	Regional Drought Contingency Plan
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RWA	Regional Water Authority
RWRP	Regional Water Reliability Plan
SGMA	Sustainable Groundwater Management Act

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1 Introduction

As stewards of the water systems that support the quality of life and well-being of nearly 2 million residents, the member agencies of the Regional Water Authority (RWA) constantly strive to maintain a reliable and safe water supply. The American River watershed, the region's primary surface water source, provides an average annual runoff of 2.7 million acre-feet, which is well in excess of the water supply needs of the region. The Sacramento River, the state's largest river in both volume and length, also runs through the heart of the region. In addition, much of the urban core overlies groundwater basins that provide 30 to 40 percent of the region's annual water supply. Despite the seemingly ideal setting for water supply, there are vulnerabilities to the reliability of the region's water resources. Identifying these vulnerabilities, along with mitigation actions to help reduce them, was the subject of this multi-year regional water reliability planning effort by RWA and its members.

*For purposes of this study, **vulnerabilities** are physical, operational, or institutional threats to a water system that could result in temporary, long-term, or even permanent loss of supply necessary to meet customer needs. **Mitigation actions** are responses that can help reduce vulnerabilities.*

1.1 Background

During development of the 2013 RWA Strategic Plan, member agencies expressed a strong interest in developing a plan to improve the overall reliability of the region's water supplies and systems. The recommendation stemmed from recent events that resulted in parts of two RWA member agencies' service areas being without water supply for days and even weeks; the events at that time occurred due to failed infrastructure during normal hydrologic years.

By late 2013, additional vulnerabilities to supply reliability took center stage. Some agencies in the region began alerting customers to very low levels of water in Folsom Reservoir, from which much of the region's supply is derived. This was just the beginning of one of the driest periods on record in the American River watershed that continued into December 2015, when Folsom Reservoir reached its lowest storage since its completion in 1956 (**Figure 1-1**). Officially, the California-wide drought spanned from 2012 to 2016. During this period, the region recognized not only vulnerabilities due to dry hydrology, but also vulnerabilities related to operational decisions beyond the region's control, such as preferential releases from Folsom Reservoir to maintain water quality in the Sacramento-San Joaquin Delta.

Regulatory threats during the drought included unprecedented curtailment orders for surface water diversions that impacted senior water right holders dating back to the year 1903. Additional regulatory impacts included mandatory conservation requirements beyond those needed to ensure water supply for the region's needs; this resulted in significant revenue impacts that also threaten long-term reliability of supply by reducing funds available to maintain water systems. Combined, these conditions revealed potentially larger risks to the reliability of the region's public water systems than previously thought. With the experiences from the previous several years in hand, the region began the effort to develop this Regional Water Reliability Plan (RWRP) in 2016.

Figure 1-1. Folsom Reservoir During Height of Recent Drought
The most recent drought highlighted the need to improve water reliability when storage in Folsom Reservoir reached an all-time low in December 2015.

1.2 Previous Efforts Contributing to Reliability

At the outset of this plan, the region recognized that it already possesses a high level of reliability from a supply and demand perspective in most years. To understand the region's current level of reliability, it is helpful to look back more than two decades. In the early 1990s, the region experienced significant conflict over concern for the American River ecosystem's health as diversions increased under existing contracts and agreements for public water supply. Stakeholder groups began convening in 1993 through the Water Forum to develop a plan with co-equal objectives: allow increased diversions from the American River for planned growth through the year 2030; and protect the habitat and environmental values of the river. The process developed an integrated set of solutions that are incorporated into the Water Forum Agreement of April 2000.

Much of the progress over the past two-plus decades can be attributed to actions related to the implementation of the Water Forum Agreement. For example, to reduce impacts on the Lower American River environmental ecosystem in dry years, the Water Forum Agreement requires the use of water supply alternatives and/or increased conservation to accommodate limitations on surface water diversions, with groundwater being perhaps the most significant water supply alternative. In the mid-1990s, many of the region's water suppliers relied predominantly on one source of water as their primary supply – either surface water or groundwater. The over-reliance on groundwater by some agencies resulted in long-term groundwater level declines, so the availability of groundwater as a dry-year alternative required changes to the way groundwater was managed.

To correct the declines in groundwater, some agencies invested significant capital funds to construct facilities and take the required contracting actions to access and use surface water in wetter years. The Cooperative Transmission Pipeline in northern Sacramento County and the Freeport Regional Water Project in central Sacramento County are examples of such projects. In northern Sacramento County, Sacramento Suburban Water District partnered with Placer County Water Agency and the City of Sacramento to implement the largest-scale conjunctive use program in the basin. Since the late 1990s, the region estimates more than 300,000 acre-feet of surface water was delivered to offset groundwater demand in the underlying basin and provide in-lieu recharge. In central Sacramento County, the completion of the Freeport Regional Water Project in 2010 further steadied and improved groundwater levels, by bringing surface water to areas previously served exclusively by groundwater. These projects not only prevented long-term groundwater level declines, but groundwater levels began a gradual recovery as evidenced in long-term hydrographs (**Figure 1-2**).

> ***Conjunctive use*** *is a coordinated water management practice with the preferential use of surface water during wet years and groundwater during dry years.*

At the same time, agencies dependent primarily on surface water also invested in infrastructure that added groundwater to their supply mix. For example, Citrus Heights Water District and Fair Oaks Water District have more than doubled their groundwater production capacity since completion of the Water Forum Agreement, with more planned wells on the way. Investments in infrastructure—expanding the capacity to divert and treat surface water, increasing the ability to pump groundwater, and interconnecting the two sources—as well as ongoing modified operations have effectively turned the groundwater basin into a large storage reservoir.

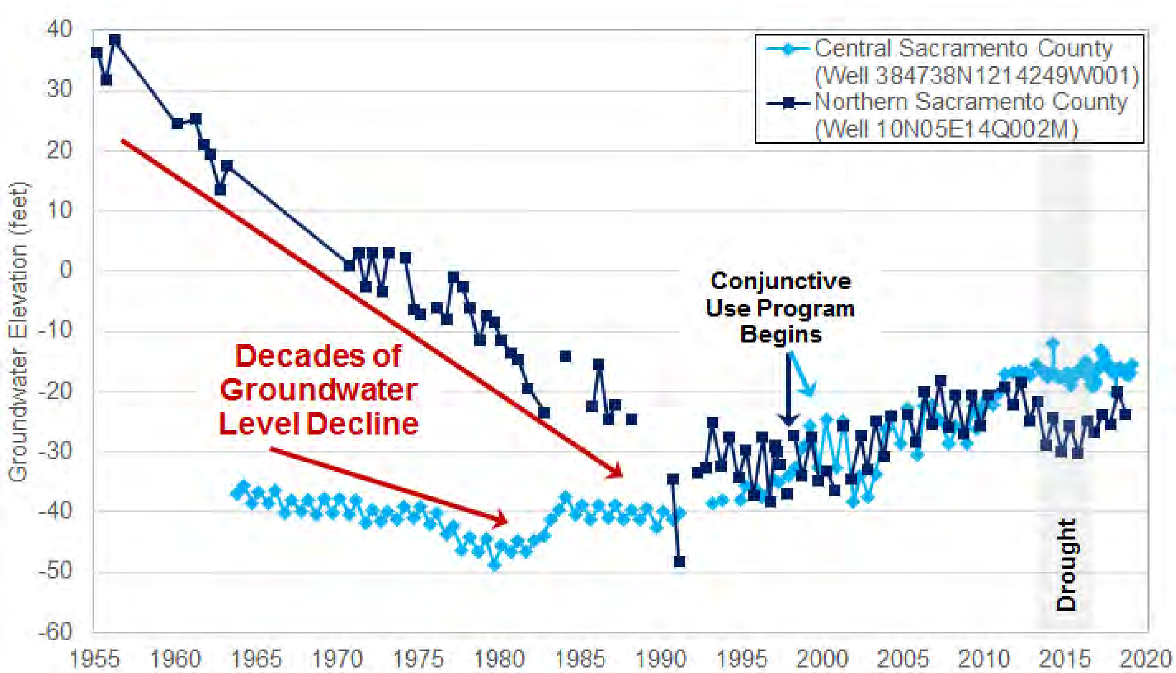

Figure 1-2. Long-Term Hydrographs

Long-term monitoring showed steady declines in groundwater elevations until conjunctive use operations began to improve groundwater levels in northern and central Sacramento County.

Even though the long-term improvements described above provided a strong foundation for a more reliable water supply, additional short-term actions were necessary to address the magnitude of the driest-ever-recorded conditions experienced from 2012 to 2015. In mid-2013, local water managers recognized that Folsom Lake was likely to approach such low storage levels that water supply for both public and environmental uses would be threatened with catastrophic reductions. Water managers responded by developing a multi-pronged approach to managing these conditions, including supply augmentation and calling for immediate significant demand reductions to further stretch limited supplies.

In early 2014, RWA worked with local water providers to identify priority projects to augment water supply and to increase the ability to move water to areas within the region most impacted by drought (**Figure 1-3**). Projects included construction of new groundwater wells and rehabilitation of existing wells that increased production capacity by about 15 million gallons per day (MGD). To better distribute water throughout the region, agencies constructed a series of interconnections to increase their ability to move water between water agency service areas by more than 50 MGD. Some agencies installed booster pumps in key locations such that groundwater could move to areas that otherwise depend on gravity flow of surface water from Folsom Lake. Finally, the drought response included improvements at two of the region's largest surface water diversions to allow for continued diversions at times of extremely low flow in local rivers. This allowed for changes in the timing of releases from Folsom Lake to optimize flows for habitat during dry conditions.

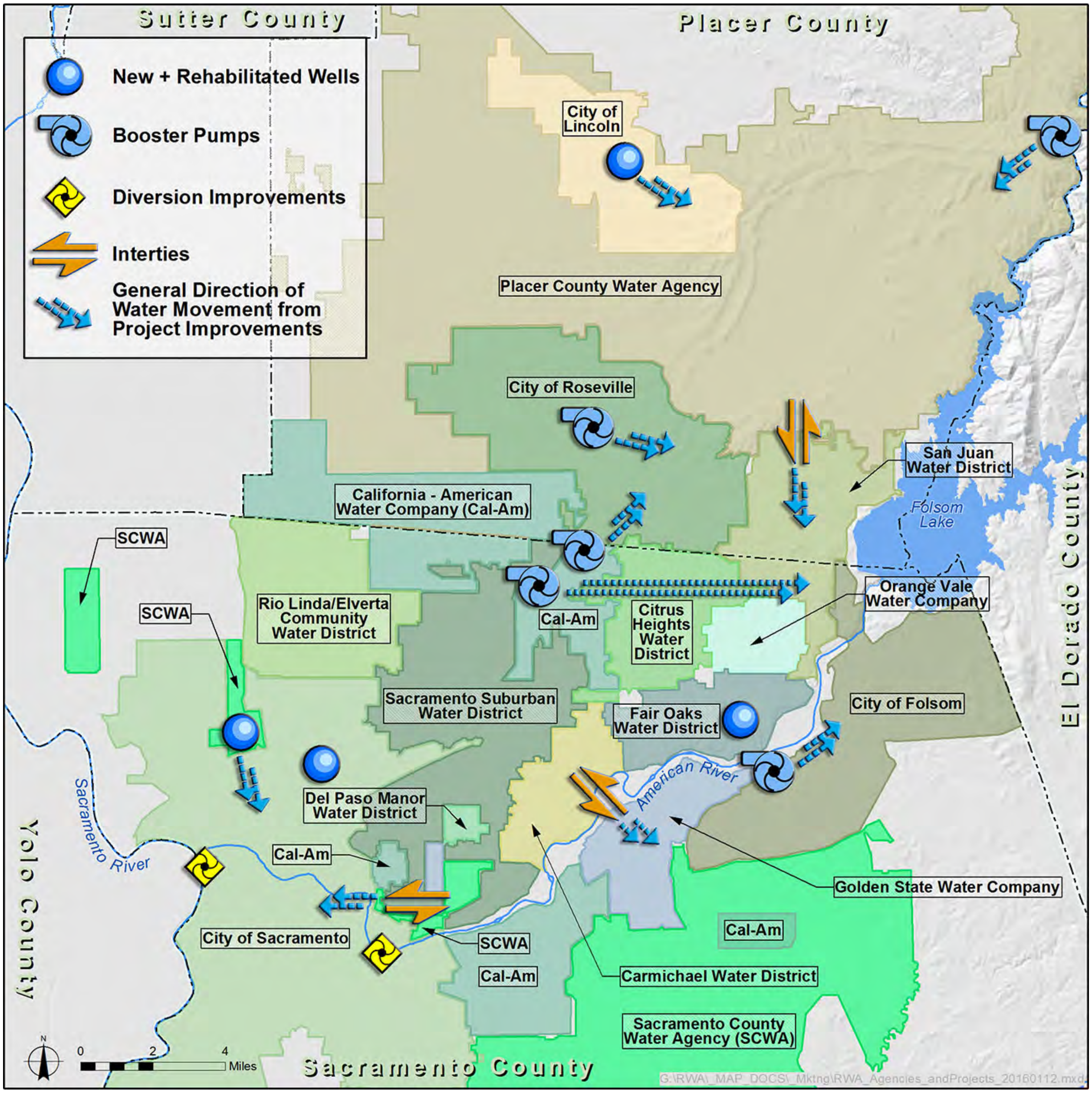

Figure 1-3. Recent Drought Response Infrastructure Projects

Drought response infrastructure projects in the region improved reliability by augmenting water supplies and increasing the ability to move water. A 2014 California Department of Water Resources Integrated Regional Water Management Drought Grant Program partially funded these projects.

Another notable contribution to the region's reliability comes through intensified demand management measures that are also largely associated with the Water Forum Agreement. Since 2001, the region's purveyors have implemented water efficiency measures with support from RWA's Water Efficiency Program. As a result, total water demand has been reduced from its peak in the early 2000s, despite significant population growth and economic expansion (**Figure 1-4**). The overall reduction in water use also reduced average demand for groundwater, which created opportunities for expanded conjunctive use in the basin to further enhance regional reliability while maintaining basin sustainability consistent with Sustainable Groundwater Management Act (SGMA) requirements.

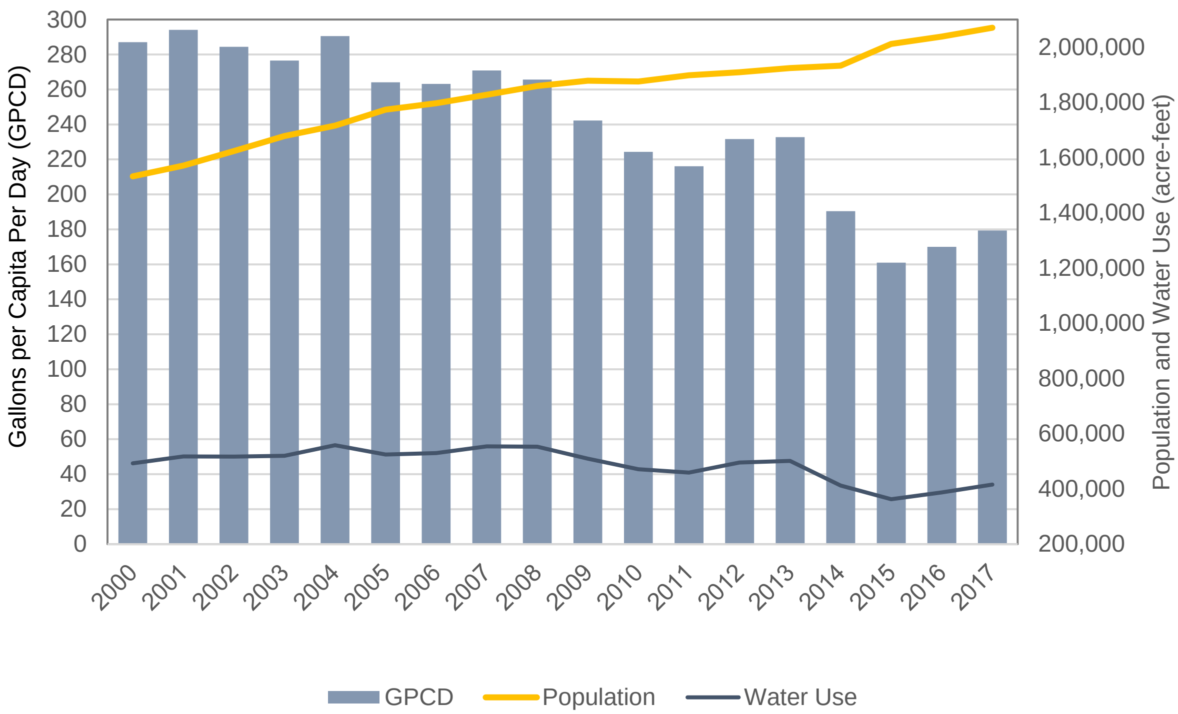

Figure 1-4. Population, Water Use, and Gallons per Capita Daily (GPCD) Trends in the Sacramento Region

Water efficiency has also contributed to the region's reliability by making supplies stretch further even as population has increased significantly.

1.3 Related Planning Efforts

There are several recently completed or ongoing planning efforts related to the RWRP that RWA and several of its member agencies have directly participated in that also promote regional reliability. These include the following:

- **North American Basin Regional Drought Contingency Plan:** The North American Basin Regional Drought Contingency Plan (RDCP), completed in fall 2017, was a collaborative planning effort supported by a grant through the U.S. Department of the Interior, Bureau of Reclamation's (Reclamation) WaterSMART Drought Response Program that provides a proactive approach to building long-term resiliency to drought. The RDCP began the process of identifying vulnerabilities and mitigation actions for many RWA member agencies, which served as the foundation of the planning process for the RWRP.

- **American River Basin Study:** Reclamation's ongoing American River Basin Study (ARBS) is examining strategies to integrate and better coordinate local and Federal water management practices, incorporate more detailed scientific information on climate change specific to the American River Basin, and address significant recent changes in conditions and regulatory requirements related to the Central Valley Project and regional water management. The ARBS will provide basin-specific, water management strategies to improve regional water supply reliability in the American River Basin, while improving Reclamation's flexibility in operating Folsom Reservoir to meet flow and water quality standards and protect endangered fishery species in the lower American River. The ARBS will identify longer-term solutions that will contribute to improved water supply reliability for American River purveyors. **Figure 1-5** shows the study area for this project.

- **American River Basin WaterSMART Water Marketing Strategy Project:** Under a Reclamation WaterSMART Water Marketing Strategy Grant awarded to El Dorado County Water Agency, this regionally-coordinated planning project will explore leveraging the potential for regional conjunctive use to further enhance existing regional market transfers through surface water reoperation and groundwater substitution practices. The proposed project will evaluate the potential for water market asset development, determine the infrastructure investments needed to realize that market, and formulate an implementation plan that includes recommendations on governance, reporting, and monitoring procedures. The marketing strategy plan will provide recommendations on specific elements of a proposed regional water bank, which is described later in this RWRP. The study area for this project is the same as that for the ARBS (Figure 1-5).

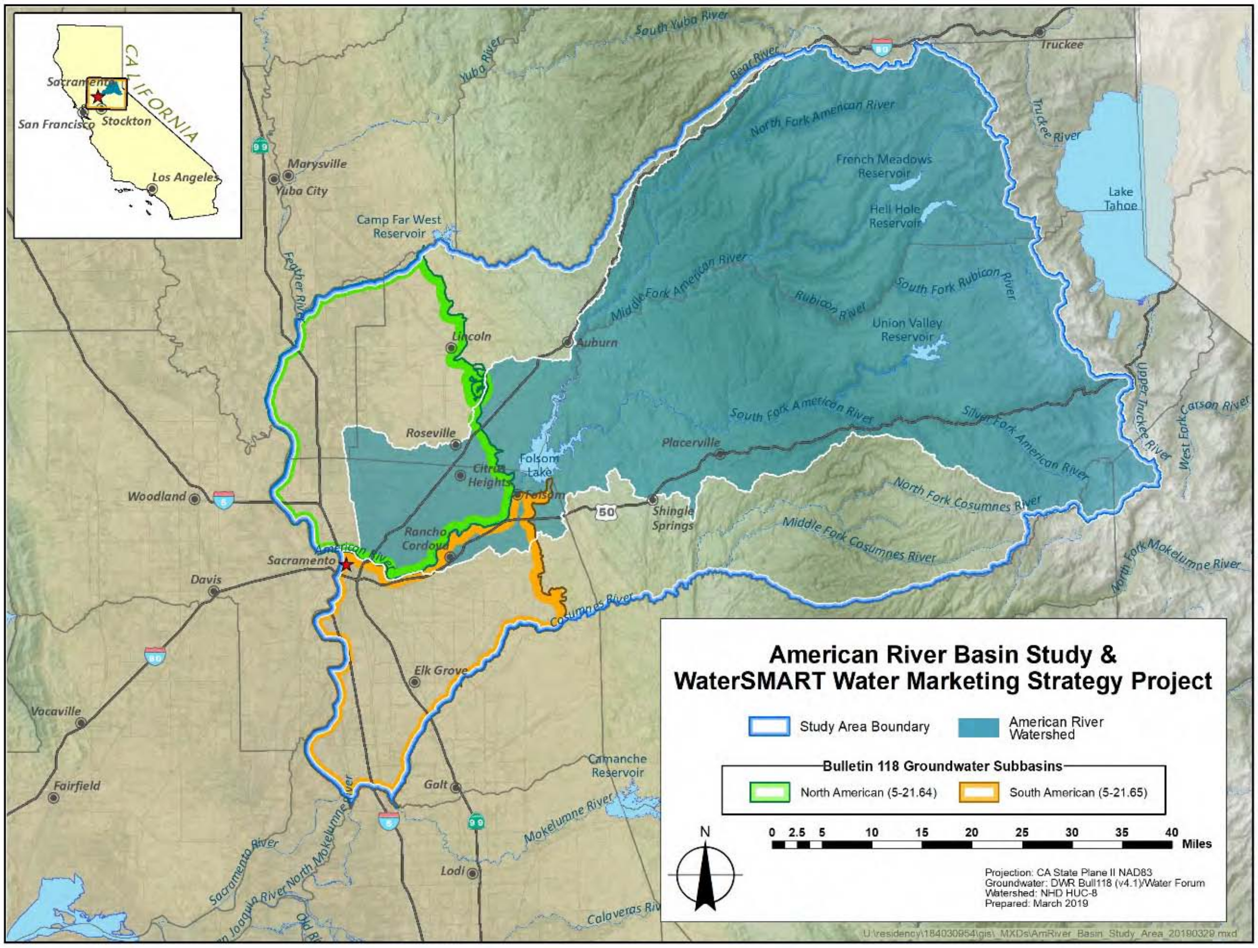

Figure 1-5. American River Basin and Groundwater Subbasins

The American River Basin Study and the WaterSMART Water Marketing Strategy Project cover an extensive area, including the entire American River Watershed, and portions of the Bear River and Cosumnes River watersheds. The area also includes the North American and South American groundwater subbasins, which are subject to Sustainable Groundwater Management Act compliance.

- **Sustainable Groundwater Management Act:** With the passage of SGMA in 2014, local Groundwater Sustainability Agencies (GSAs) in California's groundwater basins are required to develop and implement a Groundwater Sustainability Plan (GSP). The RWRP study area includes two primary groundwater subbasins–North American Subbasin and South American Subbasin. Most of the study participants are actively engaged as members of GSAs in the North American Subbasin (Sacramento Groundwater Authority GSA and the West Placer GSA) and the South American Subbasin (the Sacramento Central Groundwater Authority GSA). Many of the mitigation actions identified in the RWRP may also be identified as groundwater sustainability implementation actions in GSPs, which are required to be completed by January 31, 2022. Because of this, RWA has had close coordination with these GSAs throughout this planning process.

1.4 Study Scope

The RWRP is limited in scope to high-level identification of vulnerabilities, possible mitigation actions, regional conjunctive use potential, and interest in establishing a regional water bank – all as they may relate to increasing regional water supply reliability. **Figure 1-6** shows the study area for this plan. While some of the participants supply water for agricultural purposes, the focus of the study is to improve the reliability of the region's municipal and industrial (M&I) water supplies and distribution capabilities. Agencies provided information through interviews and follow-up data including identifying current and long-term supplies and demands as well as minimum desired levels of service during supply-constrained conditions. The participants identified mitigation actions for the RWRP, but this plan did not evaluate the feasibility of these actions nor their current status.

The region defines a ***water bank*** *as a storage and recovery program using the underlying groundwater basin in conjunction with surface water. A water bank includes an accounting system to ensure water resource sustainability and compliance with SGMA.*

While the RWRP used long-term projections of supply and demand to identify vulnerabilities, only near-term (less than about 10 years) mitigation actions were included in the regional recharge and recovery analysis. The participants will continue to identify and refine long-term mitigation actions through some of the related planning efforts described above.

The recharge and recovery analysis included the development of a spreadsheet-based calculation of recharge and recovery operations, with agencies identifying where they believed opportunities or constraints to expanded use of surface water or groundwater exist. Lastly, interest in a potential water bank was explored through a survey of participating agencies. The next section provides a description of the overall planning process and additional details of the steps in developing the RWRP.

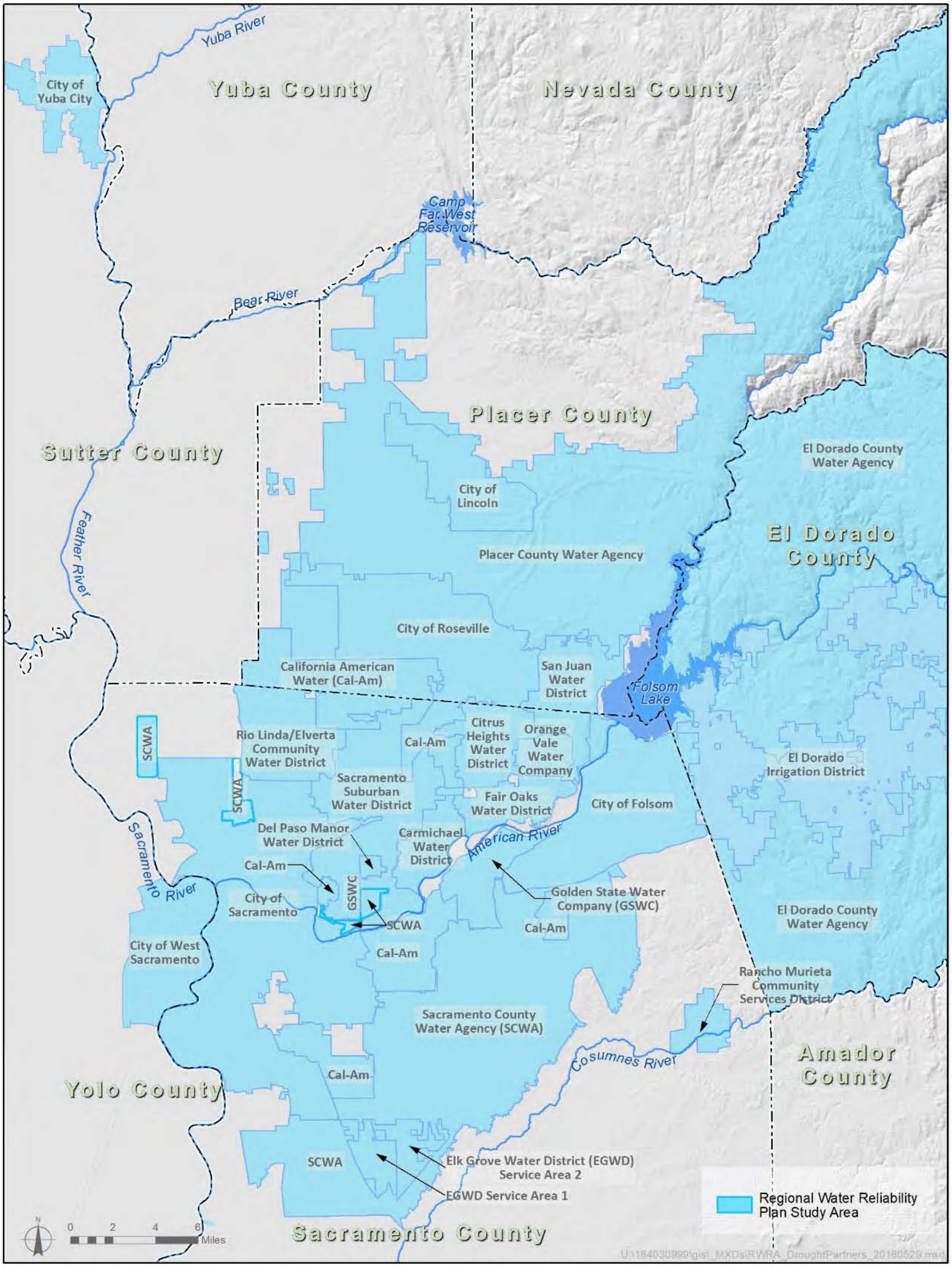

Figure 1-6. Regional Water Reliability Plan Study Area

The RWRP study area is generally focused around the lower American River. It includes 22 RWA member and associate member agencies in the greater Sacramento region.

2 Planning Process and Results

Given the large number of individual agencies and their varied water sources and distribution systems, planning for water reliability in the region is highly complex. There is no legal mandate for this type of planning, so a successful effort relied on significant collaboration among the agencies and development of a unique planning process. With participant input, a planning approach was developed as depicted in **Figure 2-1** and described in the following sections.

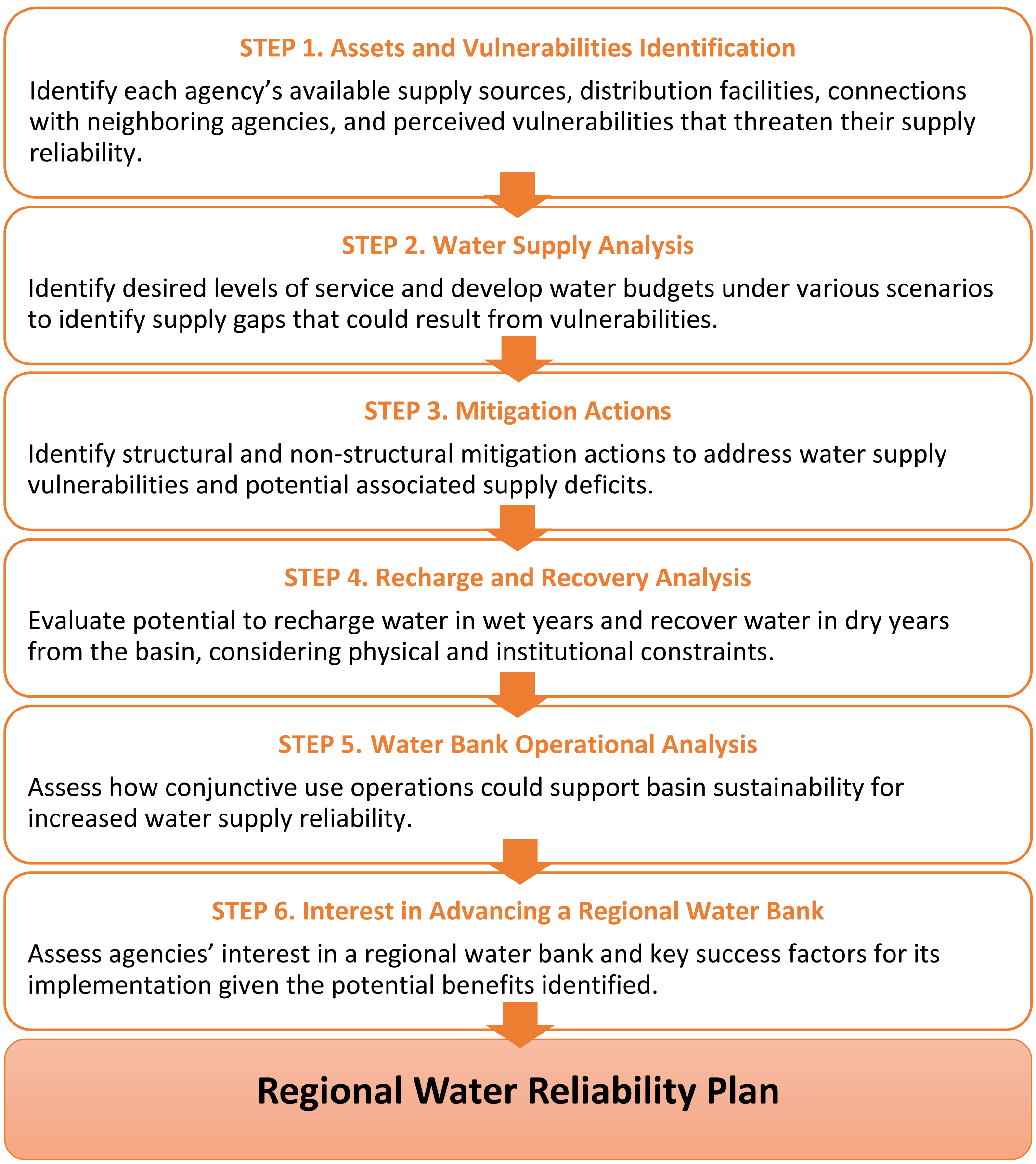

Figure 2-1. Regional Reliability Planning Process
The reliability planning process developed was unique to the needs of this region.

2.1 STEP 1 – Assets and Vulnerabilities Identification

The foundation of the RWRP started with obtaining a complete portfolio of each agency's water assets, including information on supply sources (e.g., surface water, groundwater, recycled water), water rights and contracts, distribution systems, and interties with neighboring agencies[1]. For agencies with multiple service areas, information was further broken down to account for operational and geographic differences.

In addition to the assets of the participants, each agency identified a comprehensive list of vulnerabilities during the individual interview process. Each agency's identified vulnerabilities were consolidated for the entire RWRP study area and then grouped into nearly 30 vulnerability categories. These categories fell under seven major vulnerability themes as shown in **Table 2-1**.

Vulnerabilities are influenced by external and internal factors, and may be physical (e.g., structural deficiencies or improvement needs), operational, or institutional (e.g., contractual, policy, or administrative issues). Vulnerabilities affected by external factors are those that individual agencies and the region have less control over, such as the climate, State-mandated surface water diversion curtailments, or changing Federal and State regulations and policies. Vulnerabilities affected by internal factors often include operations and infrastructure investments. Threats to groundwater availability tend to be a mix of external and local factors. An understanding of external and internal factors is critical for developing strategies to mitigate the various vulnerabilities.

Future climate change and population growth are among the factors that are likely to exacerbate these vulnerabilities over the long-term. Ongoing State-led initiatives (e.g., Delta Water Quality Control Plan) are likely to alter statewide water system operations in the future, including those affecting Folsom Reservoir and the agencies in the RWRP study area. These potential vulnerabilities may receive further assessment as part of the ongoing ARBS, which may also identify a broader set of mitigation actions beyond the scope of this RWRP.

[1] Information for the study was initially collected from existing data sources including regional, State of California (State), and federal studies and datasets, and directly from the local agencies' available planning documents. Each agency was then interviewed to confirm the accuracy and completeness of information. Agency interviews took place in December 2016 and January 2017. After the interviews, the information was again sent to the agencies for another round of review. All input provided was incorporated and sent to the agencies for their records.

Table 2-1. Identified Vulnerability Themes and Categories

Vulnerabilities identified by the participants fell into one of the seven themes shown below. Some vulnerabilities expressed by a limited number of agencies were maintained for this study and fell into an "Other Challenges" theme.

Vulnerability Theme	Vulnerability Categories
1. Institutional threats to surface water availability	• CVP/Folsom Reservoir Operations • Evolving State and Federal Regulations • Agency Specific Water Rights/Contract Limitations
2. Physical threats to surface water availability	• Climate Change/Hydrologic Variability • Inability to Divert during Low Storage/Flow Conditions • Source Contamination
3. Institutional threats to groundwater availability	• New Drinking Water Standards • New State Water Quality Regulations • Future constraints related to SGMA
4. Physical threats to groundwater availability	• Groundwater Contamination • Groundwater Production Capacity Limitations • Groundwater Injection Limitations/Lack of Infrastructure
5. Institutional limitations on sharing supplies	• Existing Place of Use/Service Area Limitations • Disparity in Cost of Water • Diverse Agency Goals & Interests
6. Physical limitations on sharing supplies	• Differing Fluoridation Practices • Limited Intertie Capacities • Incompatible Pressure Zones • Differing Water Quality • Lack of metering on interties
7. Threats to infrastructure integrity	• Aging Infrastructure • Lack of redundancy for critical facilities • Geologic Hazards • Flooding Hazards
Other Challenges	• Reliance on single supply source • Unrealized recycled water potential • Limited capacity to serve growth • Lack of Real-time Data Sharing

2.2 STEP 2 – Water Supply Analysis

The next step in the planning process was to develop monthly water budgets for representative wet years, driest years, and highly restricted supply scenarios under current and build-out conditions for each water purveyor. Note that the highly restricted supply scenario is beyond the requirements of Urban Water Management Plans. Each agency developed these budgets independently to reflect a plausible worse-case scenario during extended drought conditions or some other major loss of a source of supply.

The water supply analysis confirmed that under current conditions, agencies generally have reliable water supplies. However, some vulnerabilities do exist, especially under extreme water shortage conditions with build-out demands. If not addressed, these vulnerabilities could have a wide range of effects from localized impacts to more regional disruptions in service.

2.3 STEP 3 – Mitigation Actions

With the comprehensive list of vulnerabilities and potential supply and demand deficits identified, each agency identified mitigation actions to address those vulnerabilities and improve M&I water supply reliability. The RWRP participants also conducted a series of four sub-regional meetings in March 2017 to take a more detailed look at existing system interties and discuss potential projects between agencies that could further expand conjunctive use in the region, which was already recognized as a key reliability strategy. These meetings resulted in additional projects being included in the proposed mitigation actions. The mitigation actions continued to be updated throughout this RWRP process.

After confirming the full suite of mitigation actions, the RWRP participants grouped the actions into seven structural mitigation action categories and six non-structural mitigation action categories, as shown in **Table 2-2**. Actions in every category contribute to improving regional M&I water supply reliability by addressing needs in the seven main vulnerability themes. **Appendix A**[2] includes a full list of mitigation actions.

The total conceptual capital cost estimates for all structural actions is around $4.4 billion. Of that, near-term structural actions that are directly related to improving conjunctive use total an estimated $288 million. While the conjunctive use analysis described below only includes near-term structural conjunctive use-related actions, Table 2-2 provides a summary of all near- and long-term identified actions.

[2] This list was last updated in April 2019 and is subject to continued modification as projects move forward, are refined, or are eliminated from further consideration by a participating agency.

Table 2-2. Summary of Mitigation Actions and Contributions of Regional Reliability

Participants identified mitigation actions during the planning process. While individual agencies may have many actions proposed to address a specific issue in a water system, the actions identified here contribute to some aspect of overall regional water reliability.

Mitigation Action Category	Contribution to Regional Reliability	Number of Actions	Total Conceptual Capital Cost Estimates ($ million)[1]
Structural			
System Interties	• Facilitates sharing of supplies • Provides access to different sources of water	27	$140
Groundwater Well • Rehabilitation • New Installation • Injection	• Maintains and increases an agency's extraction capability for dry year recovery • Injection increases ability to recharge the groundwater basin • Creates opportunities for water banking and exchange	95	$220
Surface Water Treatment	• Increases capacity for sharing supplies • Provides flexibility in use of surface water	2	$430
Surface Water Storage	• Provides flexibility in the timing of delivery of surface water supplies • Provides redundancy of supplies	2	$1,550
Surface Water Diversion	• Improves access to surface water	3	$1,530
Booster Pump/ Pressure Reduction	• Increases ability to share supplies with neighboring agencies	8	$50
Recycled Water	• Provides another source of water to meet non-potable demands	9	$500
Non-Structural			
Water Transfers	• Facilitates sharing of supplies	11	n/a
Wheeling	• Facilitates movement of supplies and relieves conveyance capacity constraints • Facilitates redundancy	2	n/a
Banking	• Increases reliability of groundwater basin to provide dry year supplies • Facilitates regional collaboration	3	n/a
Modify Contracts/Place of Use	• Facilitates sharing of supplies • Maximizes beneficial use of surface water supplies	7	n/a
Federal Action and Collaboration	• Enhances water supply reliability	6	n/a
Reduce Institutional Barriers	• Enhances sharing of supplies	4	n/a

Key: n/a = not assessed

Note: 1. Conceptual capital costs provided by agencies and are subject to change as detailed designs are completed.

2.4 STEP 4 – Recharge and Recovery Analysis

As described in the introduction, conjunctive use significantly contributes to the reliability of the region's water supplies. Expanding conjunctive use operations can further expand access to both surface water and groundwater, allowing more effective management through wet and dry periods. Based on the water supply analysis and proposed near-term mitigation actions identified by the participants, the next step in the planning process was to quantify recharge and recovery potential. This analysis identified how much water the region could (1) recharge during wet years by delivering surface water to agencies that would otherwise use groundwater, and (2) recover from the basin during dry years using groundwater wells to deliver water to agencies otherwise dependent on using surface water.

2.4.1 Recharge and Recovery Analysis Assumptions

The analysis used the following assumptions:

- **Contiguous Service Areas** – To achieve recharge or recovery, the agencies in the analysis needed to have a contiguous service area with a neighboring agency. This resulted in the exclusion of a few of the participants from the analysis.

- **Fluoridation** – Only agencies with similar fluoridation practices could share supplies on a long-term basis. Note that the Division of Drinking Water allows delivery between inconsistent fluoridation practices for emergencies, or up to ninety (90) days. Based on fluoridation practices, four analysis areas were developed (**Figure 2-2**).

- **Baseline Conditions** – In this region, surface water and groundwater use vary depending on hydrological conditions. For this analysis, an average of 2011 through 2013 usage represented demand during recharge years, while 2015 usage represented demand during recovery years.

- **Existing Place of Use/Service Area Limitations** – Agencies delivered water to neighboring agencies in compliance with the terms and conditions of their water rights or contracts.

- **Infrastructure Constraints:**

    - *Capacity of Surface Water Treatment Plants* – The amount of surface water in wet years available for recharge is the available capacity of surface water treatment plants after fulfilling existing customer demands.

    - *Capacity of Groundwater Wells* – The amount of groundwater in dry years available for recovery is the available capacity of groundwater wells after fulfilling existing customer demands.

    - *Regional Water Transmission Pipelines and Inter-District Water Distribution* – The ability to receive water from neighboring agencies is the capacity of interties and transmission pipelines after accounting for existing customer demands.

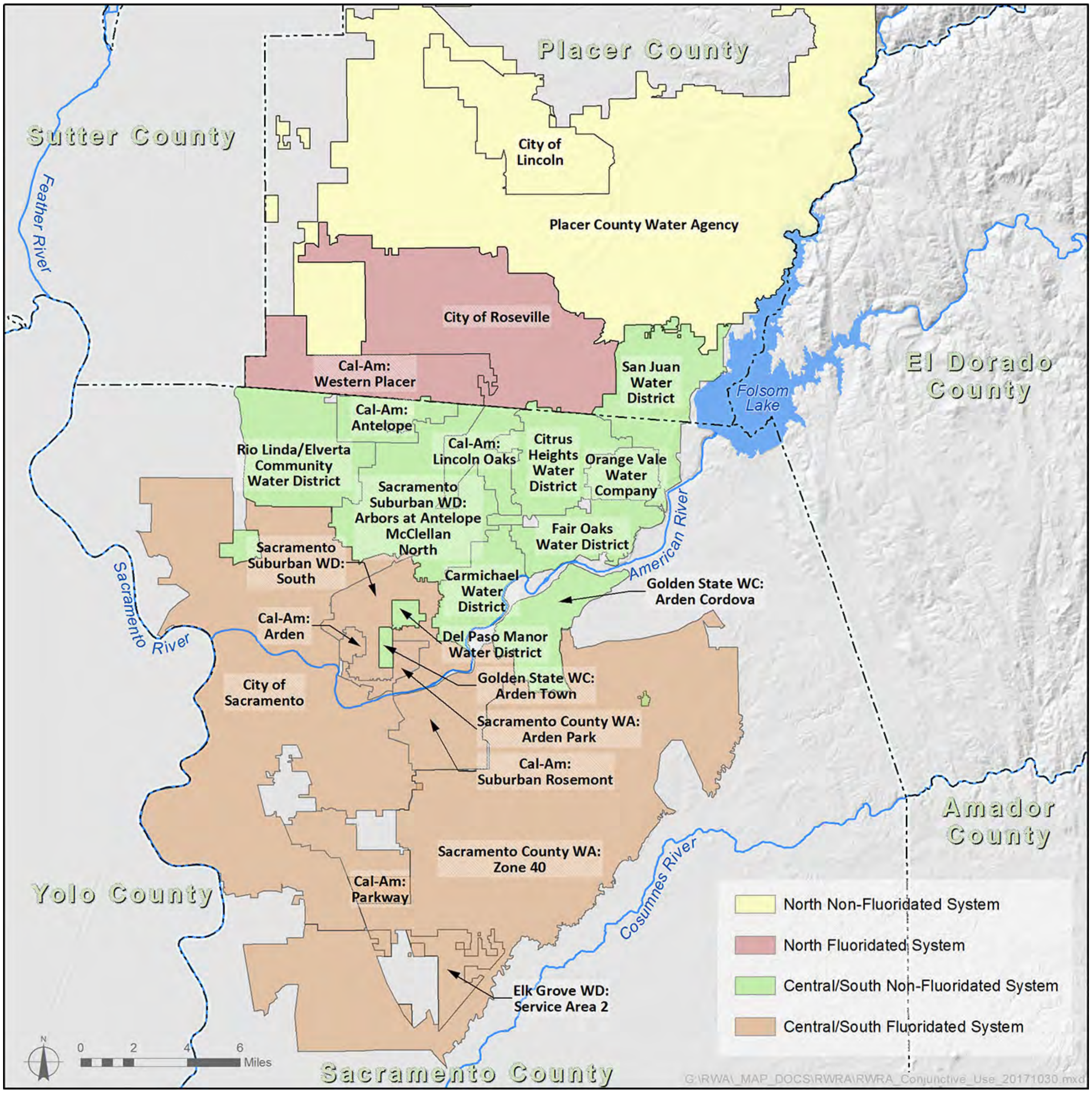

Figure 2-2. Recharge and Recovery Analysis Areas

In consideration of the assumptions described in Section 2.4.1, the RWRP divided the region into four distinct areas for the recharge and recovery analysis.

- *Intra-District Water Distribution* – The ability to distribute water to all customers within an agency using only intra-district infrastructure. For example, even if certain groundwater-using areas would be willing to use surface water, these areas could only receive surface water if connected to the larger distribution system.

- *Minimum Production Needs* – Some facilities require a minimum amount of water be produced/treated (e.g., minimum well production to meet agency policies or avoid physical damage to wells from shutting off/on). As such, the amount of water for recharge and recovery was limited by the minimum production needs of groundwater wells and surface water treatment plants.

The recharge and recovery analysis did not consider institutional concerns such as differences in the cost of water, which is one of the key barriers to expanding the use of surface water during wet periods, and whether inter-agency agreements are in place to allow a transfer. It also did not consider the potential effects of known contaminant plumes in the study area.

2.4.2 Recharge and Recovery Analysis Results

Using the assumptions described in Section 2.4.1, the annual recharge and recovery potential were computed under two scenarios:

(1) **Existing Recharge and Recovery Scenario –** This scenario considered current levels of demand and existing facilities.

(2) Potential Near-Term Recharge and Recovery Scenario – This scenario assumed the same (current) level of demand, but with improved interties and facilities. The included improvements consist of the implementation of mitigation actions within 10 years, such as interties, new in-district transmission, new groundwater wells, groundwater well rehabilitation, and new aquifer storage and recovery (ASR) wells. These actions are listed in Appendix A. Note that the mitigation action table has been refined following completion of the recharge and recovery analysis. Specifically, the number of wells shown in the appendix is higher than what was used in this analysis as detailed information was not always available from the project proponent at the time of the analysis. In all cases, the potential capacity increased, so results in this section represent conservative potential increases. Mitigation actions taking more than 10 years to implement, along with build-out demands and climate change, may be considered separately as part of the in-progress ARBS.

Figure 2-3 shows the recharge and recovery potential under these two scenarios. Based on this analysis, the region has potential to recharge 63 thousand acre-feet and recover 58 thousand acre-feet a year. With near-term improvements, recharge and recovery potential could increase by more than 50 percent.

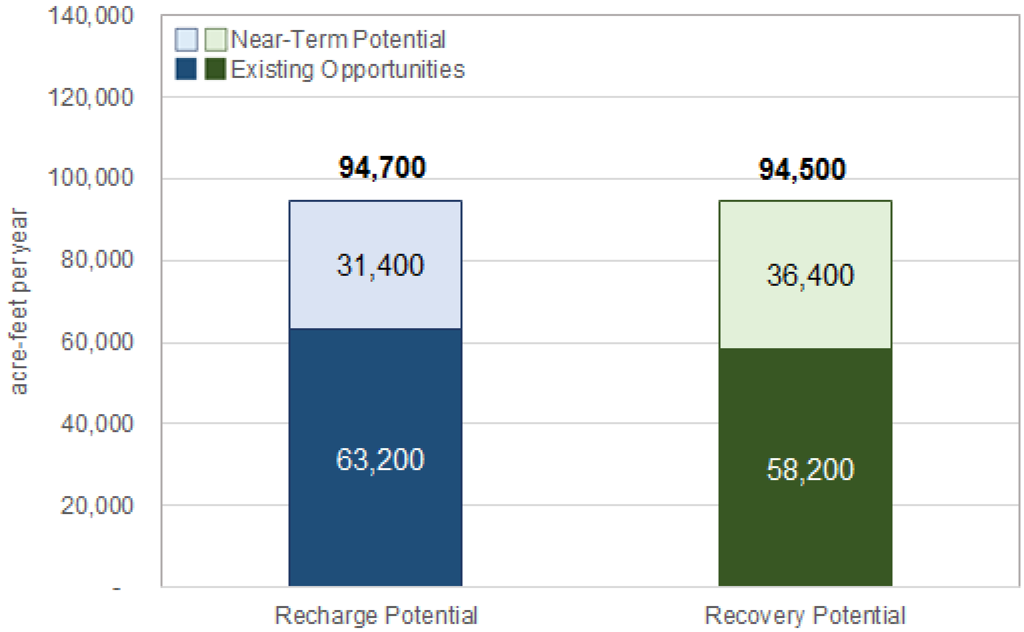

Figure 2-3. Recharge and Recovery Potential under Existing and Near-Term Conditions

Under existing conditions, the region has potential to recharge and recover around 60 thousand acre-feet a year (darker colors). Recharge and recovery potential increases by over 50 percent with near-term improvements in place (lighter colors). The cost to implement the near-term improvements is around $288 million, based on conceptual cost information from the agencies. Note the RWRP did not include technical modeling analyses to verify these estimates.

One of the more interesting aspects of recharge and recovery in the region is that opportunities exist in each month of the year – this is because most of the water provided is for M&I uses (**Figure 2-4**). While demand does peak in summer months due to landscape irrigation, there is consistent baseline usage throughout the year. Consequently, the region could increase conjunctive use practices year-round. This type of year-round recharge and recovery potential is not common in agricultural areas where there is typically no demand in the non-growing season months. Many agricultural areas, including along the Cosumnes River in Sacramento County, are exploring direct recharge on dormant crops or idle fields, but this is not a common practice at this time.

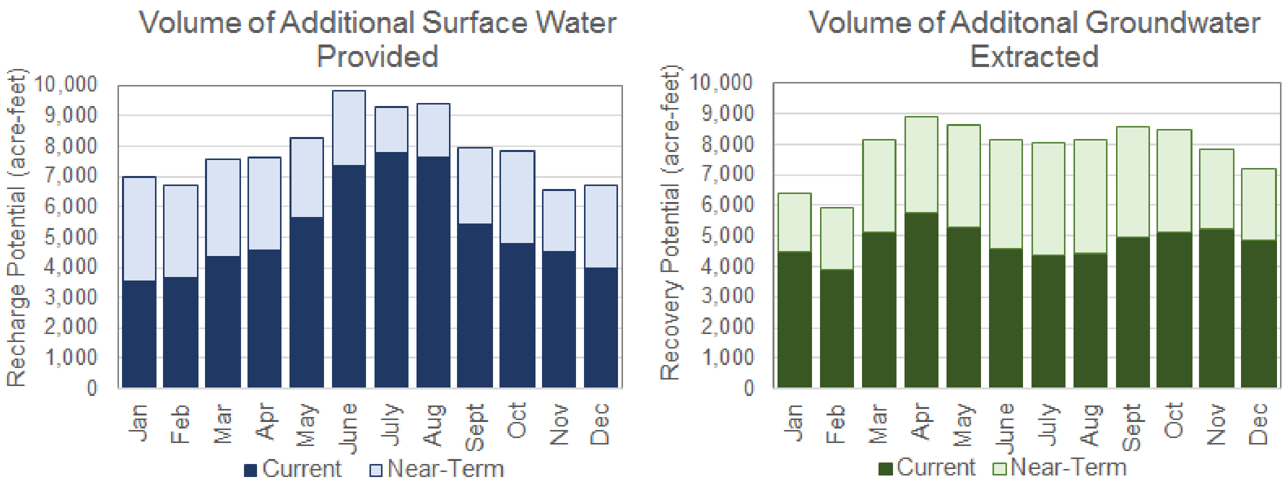

Figure 2-4. Monthly Recharge and Recovery Potential

The ability to store surface water in wet years (blue bars) and recover groundwater in dry years (green bars) occurs year-around for both existing conditions (darker colors) and with near-term improvements (lighter colors). Regionally, a few to several thousand acre-feet of water could be stored or recovered in any given month through expanded conjunctive use operations.

2.5 STEP 5 – Water Bank Operational Analysis

At the outset of the planning effort, participating agencies considered the possibility of establishing a water bank in the region. The concept is that a water bank can help incentivize expanding conjunctive use by creating an accounting program for the water recharged in the basin and allow for future recovery of the banked water through groundwater substitution transfers. These transfers could generate revenue to overcome the cost barrier to expanding conjunctive use in the region. With the estimates of annual storage and recovery potential, the next step of the RWRP was to conduct regional water bank simulations to identify: (1) the potential supply yield associated with an expanded conjunctive use program in the region; and, (2) the potential sustainability benefit to the underlying groundwater basin from operating a water bank over multiple years.

2.5.1 Water Bank Operational Analysis Assumptions

To illustrate the potential quantitative benefits of conjunctive use, a spreadsheet model to simulate longer-term recharge and recovery operations was developed. The analysis used the following assumptions:

- **Recharge and Recovery Capacity** – The bookends of the simulation include the maximum recharge potential and recovery capacity for both existing opportunities and near-term potential scenarios.

- **Timing of Recharge –** While recharge could occur at any point when supplies are available, the model conservatively assumed recharge would only take place in Water Forum Agreement wet year types.[3]

- **Timing of Recovery –** Recovery occurs in dry and critical Sacramento River Index Year Types[4]. This index was selected because it represents a more realistic estimate of demand on the overall California market. Also, dry and critical Sacramento River Index Year Types have occurred more frequently in recent past than drier Water Forum Agreement Year Types.

- **One Bank for all Subbasins –** The water bank accounting combines both the North and South American subbasins, because several RWRP participating agencies overlie both basins and interties exist that can readily move water to both basins.

- **Positive Basin Storage Requirement –** Under normal banking operations, recharge must precede recovery and the cumulative banked water balance cannot run in the negative. If the cumulative banked balance reaches zero, then recovery operations cease until the cumulative banked balance is positive. These operational assumptions were included to ensure consistency with SGMA requirements.

- **Unrecoverable Losses –** When storing water in the water bank, an annual physical loss of 1 percent was assumed to occur to account for water flowing out of the basin and a one-time loss of 10 percent of what was recharged would occur as a basin mitigation factor (e.g., a contribution to the basin). Note that the annual loss and basin mitigation factor are hypothetical assumptions used for this analysis and do not commit any potential future water bank participants to this constraint. Should the region move forward with the development of a water bank, water loss factors through a detailed technical modeling analysis would be needed.

- **Simulation Period –** The historical hydrological conditions from a 10-year period (2004 through 2013) were used to define when recharge versus recovery would occur.

Figure 2-5 shows an example of the application of these assumptions to the operational analysis.

[3] The Sacramento Water Forum Agreement defines wet years as when the projected March through November unimpaired inflow to Folsom Reservoir is greater than 1.6 million acre-feet (maf).

[4] The Sacramento River Index Type defines years based on the unimpaired runoff from River at Bend Bridge, Feather River inflow to Lake Oroville, Yuba River at Smartville, and American River inflow to Folsom Lake. It factors in the current April to July runoff forecast, current October through March runoff, and the previous water year index. Unimpaired runoff in critical years is equal to or less than 5.4 maf, and dry years is greater than 5.4 maf, but equal to or less than 6.5 maf.

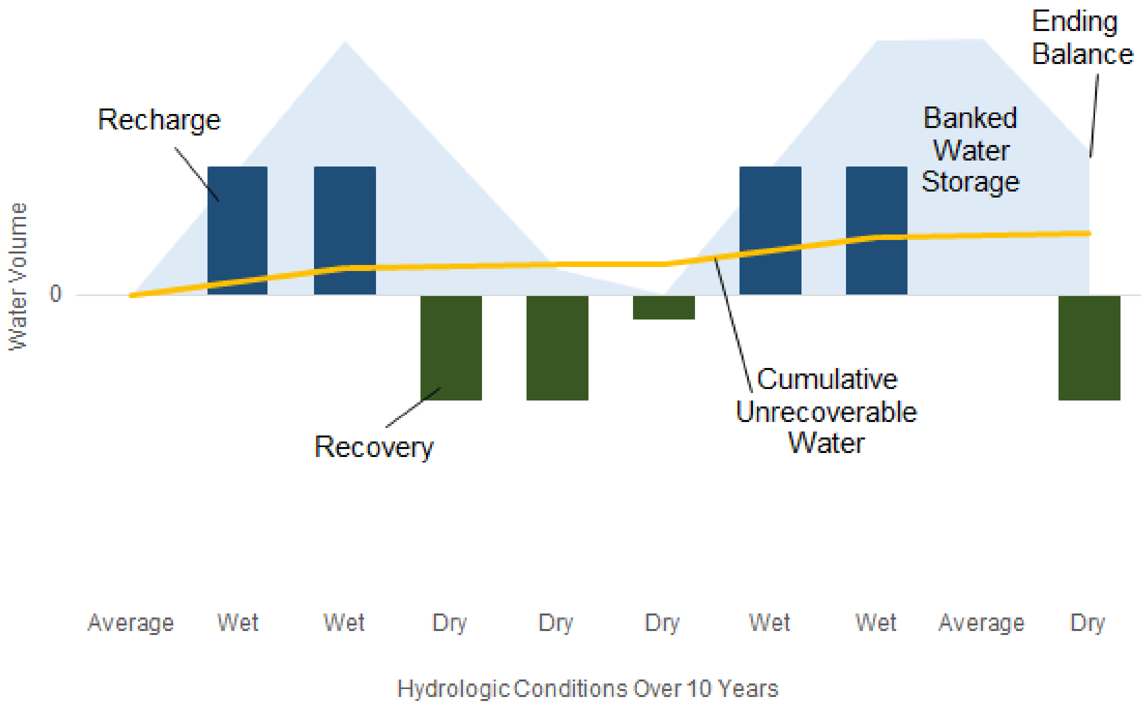

Figure 2-5. Example Ten-Year Water Bank Budget

A regional water bank operates through a series of recharge and recovery actions. A principle of the water bank is that recharge must precede recovery. In this example, no activity occurs in the first year as it is an average water year. The next two years are wet years, so recharge occurs, resulting in a positive bank balance (blue bars). Three dry years follow. The bank is nearly exhausted after two sequential dry years, limiting water extracted from the bank in the third sequential drier year (green bars). At the end of the simulation period, a cumulative banked water balance remains (light blue shaded area). Throughout this period, a hypothetical portion of the water was assumed to be unrecoverable and committed to benefit the basin (yellow line). These losses will be determined through subsequent detailed modeling as recommended in Section 4.

2.5.2 Water Bank Operational Analysis Results

Using the above assumptions, a water bank budget for both the existing opportunities and near-term potential scenarios was developed. Simulated results are shown in **Table 2-3**.

Under existing opportunities, the region could bank a long-term average of 25 thousand acre-feet per year. Of that, the region could recover an average 17 thousand acre-feet per year. At the end of the 10-year period, the ending banked balance was 71 thousand acre-feet. With near-term improvements, the amount recharged and recovered increased to an average of 38 and 26 thousand acre-feet per year, respectively. At the end of the near-term scenario's 10-year simulation, about 100 thousand acre-feet of banked water remains.

Table 2-3. Annualized Ten-Year Water Bank Budget Summary Assuming 2004 to 2013 Water Year Type Sequence (in 1,000 acre-feet per year)

The budget shown compares the annualized water bank budget for both existing opportunities and near-term potential scenarios. Losses are for illustration purposes. Actual losses would be determined through detailed modeling.

10-Year Water Bank Budget	Existing Opportunities Scenario	Near-Term Potential Scenario	Increase
Annual Banked Water	25.2	37.9	12.7
Annual Recovered Water	16.8	25.9	9.1
Average One-Time Loss of Banked Water (10%)	2.5	3.8	1.3
Annual Loss (1%) of Banked Water	0.6	0.9	0.3

2.6 STEP 6 – Interest in Advancing a Regional Water Bank

With an understanding of the quantifiable benefits of an expanded conjunctive use program that follows the principles discussed above, the next step in the RWRP process gauged participant interest in continuing to develop a regional water bank. In August 2018, the agencies responded to a survey on interests and considerations relative to establishing a regional water bank. The survey confirmed that there is broad conceptual support among RWRP participants for moving forward with more detailed analyses and planning necessary for the development of a regional water bank, including consideration of including partners from outside the region. It is, however, worth noting that a common comment accompanying responses to the survey was that agencies need additional detail on how the water bank would operate before commitments of full support and participation could be made.

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3 Conclusions

From this RWRP process, it is clear that the agencies in the region have already successfully pursued and achieved significant improvements in water supply reliability in recent years. The RWRP planning effort also identified remaining vulnerabilities and collaborative solutions available to address them. Described below are the primary conclusions regarding regional reliability.

3.1 The region currently has a reliable water supply in most years

As confirmed during the recent drought and affirmed through the RWRP's water supply analysis, in most years, the region presently has reliable water supplies. Based on the water supply analysis, the region can provide desired levels of service not only in wet/average years, but also in dry years assuming conservation measures are in place.

3.2 Some water supply reliability uncertainty remains

Water supply reliability vulnerabilities do exist. Recent drought conditions in the State revealed greater potential risks to agencies' water supplies in the greater Sacramento region than previously assumed. While past planning efforts by local water agencies assumed between a 5 to 50 percent reduction in Central Valley Project supplies in critically dry years, Reclamation reduced north of Delta Central Valley Project water allocations by 75 percent in 2015. Agency responses to these significant supply reductions revealed opportunities for collaboration and cooperation to enhance regional reliability.

These vulnerabilities were estimated in the water supply analysis' highly restricted supply scenario which assumed each agency's worst-case scenario and goes beyond presently mandated planning requirements. Under these extreme scenarios, the region could experience a 10 percent deficit mainly during the summer months. At build-out, this potential deficit increases to 25 percent of the region's minimum desired levels of service not being met. This increase in vulnerability is primarily attributable to projected demand increases resulting from population growth.

In short, M&I water supply reliability vulnerabilities exist, especially under extreme water shortage conditions at build-out. The water supply budgets highlight the vulnerabilities (both current and future) that may prevent each agency from maintaining its desired and minimum levels of service**.** If not addressed, these vulnerabilities could have a wide range of effects from localized impacts to disruptions in services region-wide.

3.2.1 Near-term reliability uncertainty associated with return to dry conditions

Among the vulnerabilities identified in this planning effort, some of the greatest concerns are centered around regulatory actions and operational decisions made at the State and federal levels.

For example, during the recent drought the State Water Resources Control Board issued surface water diversion curtailments to water rights dating back to 1903. These were the most senior water rights ever curtailed in the American River watershed, and the region is concerned that these curtailments could be even greater during future droughts. Additionally, managing water quality conditions in the Sacramento-San Joaquin Delta relied heavily on releases from Folsom Reservoir, resulting in dangerously low storage levels. These operations at Folsom Reservoir preserved cold water pool in Shasta Reservoir, which is a concerning trend among local agencies and is likely to increase in frequency into the near future.

3.2.2 Longer-term reliability uncertainty associated with future climate conditions

Much of California's population historically depended on the use of three primary reservoir systems to develop a reliable water supply – groundwater basins, surface water reservoirs, and the snowpack (**Figure 3-1**). While the total volume of water available within the region is not expected to change appreciably, the timing and form (e.g., rain versus snow) is projected to change under future climate conditions. Warming trends would make for smaller snowpack in the American River watershed, with more winter storms coming in the form of rainfall. This will reduce the effectiveness of surface water reservoirs to capture and store water that typically comes in the form of snowmelt in late spring and is subsequently available for peak demand periods in the summer months. This reduced surface water availability will put additional stress and burden on the groundwater basin, the exercise of which could become highly constrained under SGMA requirements in the absence of efforts to expand conjunctive use operations.

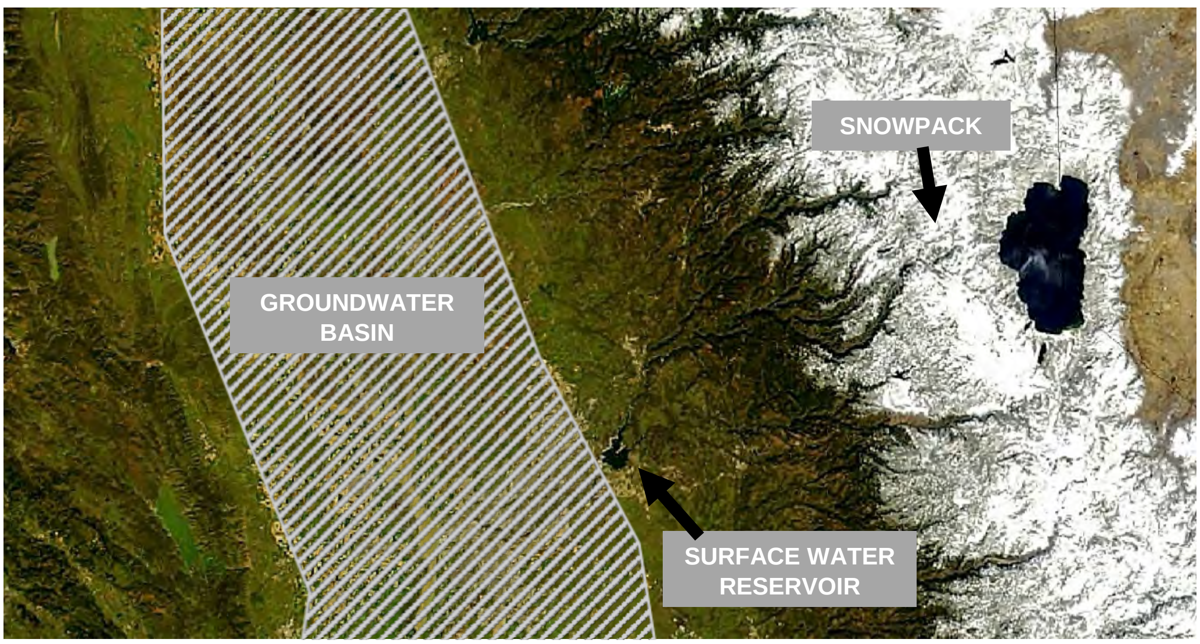

Figure 3-1. Sources of Water in the American River Watershed

The American River watershed relies on three reservoir systems as sources of water: groundwater basins, surface water reservoirs, and snowpack. Under climate change, the conditions of these sources and the region's reliance on them will change.

3.2.3 Longer-term reliability uncertainty associated with future demand during drought or other constrained conditions

While the water supply analysis showed the region possesses sufficient water supplies to meet future demand projections under normal conditions, some agencies could experience projected shortages primarily during late summer months under drought or other constrained conditions (for example, a water main break) whereby the agencies would be unable to balance calls from customers with the ability to conserve water. These potential vulnerabilities became a major focus of the future mitigation actions identified during the RWRP planning process.

3.3 There are opportunities to reduce the uncertainty around water supply reliability

The key solution to address many of the above vulnerabilities is to expand on the same practices made by the region to become more reliable over the past two decades – implementation of conjunctive use. This will allow the region to more effectively use the underlying groundwater basin as a long-term storage reservoir to better manage water supplies during extended wet and dry periods.

The RWRP recharge and recovery analysis demonstrates that there are significant opportunities to expand conjunctive use with existing facilities, and there is substantial additional opportunity by implementing near-term improvements identified by local agencies. The current ability to store an estimated 63 thousand acre-feet in wet years will help ensure a reliable groundwater supply for periods of potential curtailments of surface water diversion rights. After implementing improvements to expand the storage potential in wet years, the near-term potential increases recharge and recovery by over 50 percent which will help ensure reliable groundwater supply for future climate adaptation and reducing supply-demand deficits during drought or other supply-constrained conditions.

However, the single largest barrier to realizing this potential is the cost of instituting these changes. Today, those costs barriers are largely institutional (e.g., the differences in pricing of the various sources of water). Future cost barriers include the expense of capital improvements. To overcome these financial barriers to expanding conjunctive use, agencies in the region expressed strong support for continuing to explore establishing a water bank in the underlying groundwater basin as a means of documenting and accounting for recharge (deposits) and recovery (withdrawals) operations that increase supply yield while increasing operational sustainability of the groundwater basin consistent with SGMA. Additionally, the presence of a water bank provides an opportunity for expanded participation by the region in State or federal groundwater substitution transfer programs, which can generate substantial revenues to overcome financial barriers.

For the water bank to be effective, much planning work remains, including, but not limited to, the following:

- Determine the portion of yield generated from the water bank needed for local supply reliability. Supply yield not needed for local reliability could potentially be made available to benefit partners beyond the region.

- Develop an operational framework such that the region stores water in the bank before recovery occurs, and the water bank does not have a negative storage balance.
- Perform a detailed technical analysis to identify whether or to what degree a portion of the recharged water remains in the basin (referred to conceptually in this RWRP as a loss factor or basin mitigation factor). These factors have the potential to promote basin sustainability and compliance with SGMA requirements.

4 Recommendations

Most of the RWRP mitigation actions focused on increasing interconnectivity between agencies and expanding conjunctive use operations to ensure a reliable water supply through a variety of hydrologic conditions. A key barrier to implementing these actions is cost. The concept of establishing a water bank to create financial incentives to overcome these barriers emerged as a high priority for the region, and the actions below describe the primary recommendations of this plan.

The recommendations are organized as shown in **Figure 4-1**.

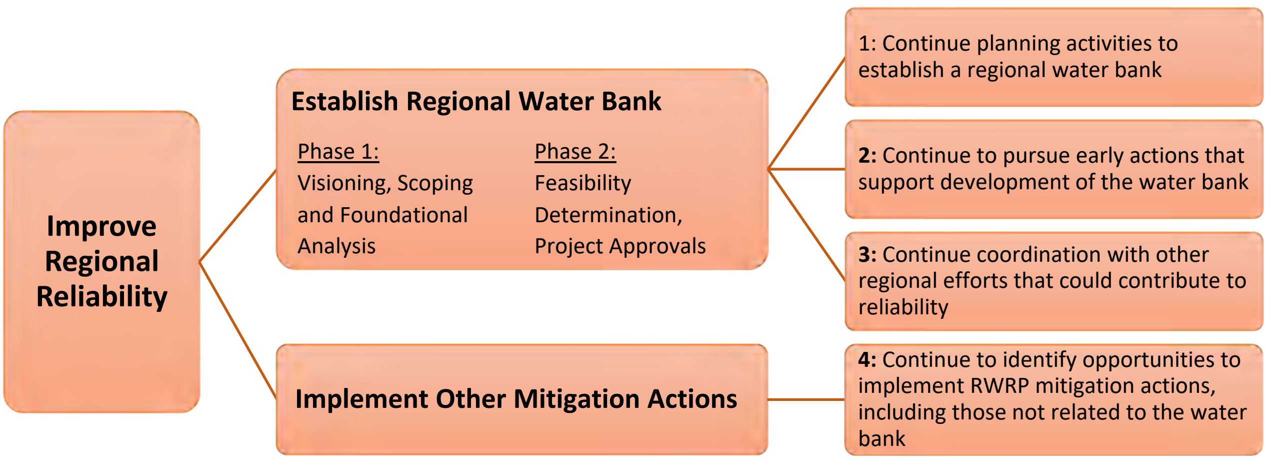

Figure 4-1. Recommendations for Improving Regional Reliability

The ultimate success of this RWRP relies on implementing many of the mitigation actions identified through this planning process. Recommendations for these mitigation actions can be separated into those that support establishment of a regional water bank and those that improve reliability through other venues.

4.1 Establish a Regional Water Bank

The RWRP identified the current and near-term potential of expanding conjunctive use operations and that the region has a high interest in continuing to pursue the establishment of a water bank. The RWRP identified the following two phases to establish a water bank:

- **Phase 1 – Visioning, Scoping & Foundational Analysis** includes: 1) developing the needed foundational technical tools for a comprehensive future environmental analysis; and, 2) engaging with local, State, and federal stakeholders and potential customers of the water bank.

- **Phase 2 – Feasibility Determination and Project Approvals** will focus on: 1) completing a programmatic environmental analysis; 2) establishing a management structure for the bank; and, 3) gaining required approvals for the bank.

The major direct and complementary activities are described below.

4.1.1 Recommendation 1: Continue planning activities to establish a regional water bank

Recommendation 1.1 **Establish a new subscription-based project under RWA to complete needed work to establish the water bank (*Phases 1 and 2*).**

This will enable RWA to coordinate and implement the two phases described above.

Recommendation 1.2 **Complete an Integrated Water Flow Model application for the North American and South American subbasins *(Phase 1)*.**

The model will be critical for simulating water banking operations to evaluate impacts for a programmatic level California Environmental Quality Act and National Environmental Policy Act analysis. Funding for the update is being collected through the water bank subscription program described above.

Recommendation 1.3 **Establish a water bank project management sub-committee *(Phase 1)*.**

A sub-committee should convene to consider issues related to the future management of a water bank. Issues explored by the sub-committee would include, but are not limited to: exploring options for governance of the water bank; potential staffing needs for operating a water bank; agreements for participants in the water bank; roles of groundwater sustainability agencies in a water bank; accounting framework; intra-regional and inter-regional transfer participation; potential fees assessed during water bank operations; and consistency with applicable GSPs.

Recommendation 1.4 **Establish a water bank communications working group *(Phase 1)*.**

Effective outreach will require receiving input from the local agencies likely to participate in the water bank. The working group will consist of volunteers from the participating agencies and will include a combination of communications and technical representatives. The working group will provide input on key messages and the development of outreach materials on a variety of topics related to the water bank.

Recommendation 1.5 **Prepare outreach materials *(Phase 1)*.**

Early in Phase1 of the water bank project, develop materials to support educating all stakeholders on the benefits of the water bank. Materials should include “leave-behinds” from meetings, including a water bank folder with a short-bound introduction to the water bank. In addition to the folder, develop a series of inserts to address specific aspects of the water bank (e.g., relation to the SGMA; environmental benefits; adapting to a future climate). Develop a web page on the existing RWA web site to host information on the water bank throughout development.

Recommendation 1.6 Engage with state and federal stakeholders *(Phase 1)*.

Successful operation of a water bank will require cooperation and conveyance from State and federal agencies such as the California Department of Water Resources, Reclamation, State Water Resources Control Board, California Department of Fish and Wildlife. Engaging early will help ensure designing a program that is compliant with, and complimentary to, those agencies.

Recommendation 1.7 Engage with local stakeholders *(Phase 1)*.

While the water bank holds much promise for positive impacts in the region, there will be concern over potential negative impacts. Engaging with local stakeholders early in the process will help reveal these concerns and allow for addressing them during program development.

Recommendation 1.8 Engage with potential partners *(Phase 1)*.

As described in the conclusion section above, the region is reliable under most conditions. Some benefit from improved operations and facilities can be available to partners beyond the region. Early steps include engaging with potential partners to confirm their level of interest. One potential benefit of this engagement is to explore funding partnerships to complete the second phase of planning to establish the water bank. Another benefit is potential funding for facilities to expand the water bank after it is operational.

Recommendation 1.9 Develop an operational framework of the water bank *(Phase 2)*.

It will be critical to identify the operations of agencies that are interested in participating in the water bank as input for the model used to conduct the environmental analysis.

Recommendation 1.10 Complete an environmental analysis *(Phase 2)*.

This will include both California Environmental Quality Act and National Environmental Policy Act analysis to evaluate water bank operations using water under State rights and contracts as well as federal contract water.

4.1.2 Recommendation 2: Continue to pursue early actions that support development of the water bank

Recommendation 2.1 Take early actions to expand conjunctive use operations and prove concepts of storage (bank deposits) and recovery (bank withdrawals) *(Phases 1 and 2)*.

In 2018, a successful regionally-coordinated pilot groundwater substitution transfer involving five local agencies made more than 10,000 acre-feet of water available to two agencies in the southern San Joaquin Valley. This transfer helped gain an understanding of the requirements on the recovery side of banking. These types of pilot actions should continue to further increase operational intelligence. If wet conditions occur, the region should look to coordinate a storage action whereby agencies that historically relied on groundwater receive surface water to achieve in-lieu storage.

4.1.3 Recommendation 3: Continue coordination with other regional efforts that could contribute to reliability

Recommendation 3.1 Coordinate with Groundwater Sustainability Agencies in the North American and South American subbasins *(Phases 1 and 2)*.

Local GSAs are in the process of developing GSPs on a similar schedule to that envisioned in this RWRP for development of a local water bank considered in this RWRP. There may be opportunities to incorporate water bank activities into GSP development. It will be important to coordinate with GSAs to ensure that water bank activities are consistent with groundwater sustainability planning efforts.

Recommendation 3.2 Explore the feasibility of expanded ASR wells in the region *(Phase 1)*.

A few agencies have expressed interest in ASR as a means of achieving direct recharge in the basin (the vast majority of current recharge is through in-lieu methods). However, there is limited local understanding of ASR operations. Concurrent with Phase 1 of the water bank project, RWA staff is working with agencies on a separate subscription-based project to evaluate the costs of ASR. The project may result in expanded ASR that could improve capacity for exercising a future water bank.

Recommendation 3.3 Continue coordination with longer-term planning efforts *(Phases 1 and 2)*.

Much of the current focus of storage and recovery operations under the proposed water bank has been the capabilities of existing and near-term facilities planned in the urban core of the greater Sacramento metropolitan area. Projects outside the core area include: the Sacramento Regional County Sanitation District's South County Ag Program; Sacramento Area Flood Control Agency's flood management efforts; the evaluation of Alder Creek reservoir in the upper American watershed; and, a new diversion off the Sacramento River, represent additional opportunities to expand the water bank program. Continued coordination will help ensure that these potential assets can contribute to both improved future regional reliability and the proposed water bank.

4.2 Implement Other Mitigation Actions

While a regional water bank may serve as a key strategy and potential driver for implementing many of the mitigation actions in the greater Sacramento metropolitan area urban core, there are additional mitigation actions that can significantly contribute to water supply reliability.

4.2.1 Recommendation 4: Continue to identify opportunities to implement RWRP mitigation actions, including those not related to the water bank

Recommendation 4.1 Track and pursue grant funding opportunities.

The reliability planning process identified mitigation actions to improve reliability for agencies outside the greater Sacramento metropolitan area urban core (e.g., actions for City of Yuba City and Rancho Murieta Community Services District). The region should continue to identify and pursue opportunities to help implement those measures in addition to those associated with the water bank. These include State bond-funded grant programs and federal grant programs such as the WaterSMART Program.

Recommendation 4.2 Support development of new funding opportunities.

The RWA Legislative and Regulatory Affairs Program should track proposed future bond proposals and seek to include the mitigation actions identified in the region as funding priorities.

Recommendation 4.3 Track progress on proposed mitigation actions.

Many of the proposed mitigation actions are in early stages of development or are still conceptual in nature. Additionally, many of the budgets are rough estimates. RWA should distribute the mitigation actions table annually to member agencies to add, delete, or update information on projects to track progress on implementation.

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Appendix A. Mitigation Actions Table

RWRP Mitigation Actions - Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners	Project Cost - Capital ($M)	Project Yield
Near-Term Actions with Potential to Improve Conjunctive Use (within 10 years)						
1	CalAm	Improve in-district infrastructure to convey water within entire Lincoln Oaks service area to improve conjunctive use.	Intertie	CalAm	$6	1,000 AFY
2	CalAm	CalAm to construct pump station with firm capacity of 1,200 gpm in Arden service area and connect to the City of Sacramento's 54-inch transmission main on Ethan Way. Bids went out in January 2019 for construction by 2020.	Intertie	CalAm, Sac City	$2.34	1.7 MGD
3	CalAm	CalAm to drill an additional groundwater well on existing well property in the Arden System	GW Well New Installation	CalAm	$2	2 MGD
4	CalAm	CalAm to drill up to 4 new wells to replace wells to replace low producers and capacity of aging wells in Lincoln Oaks to improve system capacity and conjunctive use.	GW Well New Installation	CalAm	$8	8.4 MGD
5	CalAm	CalAm to drill up to 6 additional wells in Parkway system to replace capacity of aging wells to improve system capacity and conjunctive use.	GW Well New Installation	CalAm	$12	12.9 MGD
6	CalAm	CalAm to drill up to 3 additional wells in Suburban Rosemont system to replace capacity of aging wells to improve system capacity and conjunctive use.	GW Well New Installation	CalAm	$6	6 MGD
7	CalAm	CalAm to drill up to 2 additional wells in Antelope system to replace capacity of aging wells to improve system capacity and conjunctive use.	GW Well New Installation	CalAm	$4	4.3 MGD
8*	CHWD	CHWD to install system-wide pressure control to improve conjunctive use potential. Enables CHWD to optimize their 20 MGD interties with 6 surrounding agencies.	Booster pump/ Pressure Reduction	CHWD	*TBD*	20 MGD
9	CHWD	CHWD to install 4 new production wells. Pending ongoing ASR Feasibility Study, up to 4 wells may be retrofitted with ASR.	GW Well New Installation	CHWD, SJWD	$14	7.2 MGD extraction 4 MGD injection
10	DPMWD	Construct 12-inch or 18-inch intertie between DPMWD and CWD, to provide DPMWD with surface water supplies to increase in-lieu recharge and provide redundancy in case of groundwater contamination.	Intertie	DPMWD, CWD	$3	4 - 6 MGD
11	Folsom	Construct Folsom-GSWC (Cordova)-SCWA intertie to facilitate conjunctive use and, for drought and emergency use.	Intertie	Folsom, SCWA, GSWC	$0.75 - $1.5	4,000 AFY (2,500 gpm or 3 MGD)
12	FOWD	Employ ASR in the SJWD's wholesale service area by retrofitting 2 existing wells in FOWD to enhance conjunctive use and dry-year protection.	GW Well Injection	FOWD, SJWD	$2	3 MGD injection

RWRP Mitigation Actions - Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners	Project Cost - Capital ($M)	Project Yield
13	FOWD	FOWD to rehabilitate 2 wells and install 2 new wells to provide an additional 4,750 gpm capacity, per FOWD's 2017 Water Management Flexibility and Preparedness Evaluation.	GW Well New Installation	FOWD	$6.20	4,750 gpm
14	GSWC	GSWC-Arden in need to intertie with surrounding district to get surface water.	Intertie	GSWC, unspecified (possibly SCWA, SSWD)	$0.75	2 MGD
15	GSWC	GSWC-Cordova install booster pump station to move water back to CWD to improve conjunctive use and dry year reliability.	Intertie	GSWC, CWD	$2	5 MGD
16	Lincoln	Retrofit 2 of Lincoln's existing wells for injection to expand conjunctive use opportunities. Note, anticipated that 4 wells total with be modified eventually.	GW Well Injection	Lincoln	$2	1 - 3 MGD each
17	Lincoln	Lincoln to install booster pumps (20 MGD combined capacity) in lower zones to improve conjunctive use. Note, at-grade tanks (10-15 million gallons combined storage volume) are also planned to be installed separately.	Booster pump/ Pressure Reduction	Lincoln, Developer Stakeholders	$5	20 MGD
18	Lincoln	Lincoln to install new wells to increase conjunctive use.	GW Well New Installation	Lincoln	$14	14 MGD (10,000 gpm)
19	RLECWD	RLECWD to modify current intertie with SSWD to include control valve & telemetry/SCADA equipment for better control of flow during conjunctive, drought and emergency use.	Intertie	EDCWA, SSWD, SJWD, Folsom, RLECWD	$0.26	2.2 - 2.9 MGD
20	RLECWD	RLECWD to improve internal infrastructure to deliver SW throughout service area. To be completed with #21 to get full benefits of project.	Intertie	RLECWD	*TBD*	3 TAF/yr in wet years
21	RLECWD	RLECWD construct new transmission connection to SSWD Antelope (end of Northridge line). Previously proposed was 24" line (assumed 2MGD capacity). Also potential to use different alignment to also help SSWD Capehart or CalAm. To be completed with #20 to get full benefits of project.	Intertie	SSWD, possibly CalAm	$7	See #20 above
22	Roseville	Expand Roseville's aquifer storage and recovery (ASR) program, including installing 10 wells (2,000 gpm extraction and 1,000 gpm injection each) in near-term. Note, anticipated that 12 wells total with be modified eventually.	GW Well Injection	Lincoln, PCWA, Roseville, others	$40	injection: 14 MGD extraction: 29 MGD
23	Roseville	Expand Roseville's aquifer storage and recovery (ASR) program, including building 2.1 mile-long conveyance to Cooperative Transmission Pipeline.	Intertie	Lincoln, PCWA, Roseville, others	$8 - $10	*TBD*

RWRP Mitigation Actions - Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners	Project Cost - Capital ($M)	Project Yield
24*	Sac City	Address City of Sacramento's distribution system pressure (install 3 booster pumps and flow control structure) to increase ability to share supplies with neighboring agencies to improve conjunctive use. The pumps should deliver approximately 47 MGD during peak hour conditions.	Booster pump/ Pressure Reduction	Sac City	$15.6	47 MGD in peak hour conditions
25	Sac City	Construct 1 to 2 new groundwater wells a year to replace aging City of Sacramento's wells, and to increase extraction capability for conjunctive use and emergencies. Assumed 12 wells will be constructed in near-term (24 identified in total).	GW Well New Installation	Sac City	$72	20,010 AFY increase in driest conditions
26	Sac City	City of Sacramento to add pump-to-waste to 12 existing groundwater wells to provide operational flexibility (e.g., pump less during wet periods to increase conjunctive use).	GW Well Rehabilitation	Sac City	$3.3	580 acre-feet per month
27	Sac City	City of Sacramento to improve/install 10 MGD intertie and booster station with SSWD-South to improve conjunctive use potential, especially during dry years. Project under re-evaluation between partners.	Intertie	Sac City, SSWD	$3	10 MGD
28	SCWA	SCWA to make any necessary improvements to allow for distribution of surface water in an area largely served by groundwater, therefore increasing conjunctive use and the ability to bank groundwater, throughout the southern portion of Zone 40 including the Elk Grove Wholesale area. Improvements would consist of approximately 10,000 feet of 24 inch to 30 inch pipeline to fill in the gap along Bradshaw Road and better connect the distribution system. This pipeline is listed as P-17 in the SCWA 2016 Water System Improvement Program.	Intertie	EGWD	$6	2,700 AFY increase in SW use in wet years
29	SCWA	SCWA - Zone 40 to improve in-district infrastructure to increase surface water use in an area largely served by groundwater, therefore increasing conjunctive use and the ability to bank groundwater. Improvements would include approximately 1,300 feet of new 24 inch pipeline along Power Inn Road to better connect the distribution system. The pipeline is listed as P-19 in the SCWA 2016 Water System Improvement Program.	Intertie	SCWA	$1	900 AFY increase in SW use in wet years
30	SCWA	SCWA - Arden Park looking into building 16-inch/18-inch intertie with CWD & fluoridation tank to wheel water (about 9 MGD).	Intertie	SCWA, CWD	$7.25	9 MGD
31*	SSWD	CHWD and/or SSWD to partner with SMUD for energy generation through pressure reduction project that help increase ability to share supplies. Project under re-evaluation between partners.	Booster pump/ Pressure Reduction	CHWD, SSWD, SMUD	*TBD*	*TBD*
32	SSWD	Employ ASR in SSWD's service area (by retrofitting 1 existing well) to enhance conjunctive use and dry-year protection. Project under evaluation.	GW Well Injection	SSWD	$2	2 MGD

RWRP Mitigation Actions - Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners	Project Cost - Capital ($M)	Project Yield
33	SSWD	Perform 3-4 production well modifications, rehabilitation, or abandonment; Construct replacement wells; Install groundwater treatment facilities.	GW Well Rehabilitation	SSWD	$9 - 12	minimal
Long-Term Actions with Potential to Improve Conjunctive Use						
34	EDCWA	Complete the Federal Feasibility Study per P.L. 108-361 and construct Alder Creek Reservoir (170,000 acre-feet) and add diversion points for Grizzly Flat Community Services District (e.g. White Rock). The reservoir would serve agricultural demands in the EDCWA, and potentially enhance water supply and flood protection functions of Folsom Reservoir.	SW Storage	EDCWA, Folsom, TBD	$1,500	170,000 AF
35	Lincoln	City of Lincoln to participate in construction of NID Water Treatment Plant (share of 2-5 MGD) to reduce reliance on /provide redundancy for PCWA supplies.	SW Treatment	Lincoln, NID	$125	10 MGD
36	PCWA	Complete River Arc to provide ability to divert American River supplies of the Sacramento River, to enhance conjunctive use and increase resiliency for droughts and emergencies.	Diversion	PCWA, Roseville, GSWC, Rio Linda, Sac City, SCWA, CalAm, SSWD	$1,000 - $1,500	20,000 - 80,000 AFY (10 MGD Phase 1)
37	PCWA	Construct Ophir Water Treatment Plant to provide access to Middle Fork Project supplies upstream of Folsom Lake, to enhance conjunctive use and increase resiliency for droughts and emergencies.	SW Treatment	Lincoln, PCWA, Roseville, NID, CalAm, SJWD, Potentially Others (e.g., SSWD)	$301.4	30 MGD
38	PCWA	PCWA to construct one new well in Placer Ranch to enhance conjunctive use and increase resiliency for droughts and emergencies within 10 years.	GW Well New Installation	PCWA	$3	1 MGD
Other Actions that Improve Reliability						
39	CalAm	CalAm to construct new intertie with SCWA via Mather Air Force Base in coordination with Aerojet, for emergency use.	Intertie	CalAm, SCWA, Aerojet	$2	0.5 - 1 MGD
40	CalAm	CalAm to make hydraulic improvements in eastern portion of Suburban Rosemont to increase pressure, including install 2,000 gpm booster pump station.	Booster pump/ Pressure Reduction	CalAm, Aerojet	$3	3 MGD
41	DPMWD	Construct booster pump between DPMWD and CWD, to provide CWD with groundwater during droughts and emergencies. To be installed at proposed intertie (see #10).	Booster pump/ Pressure Reduction	DPMWD, CWD	$0.5	4 - 6 MGD
42	EDCWA	Build a pump station to deliver Middle Fork Project water supplies to Georgetown Divide Public Utility District to provide another source of water to meet build-out demands.	Booster pump/ Pressure Reduction	EDCWA, PCWA	$6	up to 7,500 AFY

RWRP Mitigation Actions - Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners	Project Cost - Capital ($M)	Project Yield
43	Folsom	Construct a 30 cubic feet per second pipe and pump station from Folsom South Canal to Folsom Water Treatment Plant to provide emergency backup when water cannot be drawn from Folsom Lake. The pipeline could also provide non-potable irrigation to south Folsom Plan area.	Intertie	Folsom	$30	15,000 AFY (19 MGD)
44	Folsom	Construct Folsom-EID intertie south of Highway 50 for drought and emergency use.	Intertie	Folsom, EID	$2	2 MGD
45	Folsom	Construct Folsom-FOWD intertie for drought and emergency use.	Intertie	Folsom, FOWD	$4	5 MGD
46	Folsom	Construct a scalping plant in Folsom with 1,000-1,400 acre-feet capacity to provide an additional source of non-potable water.	Recycled Water	Folsom	$40	2.6 MGD
47	FOWD	FOWD to improve its intertie with CWD and install a booster station to allow for bi-directional transmission, per FOWD's 2017 Water Management Flexibility and Preparedness Evaluation.	Intertie	FOWD, CWD	$1	3 MGD
48	FOWD	FOWD to construct Kenneth storage reservoir and booster station, per FOWD's 2017 Water Management Flexibility and Preparedness Evaluation, to meet peak and emergency demands.	Intertie	FOWD, CWD	$5	Reservoir: 3MG (4,200 gpm for 8 hours)
49	FOWD	FOWD to build an American River South Interconnection Pipeline with American States Water Company to connect with GSWC, per FOWD's 2017 Water Management Flexibility and Preparedness Evaluation, for drought or emergency use.	Intertie	FOWD, CWD, GSWC	$2	1.5 - 4.5 MGD
50	Lincoln	Lincoln to capture stormwater by storing for later use (e.g., flooding dormant crops) to offset some agriculture demands.	GW Well Injection	multiple agencies, Lincoln	Concept only	Concept only
51	Lincoln	Increase Lincoln's capacity to provide recycled water via expansion of wastewater treatment plant and recycled water distribution system to provide an additional source of non-potable water.	Recycled Water	Lincoln, PCWA, Placer County	$25	2.1 MGD
52	PCWA	PCWA to construct new interties with Roseville (two bi-directional) and Lincoln (two one-directional from PCWA) to improve conjunctive use.	Intertie	PCWA, Roseville, Lincoln	$6	31 MGD
53	PCWA	PCWA to explore recycled water opportunities in West Placer growth area in partnership with Placer County, Roseville and Lincoln.	Recycled Water	PCWA, Roseville, Lincoln, Cal Am	$0.5	2,000 AFY
54	PCWA	Construct Foothill Water Treatment Plant raw and treated water pipeline for phasing of Ophir Water Treatment Plant (#37) and adding treated water capacity for drought and emergency use.	Diversion	PCWA	$14 raw water $5 treated water	38 MGD
55	PCWA	PCWA and NID to oversize facilities to increase redundancy and reliability of Bear River supplies.	Intertie	PCWA, NID, wholesale partners	$10	25,000 AFY

RWRP Mitigation Actions - Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners	Project Cost - Capital ($M)	Project Yield
56	PCWA	PCWA to pursue construction of three groundwater wells for drought and emergency use (2 PR, 1 RU).	GW Well New Installation	PCWA	$3	1 MGD
57	PCWA	PCWA to construct new transmission pipeline to increase redundancy and reliability of Foothill and Ophir Water Treatment Plant supplies in west Placer County.	Intertie	PCWA	$11	30 MGD
58	RMCSD	RMCSD to pursue the construction of one groundwater well for drought and emergency use. Received grant funding through Prop 84 valid through June 30, 2019 and currently requesting an appraisal for the land.	GW Well New Installation	RMCSD	*$3*	400 - 600 gpm
59	RMCSD	RMCSD to raise level of Calero Dam to provide more storage of around 1,400 acre-feet.	SW Storage	RMCSD	*TBD*	1,400 acre-feet
60	RMCSD	RMCSD to expand recycled water use pending sufficient inflow to expand use consistent with their Recycled Water Program Preliminary Design Report (2017).	Recycled Water	RMCSD	$15.6	970 - 1,595 AFY
61	RMCSD	RMCSD to implement stormwater capture and reuse from the Clementia and Bass Lake watersheds to offset demand by using raw water for irrigation of landscaping at Laguna Joaquin.	Recycled Water	RMCSD	*TBD*	25 acre-feet
62	Roseville	Expand Roseville's recycled water system to provide an additional source of non-potable water.	Recycled Water	Roseville, PCWA	$11	850 AFY
63	Sac City	Install booster pump to enable City of Sacramento to wholesale water to SCWA's Northgate 880 service area, and to flow water from Northgate 880 service area to the City of Sacramento or wheeling to other systems.	Booster pump/ Pressure Reduction	SCWA, Sac City	$0.55	2.9 MGD (max)
64	Sac City	Construct City of West Sacramento-City of Sacramento intertie to receive treated water for drought and emergency use.	Intertie	West Sac, Sac City	$6.5	6 - 10 MGD
65	Sac City	Replace uncontrolled valve at Franklin Road intertie to improve delivery of water into City of Sacramento from SCWA for emergency use.	Intertie	SCWA, Sac City	$0.1	6 MGD
66	SJWD	Construct an additional SJWD-PCWA intertie, Kokila Intertie Project, (to connect to planned pipeline from Ophir Water Treatment Plant (#37)) for drought and emergency use. The proposed intertie will provide emergency water supplies to either agency of up to 2 MGD to/from SJWD's Kokila Storage Tank, which is scheduled for construction in Fiscal Year 2020/21. Includes approximately 350-feet of 12-inch Ductile Iron pipe, a control valve station, a 12-inch meter and electrical improvements.	Intertie	PCWA, SJWD	$0.30	2 MGD, emergency
67	SRCSD	Regional San to continue to expand recycled water opportunities with SCWA and City of Sacramento through the CoGen project and expansion of conveyance. The non-potable water supply would increase conjunctive use.	Recycled Water	Regional San, SCWA, Sac City (potential)	Up to $35	Up to 1,723 AFY

RWRP Mitigation Actions - Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners	Project Cost - Capital ($M)	Project Yield
68	SRCSD	Explore recycled water opportunities in partnership with Regional San by GSWC, OVWC, and CWD for conjunctive use.	Recycled Water	Regional San, GSWC, OVWC, CWD	*TBD*	*TBD*
69	SRCSD	Use Regional San's recycled water to offset groundwater pumping for South County Ag lands.	Recycled Water	Regional San, South County Ag	$350	Up to 52,000 acre-feet per year (for largest program size)
70	West Sacramento	Install up to 5,500 gpm groundwater well at City of West Sacramento's water treatment plant to serve north portion of city during droughts and emergencies.	GW Well New Installation	West Sac	$4	5,500 gpm (6 - 10 MGD)
71	Yuba City	Yuba City to expand ASR by converting a planned second well at the Water Treatment Plant to ASR. ASR will enable Yuba City to store winter contract water.	GW Well Injection	Yuba	$1	2 MGD
72	Yuba City	Yuba City to construct intake at an alternative location near the levee (location to be identified in Master Plan update) to provide redundancy to their current single source intake.	Diversion	Yuba	*TBD*	*TBD*
73	Yuba City	Yuba City to rehabilitate and maintain its three well sites that are currently unused to provide emergency supplies.	GW Well Rehabilitation	Yuba	*TBD*	*TBD*

RWRP Mitigation Actions - Non-Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners
74	CalAm	CalAm to develop process to improve Public Utilities Commission approvals of groundwater sales to improve conjunctive use and banking potential.	Banking	CalAm
75	CHWD	CHWD to apply for a Division of Drinking Water waiver during times of water shortages to allow CHWD to receive fluoridated water from City of Roseville on a longer-term basis.	Water transfers	CHWD, Roseville
76	City of Folsom	Develop agreement with GSWC (Cordova) to provide City of Folsom with groundwater during drought or emergency conditions.	Water Transfers	GSWC, Folsom
77	City of Folsom	Develop agreement with FOWD to provide City of Folsom with groundwater during drought or emergency conditions.	Water Transfers	FOWD, Folsom
78	City of Sacramento	Expand City of Sacramento's POU to increase flexibility of transfers through the Freeport Regional Water Authority or future River Arc during droughts and emergencies.	Modify Contracts/POU	Sac City
79	City of Sacramento	Update City of Sacramento's Sacramento River/American River water rights contract to expand POU beyond city's boundary to improve conjunctive use.	Modify Contracts/POU	Sac City
80	City of Sacramento	City of Sacramento to perform economic study to evaluate value of surface water versus wholesale pricing to the region to encourage conjunctive use.	Institutional Barriers	Sac City, others
81	City of Sacramento	City of Sacramento to explore options to encourage wholesale deliveries during Hodge Flow periods to potential interested parties.	Modify Contracts/POU	Sac City
82	City of Yuba City	Increase Yuba City's contract with North Yuba district to improve conjunctive use.	Modify Contracts/POU	Yuba, North Yuba
83	City of Yuba City	Explore conjunctive use in Yuba City.	Water transfers/ wheeling/ banking	Yuba, ?
84	CWD	CWD to partner with SSWD, GSWC, DPMWD, and/or FOWD to reduce in-district groundwater extraction and improve conjunctive use.	Water Transfers	CWD, SSWD, GSWC, DPMWD, FOWD
85	EDCWA	EDCWA to get commitment by Reclamation leadership to collaborate with EDCWA on a priority basis to complete all remaining actions and expedite award of the Fazio contract by a certain date.	Federal Action & Collaboration	EDCWA, Reclamation
86	EDCWA	Modify EDCWA's SMUD Agreement Water (30 TAF/yr) without affecting SMUD's ability to generate hydropower to improve conjunctive use with a partnering agency (TBD).	Modify Contracts/POU	EDCWA, SMUD, Folsom, TBD
87	FOWD	FOWD to modify operational priority (surface water vs. groundwater use) to enhance conjunctive use.	Institutional Barriers	FOWD
88	GSWC	Expand agreement with SCWA to provide GSWC with surface water to improve conjunctive use and improve drought resiliency.	Water Transfers	GSWC, SCWA
89	PCWA	Roseville, SJWD, and Folsom to develop agreement with PCWA to receive supplies through Ophir Water Treatment Plant/PCWA system at times when diversion capacity through Folsom Dam limits realization of full conjunctive use potential.	Wheeling	Lincoln, PCWA, Roseville, Folsom, Potentially Others (e.g., SSWD)

RWRP Mitigation Actions - Non-Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners
90	PCWA	Expand PCWA's CVP service area to improve conjunctive use opportunities with NID and wholesale agencies.	Modify Contracts/POU	PCWA, NID, wholesale partners
91	RLECWD	RLECWD to form agreements with SJWD, EDCWA, SSWD, City of Folsom and/or others to receive surface water via Cooperative Transmission Pipeline extension to address groundwater contamination challenges and expand conjunctive use.	Water Transfers	SJWD, SSWD, Folsom, RLECSD, DPMWD, EDCWA, Sac City
92	RLECWD	RLECWD to resolve increased cost of taking SJWD's surface water in lieu of groundwater; address temperature and Trihalomethanes issues from delivering surface water this far west.	Water Transfers	RLECWD, SSWD, SJWD
93	SCWA	Establish an agreement between City of Sacramento and SCWA to wheel surface water to SCWA's Arden system and Northgate 880 service area to improve conjunctive use.	Modify Contracts/POU	SCWA, Sac City
94	SCWA	Develop agreement with City of Sacramento to allow SCWA to wheel water to its Southwest Track during droughts and emergencies.	Wheeling	SCWA, Sac City
95	SJWD	SJWD to enter into a banking agreement with one or more agencies in the SGA area (e.g., SSWD (North Service Area), CalAm, RLECWD, CWD, GSWC, SCWA (Arden), DPMWD) to maximize full use of supplies.	Banking	SJWD, CHWD, FOWD, SSWD (NSA), CalAm, RLECWD, CWD, GSWC, SCWA (Arden), DPMWD, Folsom, EDCWA
96	SJWD	SJWD to improve conjunctive use by pursuing institutional arrangements via (1) short- and long-term transfers with agencies outside SJWD's existing service area (e.g., Folsom, EDCWA), and/or (2) new wholesale agreements.	Water Transfers	SJWD, Folsom, EDCWA
97	SJWD	Develop agreement with SSWD to supply SJWD with groundwater for droughts and emergencies.	Water Transfers	SJWD, SSWD
98	SSWD	SSWD to evaluate long-term partnership agreement options to improve water supply reliability and operational flexibility with SCWA, City of Sacramento, and/or others.	Water Transfers	SSWD, SCWA, Sac City
99	various	Participate in regional groundwater bank.	Banking	GSWC, DPMWD, SSWD, SJWD, SCWA, Sac City, FOWD, CHWD, Folsom, EDCWA, and others
100	various	Roseville, PCWA, SCWA and SMUD to collaborate with Reclamation to promote a continuing partnership among the parties and develop a structured process and firm schedule for renewing Long-Term Water Supply Contracts by a certain date.	Federal Action & Collaboration	Roseville, PCWA, SCWA, SMUD, Reclamation
101	various	SSWD, DPMWD, GSWC, CWD to establish consistent fluoridation practices.	Institutional Barriers	SSWD, DPMWD, GSWC, CWD
102	various	Address differing fluoridation practices between PCWA, Lincoln and Roseville to improve opportunities for conjunctive use.	Institutional Barriers	PCWA, Roseville, Lincoln

RWRP Mitigation Actions - Non-Structural (Sorted by Lead Agency)

No.	Lead Agency	Mitigation Action	Category	Partners
103	various	Work with Reclamation to complete the Modified Flow Management Standard and establish a sustainable minimum instream flow and minimum storage for Lower American River and Folsom Reservoir to ensure availability of local supplies.	Federal Action & Collaboration	Reclamation, PCWA, Roseville, SJWD, Sac City, SCWA, CWD, Folsom, Water Forum, all CVP users
104	various	Attain temporary or permanent storage rights in Folsom Reservoir or further upstream in cooperation with Reclamation.	Federal Action & Collaboration	CWD, EID, EDCWA, or other local agencies for GW Storage
105	various	Collaborate with Reclamation to implement an accelerated water transfer program within the CVP American River Division to improve opportunities among CVP American River Division contractors to optimize available supplies particularly during shortage conditions.	Federal Action & Collaboration	Reclamation, PCWA, Roseville, SJWD, Sac City, SCWA, CWD, Folsom, all CVP users
106	various	Collaborate with Reclamation to determine the applicability of water purchase, financial assistance, loan, contracting and other authorities pursuant to Public Law 102-250, Reclamation States Emergency Drought Relief Act of 1991 as amended. Work with Reclamation to clarify and implement documents and procedures, including draft contracts, for immediate application in the event of drought conditions.	Federal Action & Collaboration	Reclamation, PCWA, Roseville, SJWD, Sac City, SCWA, CWD, Folsom, EID, EDCWA and local water agencies

Notes:

* Mitigation Action indirectly benefits conjunctive use opportunities through improved operations and maintenance. Potential benefit is not quantified.

Key:

AFY = acre-feet per year; ASR = aquifer storage and recovery; CalAm = California American Water; CHWD = Citrus Heights Water District; CWD = Carmichael Water District; CVP = Central Valley Project; DPMWD = Del Paso Manor Water District; EDCWA = El Dorado County Water Agency; EGWD = Elk Grove Water District; EID = El Dorado Irrigation District; Folsom = City of Folsom; FOWD = Fair Oaks Water District; gpm = gallons per minute; GSWC = Golden State Water Company; GW = groundwater; Lincoln = City of Lincoln; MGD = million gallons per day; $M = million dollars; NID = Nevada Irrigation District; OVWC = Orange Vale Water Company; PCWA = Placer County Water Agency; POU = Place of Use; Reclamation = U.S. Department of the Interior, Bureau of Reclamation; Regional San = Sacramento Regional County Sanitation District; RLECWD = Rio Linda/Elverta Community Water District; Roseville = City of Roseville; RWRP = Regional Water Reliability Plan; Sac City = City of Sacramento; SCWA = Sacramento County Water Agency; SCADA = supervisory control and data acquisition; SJWD = San Juan Water District; SMUD = Sacramento Municipal Utility District ; SRCSD = Sacramento Regional County Sanitation District; SSWD = Sacramento Suburban Water District; SW = surface water; TAF/yr = thousand acre-feet per year; TBD = to be determined; West Sac = City of West Sacramento; Yuba City = City of Yuba City